Health Technology Assessment 2003; Vol. 7: No. 17

Systematic review of endoscopic sinus surgery for nasal polyps

K Dalziel
K Stein
A Round
R Garside
P Royle

Health Technology Assessment
NHS R&D HTA Programme

How to obtain copies of this and other HTA Programme reports.
An electronic version of this publication, in Adobe Acrobat format, is available for downloading free of charge for personal use from the HTA website (http://www.hta.ac.uk). A fully searchable CD-ROM is also available (see below).

Printed copies of HTA monographs cost £20 each (post and packing free in the UK) to both public **and** private sector purchasers from our Despatch Agents.

Non-UK purchasers will have to pay a small fee for post and packing. For European countries the cost is £2 per monograph and for the rest of the world £3 per monograph.

You can order HTA monographs from our Despatch Agents:

– fax (with **credit card** or **official purchase order**)
– post (with **credit card** or **official purchase order** or **cheque**)
– phone during office hours (**credit card** only).

Additionally the HTA website allows you **either** to pay securely by credit card **or** to print out your order and then post or fax it.

Contact details are as follows:

HTA Despatch
c/o Direct Mail Works Ltd
4 Oakwood Business Centre
Downley, HAVANT PO9 2NP, UK

Email: orders@hta.ac.uk
Tel: 02392 492 000
Fax: 02392 478 555
Fax from outside the UK: +44 2392 478 555

NHS libraries can subscribe free of charge. Public libraries can subscribe at a very reduced cost of £100 for each volume (normally comprising 30–40 titles). The commercial subscription rate is £300 per volume. Please see our website for details. Subscriptions can only be purchased for the current or forthcoming volume.

Payment methods

Paying by cheque
If you pay by cheque, the cheque must be in **pounds sterling**, made payable to *Direct Mail Works Ltd* and drawn on a bank with a UK address.

Paying by credit card
The following cards are accepted by phone, fax, post or via the website ordering pages: Delta, Eurocard, Mastercard, Solo, Switch and Visa. We advise against sending credit card details in a plain email.

Paying by official purchase order
You can post or fax these, but they must be from public bodies (i.e. NHS or universities) within the UK. We cannot at present accept purchase orders from commercial companies or from outside the UK.

How do I get a copy of *HTA on CD*?

Please use the form on the HTA website (www.hta.ac.uk/htacd.htm). Or contact Direct Mail Works (see contact details above) by email, post, fax or phone. *HTA on CD* is currently free of charge worldwide.

The website also provides information about the HTA Programme and lists the membership of the various committees.

Systematic review of endoscopic sinus surgery for nasal polyps

K Dalziel[1]
K Stein[1*]
A Round[1]
R Garside[1]
P Royle[2]

[1] Peninsula Technology Assessment Group, Exeter, UK
[2] Southampton Health Technology Assessment Centre, University of Southampton, UK

* Corresponding author

Declared competing interests of authors: Kim Dalziel, Ken Stein, Ali Round, Ruth Garside and Pam Royle have no pecuniary relationship with companies making or profiting from the use of endoscopic sinus surgery.

Published August 2003

This report should be referenced as follows:

Dalziel K, Stein K, Round A, Garside R, Royle P. Systematic review of endoscopic sinus surgery for nasal polyps. *Health Technol Assess* 2003; **7**(17).

Health Technology Assessment is indexed in *Index Medicus*/MEDLINE and *Excerpta Medica*/EMBASE.

NHS R&D HTA Programme

The NHS R&D Health Technology Assessment (HTA) Programme was set up in 1993 to ensure that high-quality research information on the costs, effectiveness and broader impact of health technologies is produced in the most efficient way for those who use, manage and provide care in the NHS.

The research reported in this monograph was commissioned by the HTA Programme and funded as project number 01/34/01. Technology assessment reports are completed in a limited time to inform decisions in key areas by bringing together evidence on the use of the technology concerned.

The views expressed in this publication are those of the authors and not necessarily those of the HTA Programme or the Department of Health. The editors wish to emphasise that funding and publication of this research by the NHS should not be taken as implicit support for any recommendations made by the authors.

Criteria for inclusion in the HTA monograph series
Reports are published in the HTA monograph series if (1) they have resulted from work commissioned for the HTA Programme, and (2) they are of a sufficiently high scientific quality as assessed by the referees and editors.

Reviews in *Health Technology Assessment* are termed 'systematic' when the account of the search, appraisal and synthesis methods (to minimise biases and random errors) would, in theory, permit the replication of the review by others.

The editors and publisher have tried to ensure the accuracy of this report but do not accept liability for damages or losses arising from material published in this report.

ISSN 1366-5278

Published by Gray Publishing, Tunbridge Wells, Kent, on behalf of NCCHTA.
Printed on acid-free paper in the UK by St Edmundsbury Press Ltd, Bury St Edmunds, Suffolk.

Abstract

Systematic review of endoscopic sinus surgery for nasal polyps

K Dalziel,[1] K Stein,[1]* A Round,[1] R Garside[1] and P Royle[2]

[1] Peninsula Technology Assessment Group, Exeter, UK

[2] Southampton Health Technology Assessment Centre, University of Southampton, UK

* Corresponding author

Objectives: To provide a systematic review of the clinical effectiveness of endoscopic sinus surgery (ESS) for the removal of nasal polyps.

Data sources: Searches of electronic databases, websites and reference lists were made to identify relevant studies.

Review methods: An extensive search was performed to identify all articles where FESS is used for the excision of nasal polyps. Two reviewers independently screened articles for inclusion according to predefined criteria. Comparative studies were included if they were primary research, focused on FESS for the removal of nasal polyps, reported patient relevant outcomes and were published in English. In addition, case series studies were included if they met the above criteria and enrolled more than 50 patients with polyps. Data were then extracted by one reviewer and checked by a second. A structured form was used to assess the internal and external validity of included studies. Comparative data were reported where available. Excluded case series and case reports were grouped and described. A group of nine ear, nose and throat (ENT) experts were selected, then using the literature and their own experience, they generated a list of priority research questions. Existing economic evaluations were sought and described.

Results: Of the 33 studies included, the randomised controlled trials and controlled trials reported overall symptomatic improvement that ranged from 78 to 88% for FESS compared with 43 to 84% for similar techniques (including polypectomy, Caldwell–Luc and intranasal ethmoidectomy). Disease recurrence was 8% for FESS compared with 14% for Caldwell–Luc and polyp recurrence was 28% for endoscopic ethmoidectomy compared with 35% for polypectomy. Revision surgery was reported in one study only and was the same for FESS and Caldwell–Luc procedures. Percentage of overall complications was reported in only one comparative study and was 1.4% for FESS compared with 0.8% for conventional procedures. The case series studies reported overall symptomatic improvement for patients with nasal polyps ranging from 37 to 99% (median 89%). For the mixed patient groups (with and without polypoid disease) overall symptomatic improvement ranged from 40 to 98% (median 88%). Total complications in the case series studies ranged from 22.4 to 0.3% (median 6%).

Conclusions: The majority of studies report that symptoms improve following FESS with relatively few complications; however, only a small proportion of evidence is comparative. Results from non-comparative studies do not inform the choices that need to be made by ENT surgeons and commissioners. Health economics data are also lacking and therefore cannot inform these decisions. FESS may offer some advantages in effectiveness over comparative techniques, but there is enormous variation in the range of results reported and there are severe methodological limitations. There is a clear need for quality-controlled trials in order to answer questions regarding the effectiveness of FESS. A number of priority research questions from a selection of ENT surgeons within the UK are identified and presented.

Contents

Glossary and list of abbreviations

Glossary

Anosmia The absence of the sense of smell.

Atypia State of not being typical.

Bilateral Having two sides, or pertaining to both sides.

Bulla ethmoidalis The prominence on the lateral wall of the nose made by the anterior ethmoidal cells.

Choncha bullosa Pneumatisation of the vertical attachment of the middle turbinate.

Churg–Strauss syndrome A condition characterised by a systemic vasculitis, eosinophilia and granuloma formation. Nasal polyps and asthma are frequently found.

Ciliary dyskinesia An inherited condition in which there is poor motility of the cilia of the respiratory epithelium.

Ciliated Having cilia (microtubular, hair-like structures that cover the cells of certain tissues, such as the epithelium lining the lungs, and help those cells sweep away fluids or particles).

Columnar epithelium Epithelium formed of a single layer of prismatic cells taller than they are wide.

Congenital Existing at, and usually before, birth, referring to conditions that are present at birth, regardless of their causation.

Cytokines Non-antibody proteins secreted by inflammatory leucocytes and some non-leucocytic cells, that act as intercellular mediators. They differ from classical hormones in that they are produced by a number of tissue or cell types rather than by specialised glands. They generally act locally.

Endoscope A tube-shaped instrument inserted into a cavity of the body to investigate and treat disorders. It is equipped with lenses and a light source and can be flexible or rigid.

Endoscopy Examination of a body cavity using an endoscope in order to diagnose or treat a disorder in the cavity.

Eosinophilia syndrome The formation and accumulation of an abnormally large number of eosinophils in the blood.

Eosinophils A type of leucocyte-containing eosin-staining granules. Although the activity of eosinophils is not entirely clear, they are known to destroy parasitic organisms and play a major role in allergic reactions. They also secrete chemical mediators that can cause bronchoconstriction in asthma. Eosinophils make up 1–3% of a normal total white blood cell count.

Epistaxis Nosebleed; haemorrhage from the nose.

Epithelium The covering of internal and external surfaces of the body, including the lining of vessels and other small cavities. Epithelium is classified into types on the basis of the number of layers deep and the shape of the superficial cells.

Ethmoid The ethmoid bone, a bone of complicated structure through which the olfactory nerves pass out of the cranium and over which they are largely distributed.

Fibroblasts Connective tissue cells which differentiate into chondroblasts, collagenoblasts and osteoblasts.

Goblet cells Cell of the epithelial lining of the respiratory and gastrointestinal tracts that secretes mucus and has a very well developed Golgi apparatus.

continued

Glossary *continued*

Haematoma A localised collection of blood, usually clotted, in an organ, space or tissue, due to a break in the wall of a blood vessel.

Hyperplasia The abnormal multiplication or increase in the number of normal cells in normal arrangement in a tissue.

Hyposmia Diminished sense of smell.

Lymphocytes White blood cells that fight infection and disease.

Mast cells Resident cell of connective tissue that contains many granules rich in histamine and heparin sulphate.

Maxillary sinus An air-filled cavity within the maxilla (bone that forms the face and upper jaw). The maxillary sinus is located just below the bony prominence of the cheek.

Microdebrider A powered instrument used for the removal of tissue comprising a cutting blade, suction and irrigation.

Middle turbinate The middle thin, bony plate that is part of the ethmoidal labyrinth. It projects from the lateral wall of the nasal cavity and separates the superior meatus from the middle meatus. Also called middle nasal choncha.

Mucosa A mucous membrane which is the lubricated inner lining of the mouth, nasal passages, any membrane or lining which contains mucus-secreting glands.

Neoplastic Pertaining to or like a neoplasm (new and abnormal growth, may be benign or cancerous).

Normosmia Normal sense of smell.

Oedematous The state of having abnormally large amounts of fluid in the intercellular tissue spaces of the body.

Ostium An opening or a passageway.

Paranasal sinuses Air-filled extensions of the respiratory part of the nasal cavity into the frontal, ethmoid, sphenoid, and maxillary cranial bones. They vary in size and form in different individuals and are lined by the ciliated mucous membranes.

Patency The state of being freely open or exposed.

Polyp Soft jelly-like structures that are attached by a stalk to the surface from which they arise. The usual structure is that of a fine fibrous core covered with epithelium resembling that of the surrounding surface.

Polyposis The presence of a crop or large number of polyps.

Pseudostratified An epithelium that gives a superficial appearance of being stratified because the cell nuclei are at different levels, but in which all cells reach the basement membrane, hence it is classed as a simple epithelium.

Rhinitis Inflammation of the nose characterised by sneezing attacks, nasal discharge or nasal congestion. Rhinitis can be seasonal (intermittent) or perennial (persistent) and may be divided into mild or moderate/severe.

Rhinosinusitis Inflammation of nose and sinuses. Most cases occur as a result of infection spreading to the sinuses from the nose along the passages that drain mucus secreted by the linings of the sinuses to the nose.

Samter's triad A condition in which a person suffers from nasal polyps, aspirin intolerance and asthma.

Seromucinous glands A gland in which some of the secretory cells are serous and some mucous, a gland whose cells secrete a fluid intermediate between a watery and a viscous mucoid substance.

Sphenoethmoid Of or pertaining to both the sphenoidal and the ethmoidal regions of the skull.

continued

Glossary *continued*

Sphenoid The sphenoid bone, an irregularly shaped bone in front of the occipital in the base of the skull. It is composed of several foetal bones which become united in the adult.

Stenosis Narrowing or stricture of a duct or canal.

Stroma Applies to the tissue which forms a covering and framework of an organ.

Submucosa A layer of connective tissue beneath a mucous membrane.

Synechiae Small strands of fibrous tissue or adhesions usually between the middle turbinate and the lateral wall.

Uncinate process A small crescent-shaped piece of ethmoid bone found in the anterior middle meatus.

Young syndrome Obstructive azoospermia (the absence of mature male germ cells in the semen or failure of formation of mature male germ cells) and chronic sinopulmonary infections.

List of abbreviations

AFS	allergic fungal sinusitis
ASA	aspirin-sensitive asthma
BAWO	bilateral antral washout
BINA	bilateral intranasal antrostomy
CAS	computer-aided surgery
CF	cystic fibrosis
CIA	Confidence Interval Analysis
CL	Caldwell–Luc
CRD	Centre for Reviews and Dissemination
CSF	cerebrospinal fluid
CT	computed tomography
ENT	ear, nose and throat
ESS	endoscopic sinus surgery
FESS	functional endoscopic sinus surgery
HES	hospital episode statistics
HIV	human immunodeficiency virus
HRG	Healthcare Resource Group
ICD-10	International Classification of Diseases and Health Related Problems (10th Revision) system for coding diagnoses
IL-5	interleukin-5
ITT	intention-to-treat
NEN	Nicolet electronic navigation
NICE	National Institute of Clinical Excellence
MRI	magnetic resonance imaging
OPSC4	Office of Population and Censuses (4th Revision) system for coding operations and treatments
RCT	randomised controlled trial
YAG	yttrium aluminium garnet

All abbreviations that have been used in this report are listed here unless the abbreviation is well known (e.g. NHS), or it has been used only once, or it is a non-standard abbreviation used only in figures/tables/appendices in which case the abbreviation is defined in the figure legend or at the end of the table.

Executive summary

Background

Functional endoscopic sinus surgery (FESS) is a minimally invasive technique that uses an endoscope to improve ventilation and drainage in addition to polyp removal. The extent of surgery varies according to the extent of disease and surgeon's individual practice. This technique has been used for more than a decade in treating sino-nasal conditions. Advantages are claimed over conventional surgery: permitting a better view of the surgical field, a more precise and thorough clearance of the inflammatory change, fewer complications and lower recurrence rates.

Nasal polyp growths are round, soft, semi-translucent, pale or yellow glistening structures that originate from any part of the nasal mucosa or paranasal sinuses (although most commonly from the ethmoid or middle meatus regions). Polyp development has been linked to chronic inflammation, allergy, autonomic nervous system dysfunction and genetic predisposition.

It has been estimated that 0.2–1% of adults in the UK will have nasal polyps at some time during their life. The English Department of Health report that 12,312 patients were admitted to hospital with a primary diagnosis of nasal polyps from 1 April 2000 to 31 March 2001. The frequency of polyps increases with age until 59 years and polyps are more frequent in males than females. Nasal polyps are associated with many different disease states and it is rare to find them alone.

Objectives

To provide a systematic review of the clinical effectiveness of endoscopic sinus surgery (ESS) for the removal of nasal polyps.

Methods

A systematic review of the literature was undertaken. Searches of electronic databases, websites and reference lists were made to identify relevant studies. Comparative studies were included if they were primary research, focused on FESS for the removal of nasal polyps, reported patient relevant outcomes and were published in English. In addition, case series studies were included if they met the above criteria and enrolled more than 50 patients with polyps.

The titles and abstracts of studies, and then full text articles, were screened independently by two reviewers for inclusion. Using a structured form, the quality (internal and external validity) of the included studies was assessed by one reviewer and checked by a second reviewer.

Owing to the lack of homogeneous randomised controlled trials (RCTs) we have not performed meta-analysis. We have, however, provided comparative data where available. The assessment includes all patient-relevant outcome measures reported by the studies.

Results

Thirty-three studies were included, three RCTs, three non-RCTs and 27 case series studies. The RCTs and controlled trials reported overall symptomatic improvement that ranged from 78 to 88% for FESS compared with 43 to 84% for comparative techniques (including polypectomy, Caldwell–Luc and intranasal ethmoidectomy). Disease recurrence was 8% for FESS compared with 14% for Caldwell–Luc and polyp recurrence was 28% for endoscopic ethmoidectomy compared with 35% for polypectomy. Revision surgery was reported in one study only and was the same for FESS and Caldwell–Luc procedures. Percentage of overall complications was reported in only one comparative study and was 1.4% for FESS compared with 0.8% for conventional procedures.

The case series studies reported overall symptomatic improvement for patients with nasal polyps ranging from 37 to 99% (median 89%). For the mixed patient groups (with and without polypoid disease) overall symptomatic improvement ranged from 40 to 98% (median 88%). Total complications in the case series studies ranged from 22.4 to 0.3% (median 6%).

Conclusions

We have identified large amounts of data on FESS. The majority of studies report that people's symptoms improve following FESS with relatively few complications; however, only a small proportion of evidence is comparative. Results from non-comparative studies do not inform the choices that need to be made by ear, nose and throat (ENT) surgeons and commissioners. Health economics data are also lacking and therefore cannot inform these decisions.

FESS may offer some advantages in effectiveness over comparator techniques, but there is enormous variation in the range of results reported and there are severe methodological limitations. There is a clear need for quality-controlled trials in order to answer questions regarding the effectiveness of FESS. We have identified and presented a number of priority research questions from a selection of ENT surgeons within the UK.

Chapter 1

Aim of the review

The aim of the review is to provide a systematic review of the clinical effectiveness of endoscopic sinus surgery (ESS) for the removal of nasal polyps. The review focuses on only one possible method of managing nasal polyps, which is through functional endoscopic sinus surgery (FESS).

Chapter 2

Background

Description of underlying health problem

Definition of nasal polyps and anatomy

Nasal polyps are round, soft, semi-translucent, pale or yellow glistening swellings that originate from any part of the nasal mucosa or paranasal sinuses.[1] They are the most common mass lesions encountered in the nose.[2] Polyp development has been linked to chronic inflammation, allergy, autonomic nervous system dysfunction and genetic predisposition.[3]

Polyps are usually bilateral and are found in the maxillary, ethmoidal and sphenoidal regions. Although they can originate from any part of the nasal mucosa or paranasal sinuses, polyps generally arise from the ethmoid and middle meatus regions (see *Figure 1*).[4] Polyp disease is commonly graded as follows:[5]

- Grade 0: no polyps
- Grade 1: polyps confined to middle meatus
- Grade 2: polyps below the level of the middle meatus but not causing total obstruction
- Grade 3: polyps causing total obstruction.

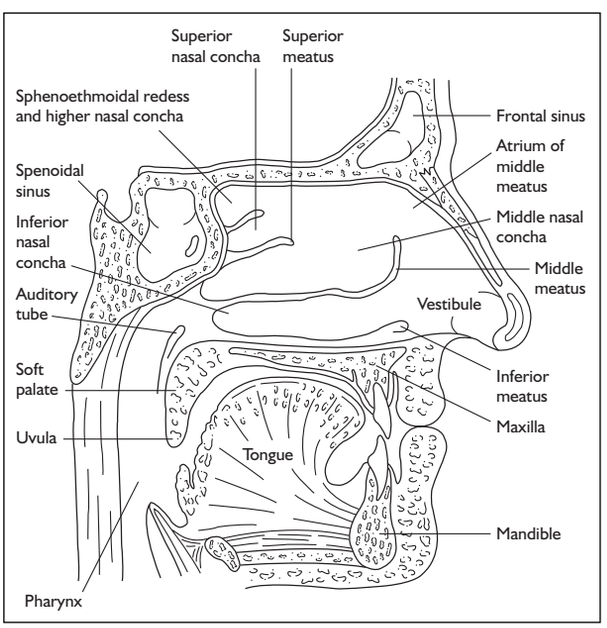


FIGURE 1 *Lateral view of the nasal cavity showing turbinates. Reproduced with permission © 1999 A&C Black (Publishers) Limited.*

Frequent recurrence is a characteristic of nasal polyps that has a great impact on patients. Following surgery to remove nasal polyps recurrence rates of up to 40% have been reported and it appears that a higher recurrence rate is associated with allergic disease and aspirin intolerance.[4]

Aetiology

Polyps have been associated with conditions that lead to chronic inflammation in the nasal cavity, including the following:[3]

- bronchial asthma
- cystic fibrosis
- allergic rhinitis
- allergic fungal sinusitis (AFS)
- ciliary dyskinesia
- aspirin intolerance
- alcohol intolerance
- Churg–Strauss syndrome
- Young syndrome
- non-allergic rhinitis with eosinophilia syndrome
- immune deficiency (congenital and acquired).

For a more detailed discussion of aetiology of nasal polyps, refer to the most recent edition of *Scott-Brown's Otolaryngology*.[6]

Pathogenesis

The pathogenesis of nasal polyps is not fully understood. A range of genetic, anatomical, inflammatory, neurovascular and histological factors have been suggested as being important.[3,4] There may be a genetic disposition to develop nasal polyps; 14% of those presenting with polyps in one study had a family history of the condition.[7] Some of the diseases associated with polyps are genetic in origin (e.g. cystic fibrosis).

It is possible that mucosal reactions explain some of the pathogenesis of polyps. These reactions

could lead to polyp formation and may be triggered by allergy, infection or inflammatory mediators.[4] Eosinophils are the most common type of inflammatory cell present in polyps. They release mediators (such as cytokines) which regulate the inflammatory response. It is thought that eosinophils are therefore important in the development of nasal polyps.[3] The mediators appear to play different roles in different disease states.

Alteration in the mucous glands is another factor that may lead to the development of nasal polyps through a break in the epithelium followed by bulging of the submucosa through to polyp development.[4]

Another theory is that neurovascular changes may contribute to polyp formation although less work has been conducted in this area. Lack of blood flow into the sinus region may limit the transport of waste compounds which may stimulate polyp growth or the loss of autonomic control due to poor nerve supply.[4]

None of these theories fully accounts for the development of nasal polyps in all circumstances. For a more detailed discussion of the pathogenesis of nasal polyps, refer to the most recent edition of *Scott-Brown's Otolaryngology*.[6]

Histopathology

The normal epithelium of the nasal cavity is pseudostratified, columnar and ciliated respiratory epithelium. The surface epithelium in the sinuses is thinner, less specialised and contains fewer cilia and goblet cells than the surface in the nasal cavity. Four main histological types can be identified in nasal polyps:[4]

1. Oedematous, eosinophilic, 'allergic'. The most common type of polyps accounting for around 85% of all cases. It is characterised by oedematous stroma, an increase in the normal number of goblet cells, an excess number of eosinophils and mast cells in the stroma and a thickened basement membrane.

2. Chronic inflammation polyp. This type of polyp represents less than 10% of all nasal polyps. It is characterised by an absence of oedema of the stroma and the lack of increase in the number of goblet cells. The thickening of the basement membrane is not as pronounced. Signs of inflammatory response may be present although lymphocytes predominate. The stroma contains fibroblasts.

3. Polyp with hyperplasia of seromucinous glands. These polyps are seen in less than 5% of all cases. The main feature is numerous glands and ducts.

4. Polyp with stromal atypia. A very rare type of polyp that may be mistaken for a neoplasm. Stromal cells are abnormal or atypical in appearance, but lack signs of neoplastic cell division.

Epidemiology

It has been estimated that 0.2–1% of adults in the UK will have nasal polyps at some time during their life.[8] Incidence increases with age until 59 years and polyps are more frequent in males than females. Nasal polyps are associated with many different diseases. *Table 1* presents the frequency of nasal polyps recorded in various disease states.[4]

Nasal polyps are rare in children unless associated with cystic fibrosis. Polyps are more frequently seen in adults with non-allergic than allergic disease.[3]

Quality of life/burden of disease

Nasal polyps are not associated with increased mortality, but may have an impact on quality of life. Small polyps may not result in symptoms.

Symptoms include nasal obstruction, anosmia (loss of smell), loss of taste, headaches, snoring, postnasal drainage and sneezing.[4] A study by Radenne and colleagues[9] reported that nasal polyps were associated with a greater reduction in quality of life (as measured by the generic SF-36 questionnaire) than perennial allergic rhinitis ($p < 0.05$). Quality of life was lowest in patients with nasal polyps associated with asthma ($p < 0.05$).

Studies have also demonstrated reduced quality of

TABLE 1 *Diseases associated with nasal polyps*

Disease	Percentage of people with disease who also have nasal polyps
Aspirin intolerance	36
Adult asthma	7
Non-allergic asthma	13
Allergic asthma	5
Chronic rhinosinusitis	2
Non-allergic rhinitis	5
Allergic rhinitis	1.5
Childhood asthma/rhinitis	0.1
Cystic fibrosis	20
Churg–Strauss syndrome	50
Allergic fungal sinusitis	85

life for conditions associated with nasal polyps such as chronic rhinosinusitis,[10,11] AFS[12] and frontal sinusitis.[13]

Radenne and colleagues reported that in patients with nasal polyps medical treatment or surgery significantly improved quality of life at 10-month follow-up.[9] Other studies have investigated the effect on quality of life for patients undergoing FESS although not specifically in patients with nasal polyps. These studies also report significant postoperative improvement in quality of life.[9,11–16]

The Sino-Nasal Outcome Test-20 (SNOT-20) is a disease-based questionnaire that has been used to assess quality of life in patients undergoing FESS and assesses outcomes such as nasal discharge/sneezing, dizziness/ear pain and difficulty sleeping or fatigue.[14] No studies of FESS for the excision of nasal polyps were identified that used generic or preference based quality of life measures.

Summary: description of the health problem

- Nasal polyps originate from any part of the nasal mucosa or paranasal sinuses.
- Polyps are associated with conditions leading to chronic inflammation of the nasal cavity.
- A range of genetic, anatomical, inflammatory, allergy-related, neurovascular and histological factors may explain the development of polyps.
- It has been estimated that 0.2–1% of UK adults will experience nasal polyps during their lifetime.
- Nasal polyps have been shown to reduce quality of life.

Current service provision

The successful management of nasal polyps is centred on early identification, accurate diagnosis and first-line medical treatment.

The English Department of Health reports Hospital Episode Statistics based on inpatient data for the years 2000–1 (1 April–31 March).[17] *Table 2* summarises hospital admissions for nasal polyps.

Using Office for National Statistics 2001 population data,[18] the annual hospital admission rate for nasal polyps is 0.02%. In other words, two people in 10,000 of the general population in England were admitted to hospital with a primary diagnosis of nasal polyps in 2000–1.

Figure 2 shows the age distributions of people admitted to hospital for nasal polyps from 2000–1. It should be noted that these statistics will underestimate the total number of patients with nasal polyps as some will present with concurrent conditions and others will be seen only as outpatients.

TABLE 2 *Hospital episode statistics for primary diagnosis of nasal polyps (2000–1)*

	Nasal polyps (J33)
Finished consultant episodes	12,349
Hospital admission	12,312
Number of males admitted (%)	8384 (68)
Mean length of stay	1.3 days
Mean age	52
Day cases	2283
Bed days	13,109

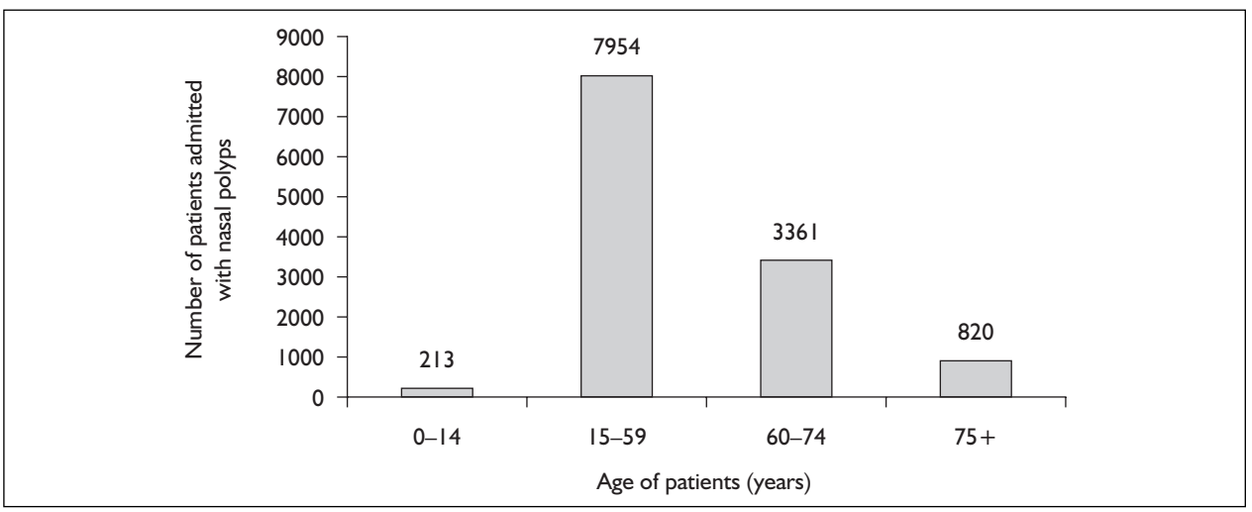


FIGURE 2 *Age distribution of patients admitted to hospital with primary diagnosis of nasal polyps (2000–1)*

There is considerable variation in how aggressively polyps are treated medically (administration of oral or topical steroids) before surgery is considered, and in the extent of surgery performed.

Summary: current service provision

- Two people in 10,000 of the general population in England were admitted to hospital with a primary diagnosis of nasal polyps in 2000–1.
- The most common age group of people admitted with nasal polyps is 15–59 years.
- There is considerable variation in current preoperative management of people with nasal polyps.

Description of the intervention

FESS

Definition of FESS

FESS is a minimally invasive technique that was introduced in the 1960s by Professors Messerklinger and Wigand. It was popularised in Europe by Stammberger and in North America by Kennedy.[19]

FESS is distinct from other procedures as it involves the use of an endoscope to improve ventilation and nasociliary clearance of mucus in addition to polyp removal. FESS aims not only to remove the polyp but also to enlarge the maxillary sinus ostium or perform ethmoidectomy with the intention of reducing recurrence rates. The extent of surgery varies from widening the maxillary antrum through to radical clearance of the entire sinuses. It therefore involves not just the removal of a polyp, but opening the thin bony lamella of the sinuses (e.g. ethmoid). The technique has been used since the 1970s in treating a variety of sinus conditions, including nasal polyps.

Terminology has also changed over time and there is considerable variation in use of the terms FESS and ESS in the literature and in practice. The term 'functional' was originally applied to endoscopic sinus surgery to indicate that it improved mucociliary clearance or 'functioning' in the sinus. The same procedure has also simply been referred to as endoscopic sinus surgery (ESS) or endoscopic polypectomy. Terms may vary depending on the patient group under consideration. When we discuss results from included studies we retain their original nomenclature for the procedure.

While there is considerable debate over the use of the term FESS, we have chosen to use it in this review as it is the most frequently used in the existing literature, and define it as: 'endoscopic procedures that open areas within the sinuses to improve ventilation and mucociliary clearance which may be performed for various sinuses diseases with or without polyps'.

Increasing numbers of procedures are now being performed with an endoscope within the sinus region, not all of which are functional. Functional surgery may also be performed without an endoscope using other methods of illumination and imaging. Increasingly there is a wider field of surgery referred to as functional sinus surgery, and one way of performing it is with an endoscope.

FESS claims advantages over conventional surgery: permitting a better view of the surgical field, a more precise and thorough clearance of the inflammatory change, fewer complications and lower recurrence rates.[20] It should be noted that the endoscope has a wide variety of other uses in ear, nose and throat (ENT) surgery, aside from FESS and removal of polyps.

FESS may be performed under local or general anaesthesia, in an outpatient or inpatient setting depending on the complexity of the procedure. FESS is usually performed under general anaesthesia in the UK. An ENT surgeon, an anaesthetist and nursing assistance are required. The majority of procedures are bilateral.

The following is a brief description of some of the more common FESS techniques. The Messerklinger/Stammberger and Wigand techniques are most commonly used in the UK (with the Yankauer technique virtually unheard of).

Messerklinger/Stammberger

This technique was developed largely for the treatment of chronic rhinosinusitis. The aim is to clear diseased ethmoid clefts and compartments and to re-establish ventilation and drainage. The technique involves a stepwise, individualised operation (based on diagnosis) ranging from isolated opening of the ethmoid to a total sphenoidectomy. In the majority of cases resection of the uncinate process is performed, which allows entry into the anterior ethmoid. The procedure was originally designed to be performed under local anaesthesia.[21]

Wigand

This technique was developed mainly for the treatment of nasal polyposis. The procedure begins with a partial resection of the posterior ethmoid, opening the sphenoid sinus. Following this the inferior surface of the anterior skill base is

followed and the ethmoid opened (from posterior to anterior). Next the frontal sinus is exposed from below, and then fenestration of the maxillary antrum with preservation of the mucosal lining is carried out.[22] The distinction between this technique and that of Messerklinger/Stammberger has become blurred and the techniques are now considered by many to be equivalent.

Yankauer

This procedure is not well known and not used in the UK but has been used in a study identified in the literature. It is usually performed under local anaesthesia. After completing this operation the entire ethmoidal labyrinth, sphenoid and maxillary sinuses are open.[23]

Comparative techniques

There are a variety of techniques that may be used instead of FESS, although there is no one procedure that could be considered the most relevant alternative in all cases of nasal polyps/sinus disease for all surgeons.

Simple polypectomy

This technique involves the removal of polyps generally using a snare.[4] The procedure is generally conservative removing polyps from the nasal cavity and may be performed with or without an endoscope.

Intranasal ethmoidectomy

This procedure involves opening and ventilating the ethmoids by entering though the nasal cavity without the use of an endoscope.

Caldwell–Luc

This technique was mainly designed for treating chronic maxillary sinusitis. It involves entering the sinuses via a transantral approach (below the upper lip), anterior maxillary fenestration, complete mucosal removal and inferior meatal antrostomy. The operation may be carried out using an endoscope.[4] Caldwell–Luc (CL) may be an appropriate comparative technique for people whose polyp disease co-exists with maxillary sinusitis, but it is not an appropriate comparative technique for all people with polyps or sinus disease.

Transantral ethmoidectomy

Involves approaching ethmoids via a CL combined with an intranasal approach.[4]

External fronto-ethmo-sphenoidectomy

This procedure involves entering the frontal sinuses or sphenoid from outside of the face.

Diagnosis and prior therapy

The decision to perform FESS is based on patient history, physical examination, a trial with medical treatment and a computed tomography (CT) scan.[20] Patient history includes documentation of nasal obstruction, facial pain, headache, postnasal drip, recurrent infection, nasal bleeding, loss of smell, previous allergy, bronchial asthma and previous nasal surgery. The physical examination should include anterior rhinoscopy with inspection of nasal mucosa, turbinates, middle meatus, allergy and infection.[4] Small polyps may be asymptomatic and identified only during physical examination. Patients should receive appropriate medical therapy with antibiotics and/or oral or topical steroids before surgical intervention. The Royal College of Surgeons of England has suggested a period of 6–8 weeks of medical therapy.[5]

Patients may be assessed prior to surgery using CT scans, magnetic resonance imaging (MRI) scans or plain X-rays. Patients are mostly assessed with a CT scan to determine suitability for surgery and to permit more extensive operative planning. The CT scan allows the extent of disease to be defined and allows location of important related structures such as the internal carotid artery.

Patient selection

There is variation in which patients are selected for which procedures. It is outside the scope of this review to perform research to investigate current practices. We are aware that the following factors may contribute to patient selection for FESS:

- failed medical treatment (although the definition varies in the literature)
- extent of disease and symptoms (including information obtained from CT scans)
- surgical preferences
- patient preferences.

Disease staging/severity scoring

The Lund–MacKay staging system has been used for some time for the quantification of inflammatory disease before surgical intervention. It is simple enough for use in routine clinical practice and is based on a numeric score derived from the CT scan.[24] The system works by recording demographic information along with the following nasal classification:

1. chronic rhinosinusitis
2. acute recurrent rhinosinusitis
3. nasal polyposis

4. miscellaneous [including frontoethmoidal mucoceles, repair of cerebrospinal fluid (CFS) leaks, orbital decompression, dacryocystorhinostomy and other extended applications of FESS].

The CT scan is examined and each sinus group (maxillary, frontal, sphenoidal, anterior and posterior ethmoidal) is assigned the following grades:

- 0 – no abnormality
- 1 – partial opacification
- 2 – total opacification.

The ostiomeatal complex is scored as not obstructed (0) or obstructed (2). A total score from 0 to 24 is obtained and each side can be scored separately.

Variation in FESS techniques

Endoscopic sinus surgery may be categorised according to four main characteristics:[5]

1. approach
2. instrumentation
3. removal techniques
4. extensiveness of surgery.

We discuss endoscopic sinus surgery along each of these dimensions in the remainder of this chapter.

Approach

There are four main approaches used in sinus surgery; sublabial, intranasal, external and transantral.[5] Intranasal surgery is the approach used in FESS for the excision of nasal polyps and involves access to the sinuses via the nasal cavity.

Illumination

All FESS procedures must involve the use of a standard rigid ENT endoscope.

Removal techniques

A standard ENT surgeons' instrument set is required, often along with a monitor used to view the endoscopic images. In FESS for nasal polyps the following instruments may be used:

- forceps: delicate instrument used to either grasp or cut though polyps or nasal mucosa;
- curettes: a spoon-shaped instrument with a sharp edge;
- snare: an instrument, consisting usually of a wireloop or noose, for removing polyps, by avulsion;
- diathermy: electrosurgical procedure (heating of body tissues) used to ablate polyps;
- lasers: capable of producing immense heat when focused at close range and may be used to remove polyps;
- debriders: a microdebrider is an automated instrument that can be used to remove polyps and the residue.

Most commonly forceps, curettes and snares are used, although debriders and lasers may be useful in specific cases such as diffuse polyposis or patients with bleeding disorders.

Extensiveness of surgery

There is variation in the extent of sinus enlargement and clearance that is performed. Partly this is due to the severity, location and recurrence of underlying disease. Variations in surgery are also due to the philosophy of the individual surgeon (i.e. how radical is their approach). The following types of procedures may be performed as part of sinus surgery[5] (for location/anatomy refer to *Figure 1*):

- nasal polypectomy: simply removal of the polyps (not defined as FESS);
- maxillary sinus surgery: involves opening the maxillary sinus;
- middle meatus antrostomy: involves creating an opening in the middle meatus;
- interior meatus antrostomy: involves creating an opening in the interior meatus;
- uncinectomy: involves creating an opening by removing part or all of the uncinate process;
- ethmoid sinus surgery to the bulla;
- anterior ethmoid sinus surgery;
- posterior ethmoid sinus surgery;
- sphenoid sinus surgery.

The most common Messerklinger/Stammberger technique is progressive, that is, it involves advancing, systematically, deeper into the sinuses. The surgery may be terminated at any of these stages.

Frontal sinus surgery does not involve progression through all of the previously mentioned areas, but involves exposing the fronto-nasal recess (via the uncinate process).[25]

Concurrent procedures may be performed. These are not directly related to the removal or prevention of nasal polyps but are sometimes performed during the same operation and include:[5]

- middle turbinate surgery (excluding simple medialisation)

- inferior turbinate surgery
- nasal septum surgery.

Studies report considerable variation in the extent of surgery, ranging from a simple polypectomy through to complete fronto-ethmo-sphenoectomy. Mostly, the extent of surgery is reported as depending on the profile of the individual patient and studies therefore report a mixture of procedures.

Summary: description of the intervention

- The most common FESS techniques are Messerklinger/Stammberger and Wigand.
- We define ESS/FESS as an intranasal procedure involving the endoscope to improve ventilation and drainage in addition to polyp removal.
- Severity, location and recurrence of polyps along with the surgeon's 'philosophy' influence the extent of sinus enlargement and clearance that is performed.

Chapter 3
Methods

Methods for reviewing the effectiveness of FESS were specified *a priori* and are outlined in the research protocol (see Appendix 1). This section provides a description of the methods used to perform a systematic review of the effectiveness of FESS (next section) and our use of the smaller excluded studies to inform future research priorities (subsequent section).

Systematic review – effectiveness of FESS

Search strategy

A search was conducted to identify all studies where FESS is used to excise nasal polyps. No restrictions were made on date of publication or study type. The search was restricted to English language publications. The search strategy, search terms, databases and websites searched are reported in Appendix 2. Bibliographies of included studies were searched for relevant articles, and the external advisory group identified further key references.

Inclusion and exclusion criteria

Studies that were identified through the search described above were assessed for inclusion in two steps. First the titles and abstracts of studies were screened independently by two reviewers (KD and KS) for inclusion. Then two reviewers (KD and KS) examined the full-text articles of the included abstracts. At each step disagreement was resolved by consensus. Decisions regarding inclusion were made independent of data extraction and prior to detailed examination of the results. In the case that duplicate publications were identified, the most recent, complete report was included.

The following exclusion criteria were applied:

- narrative reviews;
- reviews that were more than 5 years old or not focusing on the question;
- editorials;
- case studies/reports (single);
- expert opinion papers;
- animal models;
- preclinical or biological studies;
- studies assessing only the pathology or histology of the polyp.

All comparative studies were included that met the following criteria:

- compared FESS with conventional procedures;
- surgery was for the excision of nasal polyps;
- adequate description of the patient population (i.e. we were able to determine the surgical indications and how many patients had polyps);
- structured in a way that enabled the results of nasal polyp excision to be isolated from procedures for other conditions (e.g. tumours);
- patient-relevant outcomes reported (i.e. studies that only reported histological appearance of polyps, mean blood loss or duration of surgery were excluded);
- FESS used for therapy (not just diagnosis).

In addition to comparative studies case series, studies were also included if they met the following criteria:

- focused on FESS for the excision of nasal polyps;
- provided an adequate description of the patient population;
- structured in a way that enabled the results of nasal polyp excision to be isolated from procedures for other conditions (e.g. tumours);
- patient-relevant outcomes reported;
- contained more than 50 patients with nasal polyps (an arbitrary cut-off in order to reasonably limit the number of included cases).

Data extraction strategy

Data extraction of the included full-text articles was performed by one reviewer (KD) and checked by a second reviewer (RG). Any disagreements were resolved by consensus. In addition to presenting the results given by the studies, we calculated results based on intention-to-treat (ITT) (from the original data where available) and present these figures in the main tables of the report.

Quality assessment strategy

Using a structured form the quality of the included studies was assessed by one reviewer and checked by a second reviewer. For each comparative study the following were assessed.

Internal validity
- sample size;
- selection bias (allocation strategies, eligibility criteria, similarity of groups at baseline);
- performance bias (same intervention and similar concurrent therapies for both groups);
- detection bias (blinding procedures);
- attrition bias (ITT analyses, drop-outs, loss to follow-up).

External validity
- generalisability (low = no description of exclusion criteria, poor description of patient group; medium = description of exclusion criteria and patient group; high = detailed description of exclusion criteria and patient group);
- patient characteristics (in order to determine the kind of patients to whom the results will apply);
- usual care setting (in order to assess possible replication);
- standard treatment regime (outlines the treatments to which the results will apply);
- standard treatment outcomes measured (patient-relevant outcomes will be of relevance to patients);
- length of follow-up (determines timing of expected future results).

For case series studies the following were considered.

Internal validity
- sample size;
- selection bias (prospective study design, consecutive enrolment of patients, eligibility criteria);
- performance bias (same intervention and concurrent therapies for all patients);
- attrition bias (ITT analyses, drop-outs, loss to follow-up).

External validity
- generalisability (low = no description of exclusion criteria, poor description of patient group; medium = description of exclusion criteria and patient group; high = detailed description of exclusion criteria and patient group);
- patient characteristics;
- usual care setting;
- standard surgical regime;
- standard treatment outcomes measured (patient relevant);
- length of follow-up.

Methods of analysis

Owing to the lack of homogeneous randomised controlled trials (RCTs), we have not performed meta-analysis. We have, however, reported comparative data from randomised and non-randomised studies where available.

This assessment includes all patient-relevant outcome measures reported in the studies. We have not included a comparison of case series for conventional polypectomy owing to the heterogeneity in the populations studied.

Symptomatic improvement was chosen as the primary outcome measure. Revision rates, recurrence/residual disease and complications are also reported in detail. The results of studies are grouped as follows:

1. RCTs
2. non-randomised comparative studies
3. case series studies:
   (a) studies in which all patients have polyps
   (b) studies in which there were mixed patient groups with results reported separately for polyps
   (c) studies in which there were mixed patient groups with results not reported separately for polyps.

When 95% confidence intervals were not reported, they have been calculated using the Confidence Interval Analysis (CIA) program.[26]

Summary: methods of systematic review

- An extensive search was performed to identify all articles where FESS is used for the excision of nasal polyps.
- Two reviewers independently screened articles for inclusion according to predefined criteria.
- Data were extracted by one reviewer and checked by a second.
- A structured form was used to assess the internal and external validity of included studies.
- Comparative data were reported where available.

Future research priorities

Different types of patients may need FESS for nasal polyps, there are different types of polyps and there are variations in technology and the FESS procedure itself. FESS is a continually emerging technology and many of the studies exploring these subgroups are small case series that were excluded from the systematic review described above. It was thought that the smaller

and more recent case series studies may provide insight into current uncertainties in the field.

This section uses the case series and case reports that were excluded from the systematic review along with expert opinion to inform future research priorities in this area.

Data presentation

The excluded case series and case reports on FESS for nasal polyps were grouped according to patient groups, types of polyps or techniques/technologies. For each of the subgroups we present a descriptive summary of the available primary research. The citation and abstract of each study are presented in a summary table (Appendix 11).

Selection of experts

We selected a group of nine consultant ENT surgeons (five of whom were also part of our expert advisory group) and asked them to participate in this exercise. The additional surgeons were selected from the Clinical Practice Advisory Group of the British Association of Otorhinolaryngologists and Head and Neck Surgeons. All surgeons who were invited to participate agreed to be involved.

Generation of future priorities

We sought the views of the group of experts on the most pressing areas of uncertainty in the use of FESS in two steps:

1. The group were presented with the summary of the primary research that had been excluded from the systematic review. In their role as opinion leaders they were asked to assess the literature, reflect on their experience and to generate a list of research questions that were their highest priority in the area of FESS for nasal polyps.
2. Using these questions from the experts we compiled a list of future research priorities for FESS and nasal polyps. We then recirculated this list asking the external advisory group to indicate the relative importance of these areas of enquiry. They were given a total of seven votes/points which they could use to indicate their preferences about the research agenda for FESS. They could allocate the votes however they liked (i.e. allocating seven points to one question, one each to seven questions or any combination). Participants did not have to use all seven votes but were not permitted to use more than seven. This technique has not been validated but is similar to how the National Health Technology Assessment Programme assesses priorities in its expert advising panels.

The results of this prioritising exercise are presented in the future research priorities section in Chapter 4.

Economic evaluation

Existing economic evaluations of FESS for the excision of nasal polyps were sought through the search strategy outlined in Appendix 2. Our search included sources of information on current research being carried out on FESS. Results are reported in the future research priorities section in Chapter 4.

We did not attempt to model cost-effectiveness or cost-utility owing to the paucity of available effectiveness data, in particular the lack of direct comparisons of FESS with conventional surgery. Cost data for ESS are, however, provided.

We estimated possible resource use associated with FESS through contact with a manufacturer of FESS instruments (Karl Stortz Endoscopy UK Ltd) and by examination of relevant Healthcare Resource Groups (HRGs). Possible training costs and operating times were obtained from Internet searches and the expert advisory group. Estimates of the percentage of day case procedures, amount of revision surgery/follow-up and complication rates were obtained from the literature.

Summary: methods for generation of future research priorities and economic evaluation

- Excluded case series and case reports were grouped and described.
- A group of nine ENT experts were selected.
- Using the literature and their own experience, the experts generated a list of priority research questions.
- Experts assigned votes to the compiled list of research priority questions.
- Existing economic evaluations were sought and described.
- Cost data for FESS are provided.

Chapter 4
Results

The results chapter is organised as follows:

- Systematic review – effectiveness of FESS:
  - studies identified
  - quality assessment
  - assessment of effectiveness.
- Future research priorities:
  - studies excluded from systematic review
  - description of studies
  - future research priorities
  - research in progress.
- Economic evaluation of FESS:
  - existing economic studies
  - cost description.

Systematic review – effectiveness of FESS

Studies identified

The search identified a total of 444 articles, 33 of which were included after completing the selection process. The flow chart in *Figure 3* illustrates the inclusion process. A list of the full-text articles inspected and excluded (along with reasons) is given in Appendix 3.

The study designs of the 33 articles identified for inclusion are shown in *Table 3*.

The study characteristics of the included studies are presented in *Tables 4–6*.

Publication date/country and sample size

The studies were published between 1978 and 2001. Most studies were conducted in the USA (n = 12)[23,25,27–36] or Europe (UK 2,[37,38] Norway 1,[39] Denmark 1,[40] France 1,[41] Spain 1,[42] Austria 2,[21,43] Finland 1,[44] Turkey 1,[45] The Netherlands 1[46] and Germany 3).[22,47,48] Further studies were conducted in the following countries: Canada,[49] India,[50,51] Slovenia[52] and Taiwan.[53] Two studies were conducted across more than one country as follows: Germany and India,[54] and the USA, France and Canada.[55] The number of people included in each study ranged from 40 to 2523, with a median of 210.

Indications for surgery

The indications for surgery varied widely between studies. In seven studies all of the included patients had nasal polyps,[22,41,46,51,52,54,55] in 16 studies the included patients had a variety of polypoid and non-polypoid disease with the results reported separately for each,[23,25,29–34,38–40,42,43,49,50,53] and in a further 10 studies patients had a mixture of disease and results for polypoid and non-polypoid disease were not reported separately.[21,27,28,35–37,44,45,47,48]

Age and gender of participants

The included study participants varied in age from 2 to 92 years, with a median age across studies of 44 years. One study was conducted in children only,[43] eight in adults only,[29,31,33,41,45,49,51,55] 15 included a mixture of children and adults[25,27,30,34–37,39,40,44,46,48,50,53] and 10 did not report the age of study participants.[21–23,28,32,38,42,47,52,54] The male-to-female ratio was reported in 17 studies.[31,33,34,36,37,39–41,43–45,48–51,53,55] The proportion of males included in the studies ranged from 19 to 70% with a median of 51%. Nineteen studies[25,28,31,32,34,35,39–45,47,51–55] reported the percentage of patients with bilateral disease ranging from 42 to 100% with a median of 78%.

Duration of symptoms and previous surgery

The average duration of symptoms prior to surgery was reported in five studies[39–41,48,50] and ranged from 6 months to 14 years with a median of 9 months. The percentage of patients who had previous sinus surgery was reported in 17 studies with a median of 25%.[25,28–33,35,36,39–42,44,48–50] One study enrolled only patients who had previous sinus surgery[33] and two studies did not include any patients who had previous surgery.[28,48]

Length of follow-up and anaesthesia

Average length of follow-up was reported in 16 studies[23,25,28–35,38–41,50,51] and ranged from 6 to 42 months with a median of 17 months. Ten studies[32,36–38,40,42,43,50,51,53] reported the percentage of patients who had the procedure performed under general anaesthesia (as opposed to local

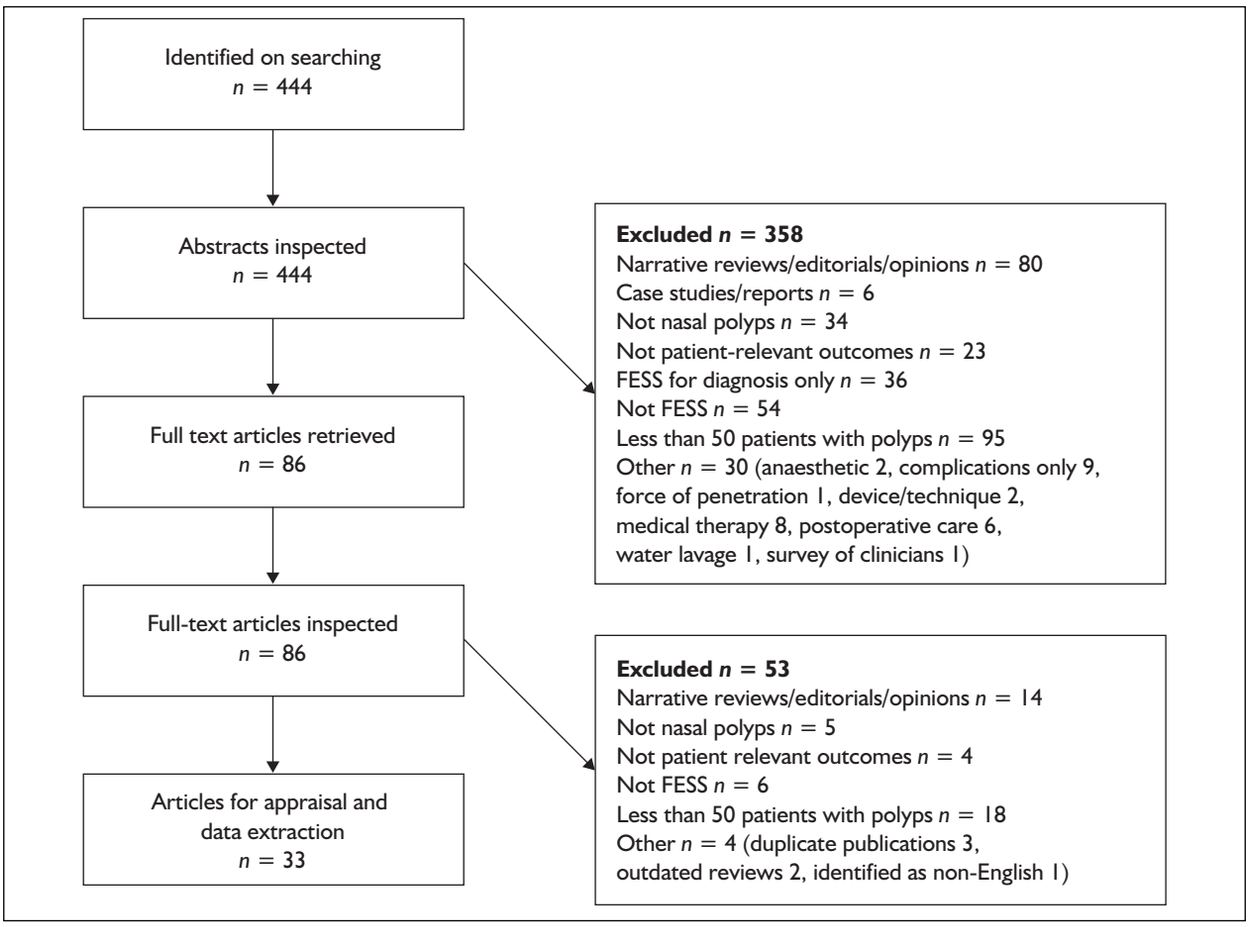


FIGURE 3 *Flowchart showing inclusion/selection process*

TABLE 3 *Study design of the included articles*

Study design	No. of studies included
Randomised controlled trials	3
Non-randomised comparative studies	3
Case series	27
Total	33

anaesthesia) and values ranged from 0 to 100% with a median of 56%.

Postoperative interventions

Fifteen of the included studies failed to provide details of postoperative management. Postoperative topical steroids were reportedly used in 12 studies and systemic steroids in two studies. Oral prednisone was administered postoperatively to patients in one study. Very few details regarding dose and duration of treatment were provided. Some studies specified the types of steroids used, which included budesonide, beclomethasone and prednisolone.

Summary: characteristics of included studies

- Thirty-three studies (six comparative) were included in the review.
- Studies were published between 1978 and 2001, mostly in the USA and Europe with a median sample size of 210.
- Seven studies only included patients with polyps and 26 included patients with a variety of disease including polyps.
- Median of participants was 44 years and median proportion of males was 51%.
- Median duration of symptoms prior to surgery was 9 months and median percentage of previous surgery was 25%.
- Median follow-up from studies was 17 months.
- Approximately half of the studies provide some details of postoperative medical management.

Quality assessment

Randomised controlled studies

The quality assessment of the three RCTs is summarised in *Table 7*.

TABLE 4 *Characteristics of included randomised controlled trials including technique and patient groups*

Author/ date	No. of patients (no. with polyps)	Country	Intervention	General anaesthesia (%)	Surgical indications	Average age in years (range)	Male:female ratio (% male)	Duration of symptoms in years (range)	Previous surgery (%)	Mean length of follow-up in months (range)
Kurent and Zargi, 1998[52]		Slovenia		Not stated	Massive bilateral nasal polyposis	–	–	–	–	–
	20 (20)		Endoscopic polypectomy							
	20 (20)		Endoscopic ethmoidectomy							
Penttilä *et al.*, 1997[44]		Finland		Not stated	Rhinogenous chronic maxillary sinusitis			–		
	75 (52)		FESS			47 (16–84)	30:45 (40)		18/75 (24)	Maximum 108
	75 (45)		CL			48 (14–88)	36:39 (48)		20/75 (27)	Maximum 108
Venkatachalam and Bhat, 1998[51]		India (New Delhi)			Nasal polyposis	20–39	35:15 (70)	(0.5–3)	–	17 (6–30)
	25 (25)		FESS	0						
	25 (25)		Conventional procedures	–						

TABLE 5 *Characteristics of included non-randomised comparative studies including technique and patient groups*

Author/ date	No. of patients (no. with polyps)	Country	Intervention	General anaesthesia (%)	Surgical indications	Average age in years (range)	Male:female ratio (% male)	Duration of symptoms in years (range)	Previous surgery (%)	Mean length of follow-up in months (range)
Harkness *et al.*, 1997[37]		UK		94	Chronic rhinosinusitis 46% Polyposis 37% Recurrent sinusitis 10% Miscellaneous 7%	45 (2–89)	56:44 (56)	–	–	
	1459		Conventional surgery (including sphenoid drainage, BAWO, frontal drainage, polypectomy, external approaches, BINA)[a]							Maximum 6
	1064		FESS							Maximum 6
Jankowski *et al.*, 1997[41]		France		–	Diffuse nasal polyposis 100%					
	37 (37)		Functional ethmoidectomy			44 (26–65)	20:9 (69)	10.4 (1–40)	15/29 (52)	24 (18–31)
	39 (39)		Radical ethmoidectomy (nasalisation)			47 (28–71)	24:10 (71)	13.7 (2–40)	24/34 (71)	34 (32–36)
Ünlü *et al.*, 1994[45]		Turkey		– –	Chronic/recurring acute rhinosinusitis			–	–	–
	50 (14)		ESS			36 (18–68)	20:20 (50)			
	50 (8)		CL			40 (18–65)	20:17 (54)			

[a] BAWO = bilateral antral washout; BINA = bilateral intranasal antrostomy.

TABLE 6 *Characteristics of included case series studies including technique and patient groups*

Author/ date	No. of patients (no. with polyps)	Country	Intervention	General anaesthesia (%)	Surgical indications	Average age in years (range)	Male:female ratio (% male)	Duration of symptoms in years (range)	Previous surgery (%)	Mean length of follow-up in months (range)
1. Studies in which all patients had polyps										
Klossek *et al.*, 1997[55]	50 (50)	USA, France, Canada	Total sphenoethmoidectomy	–	Nasal polyposis involving all sinuses 100%	47 (18–66)	27:23 (54)	–	–	Minimum 36
Stoop *et al.*, 1992[46]	72 (72)	The Netherlands	Endoscopic sinus surgery	–	Nasal polyps (extensive polyposis 44%)	44 (16–72)	–	–	–	(6–12)
Weber *et al.*, 1997[54]	325 (325)	Germany and India	Endonasal microendoscopic pansinusoperation (described at Hospital Fulda, Germany)	–	Bilateral chronic polypoid ethmoid sinusitis 100%	–	–	–	–	(10–120)
Wigand and Hosemann, 1989[22]	220 (220)	Germany	Endoscopic ethmoidectomy	–	Nasal polyposis 100%	–	–	–	–	–
2. Studies in which there were mixed patient groups with results reported separately for polyposis										
Danielsen and Olofsson 1996[39]	230 (92)	Norway	ESS, Messerklinger technique	–	Sinusitis 39% Nasal polyposis 40%	(2–79)	25:105 (19)	12	18/92 (20)	41
Friedman *et al.*, 2000[25]	200 (68)	USA	Endoscopic frontal sinus surgery	–	Persistent chronic sinusitis 100% (polyposis 34%)	41 (14–76)	–	–	59/200 (20)	12 (6–31)
Jacobs 1997[29]	112 (51)	USA	Endoscopic ethmoidectomy, modified Messerklinger approach	–	Diffuse sinonasal polyposis 27% Middle meatal polyposis 19% Encroaching cells 19% Hyperplastic sinusitis 13% Frontal recess stenosis 9% Frontal mucocele 4%	(17–72)	–	–	32/112 (29)	16 (6–42)
Jakobsen and Svendstrup, 2000[40]	237 (146)	Denmark	FESS, Stammberger approach	100	Chronic infectious sinusitis 38% Nasal polyps/polyposis 62%	46 (11–92)	141:96 (59)	9.3 (1–50)	24/237 (10)	12

continued

TABLE 6 *Characteristics of included case series studies including technique and patient groups (cont'd)*

Author/ date	No. of patients (no. with polyps)	Country	Intervention	General anaesthesia (%)	Surgical indications	Average age in years (range)	Male:female ratio (% male)	Duration of symptoms in years (range)	Previous surgery (%)	Mean length of follow-up in months (range)
Jiang and Hsu 2001[53]	1112 (499)	Taiwan	ESS, opening at least one sinus	41	Chronic sinusitis 51% Nasal polyps 46% Antrochoanal polyps 3%	(5–84)	695:417 (62)	–	–	(7–126)
Katsantonis *et al.*, 1994[23]	972 (?)	USA	Sphenoethmoidectomy, modified Yankauer approach (marsupialisation)	–	Chronic hyperplastic rhinosinusitis Recurrent nasal polyposis Sinobronchial syndrome Recurrent purulent pansinusitis	–	–	–	–	14 (6–30)
Kennedy, 1992[30]	120 (71)	USA	EES with laser	–	Non-polypoid disease 41% Middle meatal polyposis 31% Diffuse polyposis 28%	(15–77)	–	–	85/120 (71)	18 (3–51)
Lawson 1991[31]	90 (53)	USA	ESS, modified Yankauer technique	–	Focal 23% Pansinusitis 10% Panpolyposis 27% Asthma/polyps 32% Asthma/sinusitis 8%	49 (21–81)	60:30 (67)	–	36/90 (40)	42 (2–14)
Levine, 1990[32]	250 (131)	USA	FESS, modified Messerklinger approach, some with laser	17	Sinonasal polyposis 52% Chronic sinusitis 48%	–	–	–	13/250 (5)	17 (12–42)
Lund and MacKay, 1994[38]	650 (306)	UK	ESS (functional for chronic and acute sinusitis)	97	Chronic rhinosinusitis 51% Gross polyposis 47% Acute recurrent rhinosinusitis 2%	–	–	–	–	6
Massegur *et al.*, 1995[42]	250 (203)	Spain	ESS, modified Messerklinger and Stammberger technique	56	Antrochoanal polyps 12% Polyposis/ASA[a] 25% Polyposis/non-ASA 45% Chronic suppurative sinusitis 14%	–	–	–	58/250 (23)	(12–48)

continued

TABLE 6 *Characteristics of included case series studies including technique and patient groups (cont'd)*

Author/ date	No. of patients (no. with polyps)	Country	Intervention	General anaesthesia (%)	Surgical indications	Average age in years (range)	Male:female ratio (% male)	Duration of symptoms in years (range)	Previous surgery (%)	Mean length of follow-up in months (range)
					Mucoceles 3% Schwannoma 0.4% Aspergillomas 2%					
Moses *et al.*, 1998[33]	90 (50)	USA	ESS (revision)	–	Polyposis 56%	42 (20–77)	36:54 (40)	–	90/90 (100)	23 (8–44)
Nishioka *et al.*, 1994[34]	283 (48–51% of sides)	USA	FESS, modified Messerklinger approach and partial middle turbinectomy	–	Chronic sinusitis 100%	44 (4–83)	161:122 (57)	–	–	15 (1–44)
Sobol *et al.*, 1998[49]	393 (185)	Canada	FESS using standard technique, including anterior and posterior ethmoidectomies	–	Chronic sinusitis 100% (Polyposis 47%)	45 (17–77)	195:198 (50)	–	125/393 (32)	Maximum 12
Venkatachalam and Bhat, 1999[50]	210 (66)	India (New Delhi)	FESS, Messerklinger approach	0	Chronic hyperplastic sinusitis 100% (ethmoidal polyps 13%, antrochoanal polyps 19%)	31–40 (7–66)	122:88 (58)	0.5–2 (0.5–25)	39/210 (19)	18 (9–33)
Wolf *et al.*, 1995[43]	124 (53)	Austria	ESS, Messerklinger and Stammberger approach	55	Chronic recurring sinusitis 57% Chronic recurring sinusitis/diffuse polyps/antrochoanal polyps 42%	12 (3–16)	59:65 (48)	–	–	–
3. Studies in which there were mixed patient groups with results not reported separately for polyposis										
Davis *et al.*, 1991[27]	200 (147)	USA	FESS, Messerklinger approach	–	Chronic sinusitis 26% Chronic sinusitis and polyps 74%	(4–83)	–	–	–	Maximum 36
Delank and Stoll, 1998[48]	115 (89)	Germany	FESS, Wigand approach	–	No polyps 23% Polyps near middle turbinate 25% Polyps within upper/middle meatus 40% Total blockage by polyps 12%	44 (14–79)	63:52 (55)	0.9	0	–

continued

TABLE 6 *Characteristics of included case series studies including technique and patient groups (cont'd)*

Author/ date	No. of patients (no. with polyps)	Country	Intervention	General anaesthesia (%)	Surgical indications	Average age in years (range)	Male:female ratio (% male)	Duration of symptoms in years (range)	Previous surgery (%)	Mean length of follow-up in months (range)
Friedman *et al.*, 2000[28]	500 (136)	USA	ESS and middle turbinate medialisation (microdebrider)	–	Persistent chronic sinusitis 73% Polyposis 27%	–	–	–	0	10 (6–18)
Park *et al.*, 1998[35]	79 (58)	USA	FESS, removing uncinate process, bulla ethmoidalis and anterior ethmoid cells	–	Chronic sinusitis or recurrent acute sinusitis 100% (nasal polyposis 73%)	50 (6–81)	–	–	44/79 (56)	19 (12–108)
Schaefer, 1998[36]	509 (139)	USA	Endoscopic intranasal ethmoidectomy and middle meatus antrostomy/ sphenoidotomy/frontal sinostomy	99.6	Symptomatic sinusitis 63% Polyps ± sinusitis 27% Orbital abscess/sinusitis 1% Thyroid eye disease 8% AFS 2%	42 (12–84)	261:248 (51)	–	252/509 (50)	(1–60)
Stammberger and Posawetz, 1990[21]	500 (246)	Austria	FESS, Messerklinger approach	–	Massive nasal polyposis 49%	–	–	–	–	Maximum 120
Wigand *et al.*, 1978[47]	315 (?)	Germany	Endonasal sinus surgery with endoscopic control (including maxillary sinus or ethmoidectomy), Wigand technique	–	Chronic sinusitis and severe polyposis 76% Chronic ethmoiditis mostly severe polyposis 24%	–	–	–	–	(3–6)

[a] ASA, aspirin-sensitive asthma.

TABLE 7 *Methodological characteristics of included randomised controlled trials*

Author/ date	No. of patients (no. with polyps)	Adequate allocation to groups	Blinding	Comparability of groups	Same intervention to all patients	Loss to follow-up (%)	Sample size calculation	ITT	Generalisability	Main outcome measured independently	Inter-centre variability	Conflicts of interest
Kurent and Zargi, 1998[52]	40 (40)	No	No	Yes	Uncertain	13	No	No	Low	No	Not applicable	None stated
Penttilä *et al.*, 1997[44]	150 (97)	No	No	Uncertain	Uncertain	15	No	No	Low	No	Not applicable	None stated
Venkatachalam and Bhat, 1998[51]	50 (50)	Uncertain	No	Uncertain	No	4	No	Yes	Low	Uncertain	Not applicable	None stated

TABLE 8 *Methodological characteristics of included non-randomised comparative studies*

Author/ date	No. of patients (no. with polyps)	Allocation to groups	Blinding	Comparability of groups	Same intervention to all patients	Loss to follow-up (%)	Sample size calculation	ITT	Generalisability	Main outcome measured independently	Inter-centre variability	Conflicts of interest
Harkness *et al.*, 1997[37]	2523 (946)	Non-random	No	Uncertain	Uncertain	Uncertain	No	Not applicable	Low	No	Not assessed	None
Jankowski *et al.*, 1997[41]	76 (76)	Non-random	No	No	Uncertain	18	No	No	Medium	Yes	Not applicable	None stated
Ünlü *et al.*, 1994[45]	100 (22)	Non-random	No	Uncertain	Uncertain	23	No	No	Low	No	Not applicable	None stated

Internal validity

Sample size. Kurent and Zargi[52] randomised 20 people to endoscopic polypectomy and 20 to endoscopic ethmoidectomy. Penttilä and colleagues[44] enrolled a total of 150 people with chronic maxillary sinusitis and randomised 75 to FESS and 75 to CL. Venkatachalam and Bhat[51] enrolled a total of 50 patients and randomised 25 to FESS and 25 to conventional procedures.

No sample size or power calculations were performed prior to commencing these RCTs. Kurent and Zargi[52] did not have sufficient power to detect a significant result (power of 50% requires between 162 and 675 in each group, or in other words there is only a 50% chance of declaring their observed difference as significant even if they had between 162 and 675 in each study group). Penttilä and colleagues[44] had power of 95% to detect a significant result (>63 in each group was required). Venkatachalam and Bhat[51] had less than 50% power to detect a significant result based on their reported difference between the two groups for their main outcome (for the given difference power of 50% requires 37 people in each group, or in other words there is only a 50% chance of declaring their observed difference as significant with 37 people in each arm of the study).

Selection bias. The Kurent and Zargi study[52] was probably not truly random or secure as they describe their allocation to groups as 'alternative'. Penttilä and colleagues[44] describe their randomisation process as involving lots of equal numbers being drawn, a list being created and patients being put on the list in order of recruitment. We are unable to assess if allocation to groups was truly random, and it appears not to be secure. Venkatachalam and Bhat[51] failed to provide details of randomisation or security.

The Kurent and Zargi study groups were similar for age, sex, duration of symptoms and presence of asthma and allergy.[52] In the study by Penttilä and colleagues,[44] the FESS and CL groups were similar for age, sex and previous surgery but more people in the FESS group had bilateral disease. Venkatachalam and Bhat[51] failed to provide baseline characteristics of their FESS and conventional procedures groups. The latter two studies are prone to bias owing to inadequate randomisation and possible incomparability of the two study groups.

Performance bias. Sinus surgery is a difficult procedure to standardise as, in most cases, the extent of surgery performed is influenced by the extent of underlying disease. It is important, however, that the surgical strategy or philosophy is clearly outlined and that a rationale is provided for the variations of the procedure. Kurent and Zargi[52] fail to provide details of endoscopic polypectomy or ethmoidectomy and it is possible that the interventions varied between patients and surgeons. Penttilä and colleagues[44] provide few details of the intervention and comparison, only that FESS involved middle meatal antrostomy and that CL involved inferior meatal antrostomy. It is likely that the intervention varied. Venkatachalam and Bhat[51] provide few details of FESS and report that conventional procedures included a variety of other techniques. There is a high potential for performance bias as procedures were not standard across patients, with the conventional procedures group being particularly variable.

In addition, postoperative management varied across studies and is another source of potential performance bias. Kurent and Zargi[52] report the use of topical steroids and saline physiological solution; Penttilä and colleagues[44] report the use of nasal suction cleaning and antral irrigation; and Venkatachalam and Bhat[51] report using steroid nasal spray (bedesonide), two puffs twice a day for 6 months.

Detection bias. Blinding is difficult to achieve with surgical interventions. It is possible, however, to blind those assessing/recording outcomes and analysing data. None of the three RCTs[44,51,52] report blinding any of these parties.

Attrition bias. Kurent and Zargi[52] report that at a maximum of 36 months follow-up, 15% of patients were lost from the polypectomy group and 10% from the ethmoidectomy group. Penttilä and colleagues[44] report that at 12 months follow-up, 5% in the CL group and 4% in the FESS group were lost. At 5–9 years follow-up, 15% in the CL group and 12% in the FESS group were lost. Venkatachalam and Bhat[51] report that 4% were lost to follow-up in each of the FESS and conventional procedures groups. Venkatachalam and Bhat[51] were the only authors to perform their analysis on an ITT basis. This may have introduced bias in the other two trials as patients who dropped out of the study may have differed from those who remained (e.g. they may have had more negative or more positive outcomes and differed according to intervention).

External validity

The generalisability (as rated by reviewers KD and RG; see the quality assessment strategy section on

pp. 11–12) of all three RCTs was classified as low. The study by Kurent and Zargi[52] contained few details regarding the procedure, patients' characteristics and exclusion criteria. The study by Penttilä and colleagues[44] contained few details of the procedure performed and the limited patients to which the CL comparator may apply. The study by Venkatachalam and Bhat[51] did not provide exclusion criteria and details of patients' characteristics and procedures were sparse.

Kurent and Zargi[52] did not provide details of age and sex, but the other two RCTs did. Penttilä and colleagues[44] provided a breakdown of age and sex for each study group, along with the percentage of patients who had undergone previous surgery. The Venkatachalam study[51] reported average duration of symptoms.

No details of setting were provided and only the Venkatachalam study[51] provided details of anaesthesia, thus limiting generalisability.

Penttilä and colleagues[44] assessed symptomatic improvement using a postoperative interview that was not independent. Venkatachalam and Bhat[51] did not provide details of how outcomes were assessed so we are uncertain if they were independent. Kurent and Zargi[52] only reported polyp recurrence that was measured at endoscopic follow-up.

Outcomes in a patient group where disease is frequently recurrent depend on the length of follow-up. A longer follow-up period will give more detail as to the results that could be realistically expected in a similar patient group over time. Follow-up was a maximum of 36 months in the study by Kurent and Zargi.[52] Follow-up occurred 1 year after surgery and again between 5 and 9 years in the Penttilä study.[44] Patients in the Venkatachalam study[51] were followed for a mean of 16.5 months (range 6–30 months).

Non-randomised comparative studies

The quality assessment of the three non-randomised comparative studies is summarised in *Table 8*.

Internal validity

Sample size. The Harkness study[37] enrolled a total of 2523 patients; 1064 received FESS and 1459 received conventional procedures (including sphenoid sinus drainage, BAWO, frontal sinus drainage, nasal polypectomy, external ethmoidectomy, intra-ethmoidectomy, CL and BINA). Jankowski and colleagues[41] studied a total of 76 patients; 37 received functional ethmoidectomy and 39 received radical nasalisation. Ünlü and colleagues[45] studied a total of 100 patients; 50 received ESS and 50 received CL.

No sample size or power calculations were performed prior to commencing any of these studies. Retrospectively, given the observed results, Harkness and colleagues[37] had power of 85% to detect a 5% difference between groups (>1036 people were required in each group). Jankowski and colleagues[41] had power of 80% to detect a significant difference (>36 people were required in each group) and Ünlü and colleagues[45] had power of 99% to detect a significant difference between the groups (>48 people were required in each group).

Selection bias. All three studies were historical (i.e. selected and analysed results for patients who had previously had the procedure), so patients were allocated to groups based purely on factors such as severity of disease or current practice of the department, which may also affect outcomes. None of the studies stated that the patients were consecutively enrolled.

Harkness and colleagues[37] provide no details of the baseline characteristics of the two study groups, so we are unable to determine if they were comparable. Jankowski and colleagues[41] report that their two groups were similar for age, sex and duration of symptoms, although there were more patients with polyps in the functional ethmoidectomy group and more asthma and prior surgery in the nasalisation group. Both studies are prone to bias due to the incompatibility or possible incomparability of the two study groups.

Ünlü and colleagues[45] report that their study groups were similar for age, sex, presence of allergy and asthma, but report that a longer period of time had passed between surgery and evaluation for CL patients and that there was more bilateral disease for ESS patients. The researchers excluded patients with a mucocele or who had undergone ESS following CL.

Performance bias. Harkness and colleagues[37] report few details of what is meant by 'FESS'. It is possible that the procedure varied with different surgeons and centres that participated in the study, thus introducing the possibility of performance bias. Jankowski and colleagues[41] report a more detailed description of the procedures used. The nasalisation procedure was standardised and the

ethmoidectomy procedure varied according to extent of disease. Both procedures were performed by single surgeons, which lessens the possibility of performance bias but increases the possibility of operator variation. In this study the surgeon performing radical nasalisation had 4 years experience, while the surgeon performing functional ethmoidectomy had shorter experience. Although Ünlü and colleagues[45] report some details of the procedures, it is possible that practices varied over the 7-year study inclusion period.

Postoperative interventions were not reported for any of the three non-randomised trials. If postoperative therapies differed for each study group, then a further bias would be introduced.

Detection bias. None of the studies report blinding any parties.

Attrition bias. Harkness and colleagues[37] report no loss to follow-up, mainly owing to the historical nature of their study design. Jankowski and colleagues[41] report that at 24 months follow-up 13% in the nasalisation group and 22% in the ethmoidectomy group were lost. Ünlü and colleagues[45] reported that 23% of patients did not return to be evaluated. Jankowski and colleagues[41] and Ünlü and colleagues[45] did not perform their analysis on an ITT basis, nor did they compare those who dropped out with those who remained in the study. This may have introduced bias as the outcomes for patients who dropped out of the study may have differed for those who remained.

External validity

The generalisability (as rated by reviewers KD and RG, see the quality assessment strategy section on pp. 11–12) of the study by Harkness and colleagues[37] was classified as low owing to the lack of exclusion criteria and the lack of procedural details. The generalisability of the study by Jankowski and colleagues[41] was classified as medium as there was a good description of the procedures performed and patients were described, although exclusion criteria were omitted. The generalisability of the Ünlü study[45] was classified as low owing to the lack of details about the procedures performed and uncertainty surrounding the generalisability of CL results.

Each study provided details of age and sex. Jankowski and colleagues[41] and Ünlü and colleagues[45] provided a breakdown of age and sex for each study group. Only Jankowski and colleagues[41] provided a description of duration of symptoms and previous surgery.

Harkness and colleagues[37] performed 18% of their procedures as day cases and 6.5% under local anaesthesia. No details of setting and type of anaesthesia were provided for the other two studies.[41,45] This has implications for replicating the study.

The surgical technique was well described in the study by Jankowski and colleagues.[41] The nasalisation technique was standardised although the ethmoidectomy technique varies systematically with extent of disease. Harkness and colleagues[37] and Ünlü and colleagues[45] failed to provide detailed descriptions of the techniques used in their studies. The study by Harkness and colleagues[37] was conducted across more than one site, which introduces further variability. No assessments of inter-centre variability were made.

Harkness and colleagues[37] relied on consultant ENT surgeon assessment to measure their main outcome, which was symptomatic improvement. This introduces a measurement bias as the outcome was not measured independently. Jankowski and colleagues[41] assessed the main outcome of 'functional benefit of surgery' using a questionnaire which included a 10-point visual analogue scale, which is a more objective assessment. Ünlü and colleagues[45] did not report the method used to assess outcomes, although it is unlikely to have been independent.

Harkness and colleagues[37] followed patients for a maximum of 6 months, Jankowski and colleagues[41] followed patients for a mean of 34 months (nasalisation group) and 24 months (ethmoidectomy group) and Ünlü and colleagues[45] followed patients for a median of 18 months (CL group) and 13 months (ESS group). Where follow-up was variable, survival analysis would be a more appropriate method of analysis.

Case series studies

Case series studies are highly prone to a number of potential biases and the direction of effect in each case is unknown. Their principle limitation is the absence of an appropriate control group, severely restricting the ability of such studies to give an estimate of the true effects of treatment. The quality assessment of the case series studies is summarised in *Table 9*.

Internal validity

Sample size. We arbitrarily excluded studies with less than 50 patients with nasal polyps (see the

TABLE 9 *Methodological characteristics of included case series studies*

Author/ date	No. of patients (no. with polyps)	Prospective	Consecutive patients	Same intervention to all patients	Loss to follow-up (%)	ITT	Generalisability	Main outcome measured independently	Inter-centre variability	Conflicts of interest
1. Studies in which all patients had polyps										
Klossek *et al.*, 1997[55]	50 (50)	Yes	Uncertain	Yes	0	Not applicable	Low	Yes	Not assessed	None stated
Stoop *et al.*, 1992[46]	72 (72)	Yes	Uncertain	Uncertain	0	Not applicable	Low	Uncertain	Not applicable	No
Weber *et al.*, 1997[54]	325 (325)	No	Yes	Uncertain	52	No	Low	No	Not assessed	None stated
Wigand and Hosemann, 1989[22]	220 (220)	Uncertain	Uncertain	No	Uncertain	Uncertain	Low	No	Not applicable	None stated
2. Studies in which there were mixed patient groups with results reported separately for polyposis										
Danielsen and Olofsson, 1996[39]	230 (92)	Yes	Uncertain	No	6	No	Low	Yes	Not applicable	Yes
Friedman *et al.*, 2000[25]	200 (68)	No	Yes	No	0	Not applicable	Medium	Uncertain	Not applicable	None stated
Jacobs, 1997[29]	112 (51)	No	Uncertain	No	10	No	Medium	Uncertain	Not applicable	None stated
Jakobsen and Svendstrup, 2000[40]	237 (146)	Yes	Yes	No	3	No	Low	Uncertain	Not applicable	None stated
Jiang and Hsu, 2001[53]	1112 (499)	No	No	No	39	No	Low	Yes	Not applicable	None stated
Katsantonis *et al.*, 1994[23]	972 (?)	No	No	No	Uncertain	Uncertain	Low	No	Not assessed	None stated
Kennedy, 1992[30]	120 (71)	Uncertain	Uncertain	No	Uncertain	Uncertain	Medium	Yes	Not assessed	None stated
Lawson, 1991[31]	90 (53)	Yes	No	Uncertain	Uncertain	Uncertain	Medium	Uncertain	Not applicable	None stated
Levine, 1990[32]	250 (131)	No	Uncertain	No	12	No	Low	Uncertain	Not applicable	None stated
Lund and MacKay, 1994[38]	650 (306)	No	Uncertain	No	0	Not applicable	Low	Uncertain	Not applicable	None stated
Massegur *et al.*, 1995[42]	250 (203)	No	Uncertain	No	0	Not applicable	Low	Yes	Not applicable	None stated
Moses *et al.*, 1998[33]	90 (50)	No	No	Uncertain	0	Not applicable	Low	No	Not applicable	None stated
Nishioka *et al.*, 1994[34]	283 (48–51% sides)	Uncertain	Yes	Uncertain	0	Not applicable	Medium	No	Not assessed	None stated

continued

TABLE 9 *Methodological characteristics of included case series studies (cont'd)*

Author/ date	No. of patients (no. with polyps)	Prospective	Consecutive patients	Same intervention to all patients	Loss to follow-up (%)	ITT	Generalisability	Main outcome measured independently	Inter-centre variability	Conflicts of interest
Sobol *et al.*, 1998[49]	393 (185)	No	Uncertain	No	32	No	Low	No	Not applicable	None stated
Venkatachalam and Bhat, 1999[50]	210 (66)	Uncertain	Uncertain	No	4	No	Low	Uncertain	Not applicable	None stated
Wolf *et al.*, 1995[43]	124 (53)	No	Uncertain	No	43	No	Low	Yes	Not applicable	None stated
3. Studies in which there were mixed patient groups with results not reported separately for polyposis										
Davis *et al.*, 1991[27]	200 (147)	Yes	Yes	No	42	No	Medium	Yes	Not assessed	None stated
Delank and Stoll, 1998[48]	115 (89)	Yes	Uncertain	No	0	Not applicable	Medium	Yes	Not applicable	None stated
Friedman *et al.*, 2000[28]	500 (136)	No	Uncertain	Uncertain	0	Not applicable	Medium	No	Not applicable	None stated
Park *et al.*, 1998[35]	79 (58)	No	No	No	0	Not applicable	Medium	Yes	Not applicable	None stated
Schaefer, 1998[36]	509 (139)	No	No	No	0	Not applicable	Medium	No	Not applicable	None stated
Stammberger and Posawetz, 1990[21]	500 (246)	No	No	No	Uncertain	Uncertain	Low	Yes	Not applicable	None stated
Wigand *et al.*, 1978[47]	315 (?)	No	Yes	Uncertain	0	Not applicable	Low	Uncertain	Not applicable	None stated

inclusion and exclusion criteria section on pp. 11), so the range of sample sizes of the included studies was 50–1112. The median sample size of the included case series studies was 230.

Selection bias. Case series studies are highly prone to selection bias (the selection of an atypical group or a group where outcomes are related to baseline characteristics). A prospective study design may reduce the potential for selection bias when inclusion criteria are defined *a priori*.

The relative importance of prospective and consecutive enrolment is uncertain, although both characteristics are likely to reduce selection bias. Of the included case series studies seven had prospective study design,[27,31,39,40,46,48,55] 16 were retrospective[21,23,25,28,29,32,33,35,36,38,42,43,47,49,53,54] and four provided insufficient details to assess.[22,30,34,50]

Six case series studies enrolled consecutive patients.[25,27,34,40,47,54] Seven studies did not select consecutive patients[21,23,31,33,35,36,53] and the remaining 14 studies did not report sufficient details to assess.[22,28–30,32,38,39,42,43,46,48–50,55]

Performance bias. It is difficult to standardise interventions in surgery. The nature of sinus disease means that in many cases the extent of surgery will depend on the severity of disease. Only the case series study by Klossek and colleagues[55] applied the same intervention to all patients. In this study the same surgeon performed a bilateral total sphenoethmoidectomy with wide middle antrostomies and frontal irrigation on all patients. In all other studies surgery varied between patients. Studies differed in the details of the surgical technique that were provided.

Studies also varied in the concurrent therapies provided to patients. Postoperative steroid use was reported in 14 studies.[21,27,29,30,32,34,35,38,39,42,43,46,54,55]

Attrition bias. Loss to follow-up is an important source of bias as patients who drop out of the series may differ systematically from those who remain. Of the 27 included case series studies, 12 reported no loss to follow-up.[25,28,33–36,38,42,46–48,55] In the remaining 15 studies loss to follow-up was reported in 10 studies[27,29,32,39,40,43,49,50,53,54] and ranged from 3 to 52%, that is, four out of six prospective studies and three out of six consecutive studies had loss to follow-up. None of the studies that reported loss to follow-up reported their results on an ITT basis.

External validity

Generalisability was categorised as low in 17 studies[21–23,32,33,38–40,42,43,46,47,49,50,53–55] and medium in 10[25,27–31,34–36,48] (for details of classification, see the quality assessment strategy section pp. 11–12).

Patients' characteristics are important in determining to whom the results of a study will apply. Thirteen case series studies[25,31,33–36,40,43,46,48–50,55] provided details of participants' average age and 12 studies[31,33,34,36,39,40,43,48–50,53,55] reported the gender of participants. Fifteen case series studies[25,28–33,35,36,39,40,42,48–50] stated the percentage of patients who had had previous surgery and four[39,40,48,50] presented the duration of previous symptoms for the included patients.

Only the case series study by Danielson and Olofsson[39] reported the setting in which their procedures took place, namely day-care outpatients for 91% of patients. Eight studies[32,38,40,42,43,50,53] reported the percentage of procedures that were performed under general anaesthetic (as opposed to local anaesthesia).

The type of surgical regime varied widely between studies. Ten studies reported using the Messerklinger technique, Stammberger technique or modified variations.[21,27,29,32,34,39,40,42,43,50] The Yankauer technique was used in two studies[23,31] and the Wigand technique in two others.[47,48] One study performed only sphenoidectomies[55] and another only frontal sinus surgery.[25] Some studies reported using a microdebrider and some used a laser. Some studies failed to provide a clear description of their FESS technique.

Six of the 25 included case series studies were performed across more than one site.[22,23,27,30,34,55] This introduces further possible variation in how the procedure was performed and therefore lessens generalisability. None of these six studies assessed inter-centre variability.

All case series studies reported patient relevant outcomes (see the inclusion and exclusion criteria section on p. 11). In 10 of the 25 studies the main outcome was measured independently.[21,27,30,35,39,42,43,48,53,55]

The average length of follow-up was reported in 14 case series studies[23,25,28–35,38–40,50] and ranged from 6 to 42 months. A further 10 studies[21,27,36,42,46,47,49,53–55] reported a maximum length of follow-up or a range and three studies failed to report a follow-up period.[22,43,48]

Summary: quality of included studies

- RCTs: the main threats to internal validity were limited study power (two studies), inadequate randomisation (three studies), baseline differences of study groups (two studies), variation in intervention applied (three studies) and loss to follow-up (three studies).
- Non-randomised comparative studies: the main threats to internal validity were non-random allocation to groups (three studies), baseline differences of study groups (three studies), variation in intervention applied (three studies) and loss to follow-up (two studies).
- Case series: the main threats to internal validity were lack of control group, susceptibility to selection bias, variation in intervention applied and loss to follow-up (15 studies).
- All study types: the main threats to external validity were low generalisability to UK setting, non-independent assessment of outcomes and variable length of follow-up.

Assessment of effectiveness

Reporting of outcomes

Complications were reported by all studies except two RCTs,[51,52] one comparative study[45] and four case series studies.[33,46-48] Symptomatic improvement was reported in all studies except one RCT[52] and seven case series.[23,33,34,36,43,46,48] Other outcomes varied widely in the extent to which they were reported by the included studies. A summary of all outcomes and the frequency with which they were reported is presented in *Table 10*.

Outcomes are reported in detail for those considered most relevant to patients (according to clinical opinion of our expert advisory group) and for those reported by the greatest number of studies.

Symptomatic improvement

Symptomatic assessment was classified as greatly improved, improved, same or worse. The results are presented separately for each study design and separately for patients with nasal polyps versus mixed patient groups (those with and without polyps). The results for symptomatic improvement are reported in *Tables 11–13*. Some of the studies had significant loss to follow-up. We have calculated and reported outcomes based on ITT and have presented the ITT results in the tables. On inspection, the ITT results seem to over-compensate for potential bias by assigning all patients that were lost to follow-up a negative outcome (results calculated on ITT basis cluster around 30–40% whereas studies without loss to follow-up cluster around 70–90% for symptom improvement). For these reasons, the results described below are not based on ITT analysis.

Randomised controlled trials

Kurent and Zargi[52] did not report symptomatic improvement. Penttilä and colleagues[44] reported that for those undergoing ESS, 78% showed improved symptoms and 4% were the same. In those undergoing CL, 51% were improved (i.e. difference of 27%, 95% CI 2 to 59%), 14% were the same and 6% were worse. Overall symptomatic

TABLE 10 *Number of studies that reported main outcomes broken down by study design*

Outcome reported	Randomised controlled trials (*n* = 3)	Non-randomised comparative studies (*n* = 3)	Case series studies (*n* = 27)
Symptomatic improvement	2	3	20
Recurrence of polyps/disease	1	–	12
Revision surgery	1	1	10
Residual disease	–	1	4
Complications	2	2	23
Sense of smell	–	1	6
Patency	1	1	6
Nasal blockage/obstruction	–	1	5
Surgical success	–	–	5
Normal mucosa	–	–	4
Additional medical management	–	1	3
Patient satisfaction	–	–	3
Mean blood loss	–	–	1
Synechiae formation	–	–	3
Stenosis	–	–	1
Hospitalisation	–	–	1

TABLE 11 *Summary of symptomatic improvement in randomised controlled trials*

Author/date	Study group	No. of patients (no. with polyps)	Results for patients with polyps only (%) (ITT %)				Results for mixed group of patients (%) (ITT %)			
			Greatly improved	Improved symptoms	Symptoms the same	Symptoms worse	Greatly improved	Improved symptoms	Symptoms the same	Symptoms worse
Kurent and Zargi, 1998[52]	Endoscopic ethmoidectomy	20 (20)	–	–	–	–	–	–	–	–
	Endoscopic polypectomy	20 (20)	–	–	–	–	–	–	–	–
Penttilä *et al.*, 1997[44]	FES	75 (52)	–	–	–	–	78 (75 ITT)	–	4 (4 ITT)	–
	CL	75 (45)	–	–	–	–	51 (48 ITT)	–	14 (13 ITT)	6 (5 ITT)
Venkatachalam and Bhat, 1998[51]	FESS	25 (25)	(72 ITT)	(16 ITT)	(8 ITT)	–				
	Conventional procedures	25 (25)	(48 ITT)	(36 ITT)	(12 ITT)	–				

TABLE 12 *Summary of symptomatic improvement in non-randomised comparative studies*

Author/date	Study group	No. of patients (no. with polyps)	Results for patients with polyps only (%) (ITT %)				Results for mixed group of patients (%) (ITT %)			
			Greatly improved	Improved symptoms	Symptoms the same	Symptoms worse	Greatly improved	Improved symptoms	Symptoms the same	Symptoms worse
Harkness *et al.*, 1997[37]	Conventional procedures	1459 (715)	–	82	–	–	–	–	–	–
	FESS	1064 (234)	–	82	–	–	–	–	–	–
Jankowski *et al.*, 1997[41]	Functional ethmoidectomy	37 (37)	10 (8 ITT)	62 (49 ITT)	21 (16 ITT)	7 (5 ITT)				
	Radical nasalisation	39 (39)	48 (41 ITT)	52 (44 ITT)	0	0				
Ünlü *et al.*, 1994[45]	ESS	50 (14)	–	–	–	–	55 (44 ITT)	30 (24 ITT)	8 (6 ITT)	0
	CL	50 (8)	–	–	–	–	8 (6 ITT)	35 (26 ITT)	35 (26 ITT)	8 (6 ITT)

TABLE 13 *Summary of symptomatic improvement in case series studies*

Author/date	No. of patients (no. with polyps)	Results for patients with polyps only (%) (% ITT)				Results for mixed group of patients (%) (% ITT)			
		Greatly improved	Improved symptoms	Symptoms the same	Symptoms worse	Greatly improved	Improved symptoms	Symptoms the same	Symptoms worse
1. Studies in which all patients had polyps									
Klossek *et al.*, 1997[55]	50 (50)	–	96	–	–				
Stoop *et al.*, 1992[46]	72 (72)	–	–	–	–				
Weber *et al.*, 1997[54]	325 (325)	23 (12 ITT)	66 (34 ITT)	9 (5 ITT)	2 (1 ITT)				
Wigand and Hosemann, 1989[22]	220 (220)	24	58	12	6				
2. Studies in which there were mixed patient groups with results reported separately for polyposis									
Danielsen and Olofsson 1996[39]	230 (92)	33	27	20	0	25 (24 ITT)	15 (15 ITT)	10 (10 ITT)	0
Friedman *et al.*, 2000[25]	200 (68)	–	–	–	–	76	16	8	1
Jacobs, 1997[29]	112 (51)	73	18	10	0	69 (63 ITT)	15 (13 ITT)	16 (14 ITT)	0
Jakobsen and Svendstrup, 2000[40]	237 (146)	50 (49 ITT)	43 (42 ITT)	8 (8 ITT)	0	45 (43 ITT)	44 (43 ITT)	11 (11 ITT)	0.4 (0.4 ITT)
Jiang and Hsu, 2001[53]	1112 (499 surgeries)	6 procedures	31 procedures	5 procedures	1 procedure	12 procedures	66 procedures	16 procedures	6 procedures
Katsantonis *et al.*, 1994[23]	972 (?)	–	–	–	–	–	–	–	–
Kennedy, 1992[30]	120 (71)	87	11	1	0	85	13	3	0
Lawson 1991[31]	90 (53)	–	64	–	–	–	73	–	–
Levine, 1990[32]	250 (131)	–	–	–	–	–	–	16 (14 ITT)	1 (1 ITT)
Lund and MacKay, 1994[38]	650 (306)	–	–	–	–	9	78	11	2
Massegur *et al.*, 1995[42]	250 (203)	73	20	7	–	74	16	9	0
Moses *et al.*, 1998[33]	90 (50)	–	–	–	–	–	–	–	–
Nishioka *et al.*, 1994[34]	283 (48–51% of sides)	–	–	–	–	–	–	–	–
Sobol *et al.*, 1998[49]	393 (185)	–	–	–	–	–	70 (47 ITT)	30 (21 ITT)	–
Venkatachalam and Bhat, 1999[50]	210 (66)	–	–	–	–	70	19	7	–
Wolf *et al.*, 1995[43]	124 (53)	–	–	–	–	–	–	–	–

continued

TABLE 13 *Summary of symptomatic improvement in case series studies (cont'd)*

Author/date	No. of patients (no. with polyps)	Results for patients with polyps only (%) (% ITT)				Results for mixed group of patients (%) (% ITT)			
		Greatly improved	Improved symptoms	Symptoms the same	Symptoms worse	Greatly improved	Improved symptoms	Symptoms the same	Symptoms worse
3. Studies in which there were mixed patient groups with results not reported separately for polyposis									
Davis *et al.*, 1991[27]	200 (147)					–	96 (33 ITT)	–	–
Delank and Stoll, 1998[48]	115 (89)					–	–	–	–
Friedman *et al.*, 2000[28]	500 (136)					78	14	7	1
Park *et al.*, 1998[35]	79 (58)					–	86	–	–
Schaefer, 1998[36]	509 (139)					–	–	–	–
Stammberger and Posawetz, 1990[21]	500 (246)					85	10	5	–
Wigand *et al.*, 1978[47]	315 (?)					76	–	–	–

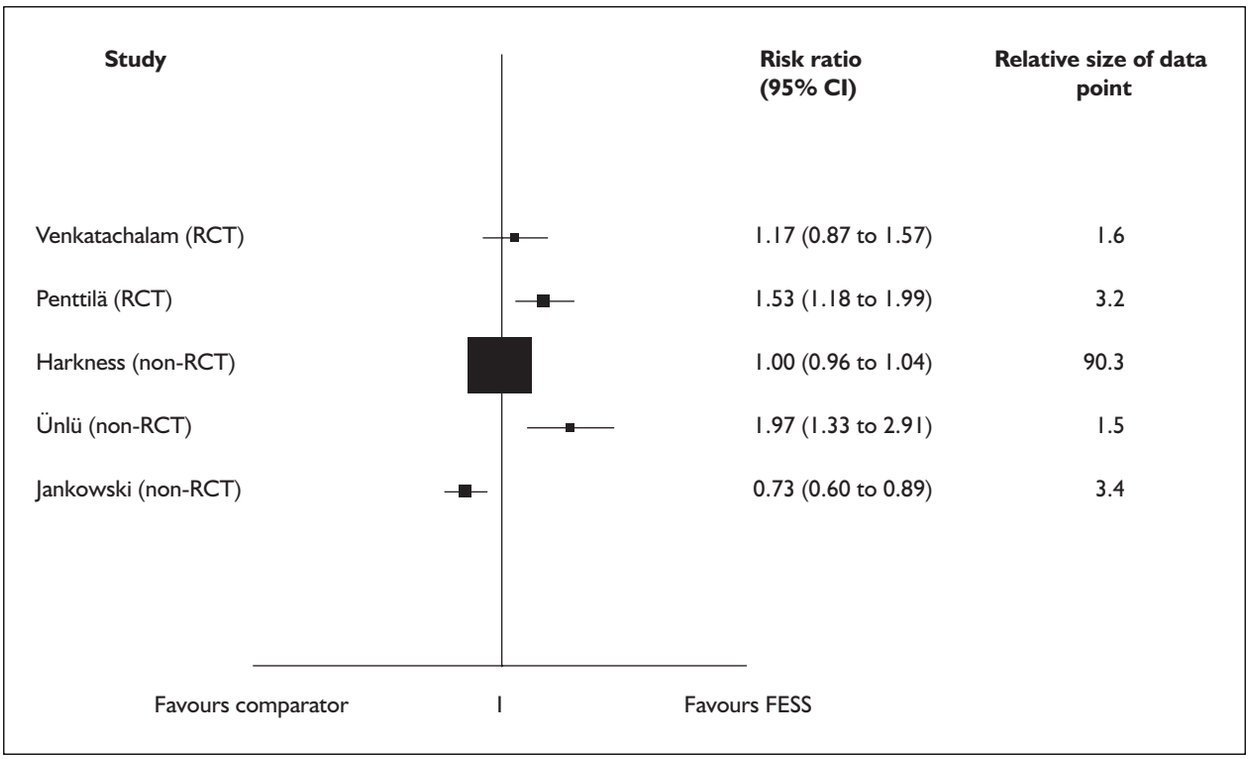


FIGURE 4 *Forest plot showing symptomatic improvement for RCTs and non-randomised comparative studies*

improvement was 78% for the FESS group and 51% for the CL group (i.e. difference of 27%, 95% CI 12 to 42%).

Venkatachalam and Bhat[51] reported their results based on ITT. All enrolled patients had nasal polyps. For those randomised to FESS, 72% reported marked symptomatic improvement, 16% improvement and 8% the same. In comparison, of those randomised to conventional procedures 28% reported marked improvement, 36% improvement and 12% the same. Overall symptomatic improvement was 84% for the FESS group compared with 72% for conventional procedures (i.e. difference of 12%, 95% CI –11 to 35%).

Non-randomised comparative studies

Harkness and colleagues[37] reported exactly the same percentage of patients with improved symptoms (82%) for both conventional procedures and FESS groups (i.e. difference of 0.02%, 95% CI –3 to 3%). Jankowski and colleagues[41] reported more favourable results for radical nasalisation compared with functional ethmoidectomy, with 41% of patients being greatly improved compared with 8% (i.e. difference 27%, 95% CI 13 to 41%). The overall functional benefit of surgery as measured by the mean visual analogue scale score was statistically significantly greater in the nasalisation group (8.8 ± 0.22) than in the ethmoidectomy group (5.92 ± 0.64; $p = 0.0001$). Ünlü and colleagues[45] reported that those undergoing ESS experienced great symptomatic improvement in 55% of cases, improvement in 30% and 8% remained the same. In comparison, those undergoing CL reported great improvement in 8% of cases, improvement in 35%, the same in 35% and worse in 8%. Overall symptomatic improvement was 85% for the FESS group and 43% for the CL group (i.e. difference of 42%, 95% CI 22 to 61%).

Figure 4 illustrates the overall symptomatic improvement for the RCTs and non-randomised comparative studies. The size of each data point represents the sample size of the study. It can be seen that one RCT and one non-RCT cross the line representing no difference between the groups and that one RCT and one non-randomised study favour FESS. The Jankowski study favours radical FESS compared with conventional FESS. Overall there is lack of agreement between the studies as to whether FESS is statistically significantly more effective in improving symptoms than comparative techniques from the included comparative studies. It should be noted that study results have not been statistically combined owing to the heterogeneity of studies and the fact that they are not all randomised trials.

Case series studies
When considering only the results of the patients with nasal polyps, the percentage of symptoms being greatly improved ranged from 6 to 87% and the percentage who were improved ranged from 11 to 96% (*Table 13*). On combining these categories, the range of percentages for patients with nasal polyps showing overall improvement was 37–99%. The median of the average improvement for all the studies that reported this outcome for patients with nasal polyps was 89%.

For the mixed group of patients (those with and without nasal polyps), the percentage of symptoms being greatly improved ranged from 9 to 85% and the percentage who were slightly improved ranged from 10 to 96% (*Table 13*). On combining these two categories the range of overall improvement for the mixed patient groups was 40–98%. The median of the average improvement for all the studies that reported this outcome for mixed patients was 88%.

The study by Friedman and colleagues[25] had mixed patients (polyp and non-polypoid) and focused on frontal sinus surgery. They reported that 92% of patients showed improvement, 8% remained the same and 1% were worse following surgery.

Exploration of potential confounders
There are a number of factors which may influence the results obtained for symptomatic improvement, such as severity of underlying disease, length of follow-up, method of assessing improvement, time since surgery, loss to follow-up, sample size, publication date, concurrent therapies, extent of previous surgery, method of selecting patients and study design. We explored some of these factors by producing scatterplots of symptomatic improvement and various potential confounding factors to assess relationships (Appendices 9 and 10). Data have been included from RCTs, comparative studies and case series studies where available. We explored factors separately for results for patients with polyps and for mixed patient results.

For patients with polyps we conclude the following:

- Studies that were not conducted prospectively reported greater symptomatic improvement than studies that were conducted prospectively (suggesting potential bias).
- No clear relationship between percentage improvement in symptoms and whether patients were enrolled consecutively.
- No clear difference in percentage improvement according to whether outcomes were assessed independently.
- The longer patients were followed up, less percentage improvement in symptoms was found (suggesting that improvement may be short-lived).
- No clear relationship between percentage improvement in symptoms and percentage loss to follow-up.
- No clear relationship between sample size and percentage improvement in symptoms.
- No clear relationship between the percentage of patients who had had previous surgery and the percentage improvement in symptoms.
- Studies published more recently reported higher percentage improvement in symptoms (may be related to improved technique due to greater experience).

For mixed patient groups (with and without polyps) we conclude the following:

- Studies that were not conducted prospectively reported greater symptomatic improvement than studies that were conducted prospectively (suggesting potential bias).
- No clear relationship between percentage improvement in symptoms and whether patients were enrolled consecutively.
- No clear relationship between percentage improvement in symptoms and whether outcomes were measured independently.
- The longer patients were followed up, the greater the percentage improvement in symptoms.
- No clear relationship between percentage improvement in symptoms and percentage loss to follow-up.
- No clear relationship between percentage improvement in symptoms and sample size.
- The greater the percentage of previous surgery the higher percentage of symptom improvement.
- No clear relationship between percentage improvement in symptoms and date of publication.

Overall, our exploration provided few answers as to the potential confounders that may influence the main outcome of symptomatic improvement. Even when a trend was identified, it was usually weak and data points were spread over a wide range. Some trends for the same variable (e.g. average length of follow-up) were in the opposite direction for the polyp and mixed groups, further demonstrating the unreliability of the data. Some of the charts have a limited number of data points

and may not be sufficient to accurately detect a trend. It is likely that a number of these factors have a cumulative effect and the direction of bias will vary. From the data and studies available we are unable to determine the likely overall direction or magnitude of bias.

Summary: results for symptomatic improvement

- Comparative studies: three studies reported greater symptomatic improvement for FESS than comparative techniques (two statistically significant), one study reported no difference and one reported that radical nasalisation showed greater improvement than conventional ethmoidectomy.
- Case series: for patients with polyps symptomatic, improvement ranged from 37 to 99%, median 89%.
- Case series: for patients with mixed disease (with and without polyps), symptomatic improvement ranged from 40 to 98%, median 88%.
- Potential confounders include prospective study design, length of follow-up and publication date.
- We are unable to determine the likely overall direction or magnitude of bias.

Recurrence of polyps/disease

Tables 14, *15* and *16* report results for the included randomised trials, comparative and case series studies, respectively. Polyp/disease recurrence refers to disease or polyps returning after surgical treatment. For studies in which patients had nasal polyps, this outcome related strictly to the recurrence of polyps, whereas for those with mixed disease, this outcome referred to the recurrence of polyps or sinus disease (depending on the original indication).

Randomised controlled trials

Kurent and Zargi[52] report 35% polyp recurrence in the polypectomy group compared with 28% in the ethmoidectomy group (i.e. difference of 8%, 95% CI –23 to 38%). Neither Penttilä and colleagues[44] nor Venkatachalam and Bhat[51] report disease recurrence.

Non-randomised comparative studies

Neither Harkness and colleagues[37] nor Jankowski and colleagues[41] report disease recurrence in their studies. Ünlü and colleagues[45] report disease recurrence in 14% of the CL group and in 8% of the ESS group (i.e. difference of 6%, 95% CI –8 to 20%) with length of follow-up not reported.

Figure 5 illustrates disease recurrence for the RCTs and non-randomised comparative studies that reported this outcome. The size of each data point represents the sample size of the study. Both studies indicate more recurrence of disease for comparison groups but both cross the line, indicating no statistically significant difference between groups. It should be noted that study results have not been statistically combined owing to the heterogeneity of studies and the fact that they are not both randomised trials.

Case series studies

For the studies that reported the results for patients with nasal polyps alone, 13 reported polyp recurrence (*Table 16*). The percentage of patients that experienced polyp recurrence within the study periods ranged from 8 to 66% (median from the studies was 25%).

In case series studies with mixed patient groups, disease recurrence varied from 4 to 33% with a median of 22% (*Table 16*). Kennedy[30] reports 4% recurrence (mean follow-up 18 months), Massegur and colleagues[42] report 16% recurrence (follow-up 1–4 years), Wolf and colleagues[43] studied children only and report 16% recurrence (follow-up not stated), the Danielson and Olofsson[39] and Lawson[31] studies both report 27% recurrence (mean follow-up 41 and 42 months, respectively) and Moses and colleagues[33] studied only patients who had previous sinus surgery and report 33% recurrence (mean follow-up 23 months).

Klossek and colleagues[55] report a range of recurrence from 3 to 49% after performing total sphenoidectomy. Two studies[22,54] report results separately for the ethmoid, maxillary and sphenoid regions. Weber and colleagues[54] report polyp recurrence rates of 25% in the ethmoid and 13% in the sphenoid. Wigand and Hosemann[22] report 18% polyp recurrence in the ethmoid, 1% in maxillary region and zero in the sphenoid. Where follow-up was variable, survival analysis would be a more appropriate method of analysis.

We explored the potential relationship between length of follow-up and polyp recurrence for all studies (*Figure 6*). Polyp recurrence varies with the length of time for which patients are followed. The longer patients are followed, the higher is the percentage of polyp recurrence. There are few data points but the trend line suggests that, as may be expected, there is a relationship between length of follow-up reported by studies and reported disease recurrence.

TABLE 14 *Recurrence rates, revision surgery and residual disease for randomised controlled studies*

Author/date	Study groups	No. of patients (no. with polyps)	Results for patients with polyps only (%) (% ITT)			Results for mixed group of patients (%) (% ITT)		
			Polyp recurrence (%)	Revision surgery (%)	Residual disease (%)	Disease recurrence (%)	Revision surgery (%)	Residual disease (%)
Kurent and Zargi, 1998[52]	Endoscopic ethmoidectomy		28 (25 ITT)	–	–			
	Endoscopic polypectomy		35 (30 ITT)	–	–			
Penttilä *et al.*, 1997[44]	FES	75 (52)	–	–	–	–	21 (19 ITT)	–
	CL	75 (45)	–	–	–	–	21 (17 ITT)	–
Venkatachalam and Bhat, 1998[51]	FESS	25 (25)	–	–	–			
	Conventional techniques	25 (25)	–	–	–			

TABLE 15 *Recurrence rates, revision surgery and residual disease for non-randomised comparative studies*

Author/date	Study groups	No. of patients (no. with polyps)	Results for patients with polyps only (%) (% ITT)			Results for mixed group of patients (%) (% ITT)		
			Polyp recurrence (%)	Revision surgery (%)	Residual disease (%)	Disease recurrence (%)	Revision surgery (%)	Residual disease (%)
Harkness *et al.*, 1997[37]	Conventional procedures	1459 (715)	–	–	–	–	–	–
	FESS	1064 (234)	–	–	–	–	–	–
Jankowski *et al.*, 1997[41]	Functional ethmoidectomy	37 (37)	–	14 (11 ITT)	–			
	Radical Nasalisation	39 (39)	–	6 (5 ITT)	–			
Ünlü *et al.*, 1994[45]	ESS	50 (14)	–	–	–	8 (6 ITT)	–	–
	CL	50 (8)	–	–	–	14 (10 ITT)	–	–

TABLE 16 *Recurrence rates, revision surgery and residual disease for case series studies*

Author/date	No. of patients (no. with polyps)	Results for patients with polyps only			Results for mixed group of patients		
		Polyp recurrence (%)	Revision surgery (%)	Residual disease (%)	Disease recurrence (%)	Revision surgery (%)	Residual disease (%)
1. Studies in which all patients had polyps							
Klossek *et al.*, 1997[55]	50 (50)	3–49	–	–			
Stoop *et al.*, 1992[46]	72 (72)	50 (at 6 months) 56 (at 12 months)	–	–			
Weber *et al.*, 1997[54]	325 (325)	25 ethmoid 13 maxillary	–	–			
Wigand and Hosemann, 1989[22]	220 (220)	18 ethmoid 1 maxillary 0 sphenoid	–	–			
2. Studies in which there were mixed patient groups with results reported separately for polyposis							
Danielsen and Olofsson 1996[39]	230 (92)	66	–	–	27	6	–
Friedman *et al.*, 2000[25]	200 (68)	–	–	–	–	6	–
Jacobs, 1997[29]	112 (51)	–	–	75 sides	–	–	59 sides
Jakobsen and Svendstrup, 2000[40]	237 (146)	28	10	–	–	9	–
Jiang and Hsu, 2001[53]	1112 (499 surgeries)	–	–	–	–	–	–
Katsantonis *et al.*, 1994[23]	972 (?)	–	–	12	–	–	–
Kennedy, 1992[30]	120 (71)	8 sides	–	59 sides	4	–	45 sides
Lawson, 1991[31]	90 (53)	36	–	–	27	–	–
Levine, 1990[32]	250 (131)	12 (11 ITT)	–	–	–	4	18 (16 ITT)
Lund and MacKay, 1994[38]	650 (306)	–	–	–	–	3	–
Massegur *et al.*, 1995[42]	250 (203)	15	6	–	16	6	–
Moses *et al.*, 1998[33]	90 (50)	–	42	–	33	–	–
Nishioka *et al.*, 1994[34]	283 (48–51% of sides)	22 (11 ITT)	–	–	–	–	–
Sobol *et al.*, 1998[49]	393 (185)	8	–	–	–	4	–
Venkatachalam and Bhat, 1999[50]	210 (66)	(7 ITT)	–	–	–	–	–
Wolf *et al.*, 1995[43]	125 (53)	–	34	–	16	–	–

continued

TABLE 16 *Recurrence rates, revision surgery and residual disease for case series studies (cont'd)*

Author/date	No. of patients (no. with polyps)	Results for patients with polyps only			Results for mixed group of patients		
		Polyp recurrence (%)	Revision surgery (%)	Residual disease (%)	Disease recurrence (%)	Revision surgery (%)	Residual disease (%)
3. Studies in which there were mixed patient groups with results not reported separately for polyposis							
Davis *et al.*, 1991[27]	200 (147)				–	–	–
Delank and Stoll, 1998[48]	115 (89)				–	–	–
Friedman *et al.*, 2000[28]	500 (136)				–	–	–
Park *et al.*, 1998[35]	79 (58)				–	–	–
Schaefer, 1998[36]	509 (139)				–	3	–
Stammberger and Posawetz, 1990[21]	500 (246)				–	–	–
Wigand *et al.*, 1978[47]	315 (?)				–	5	

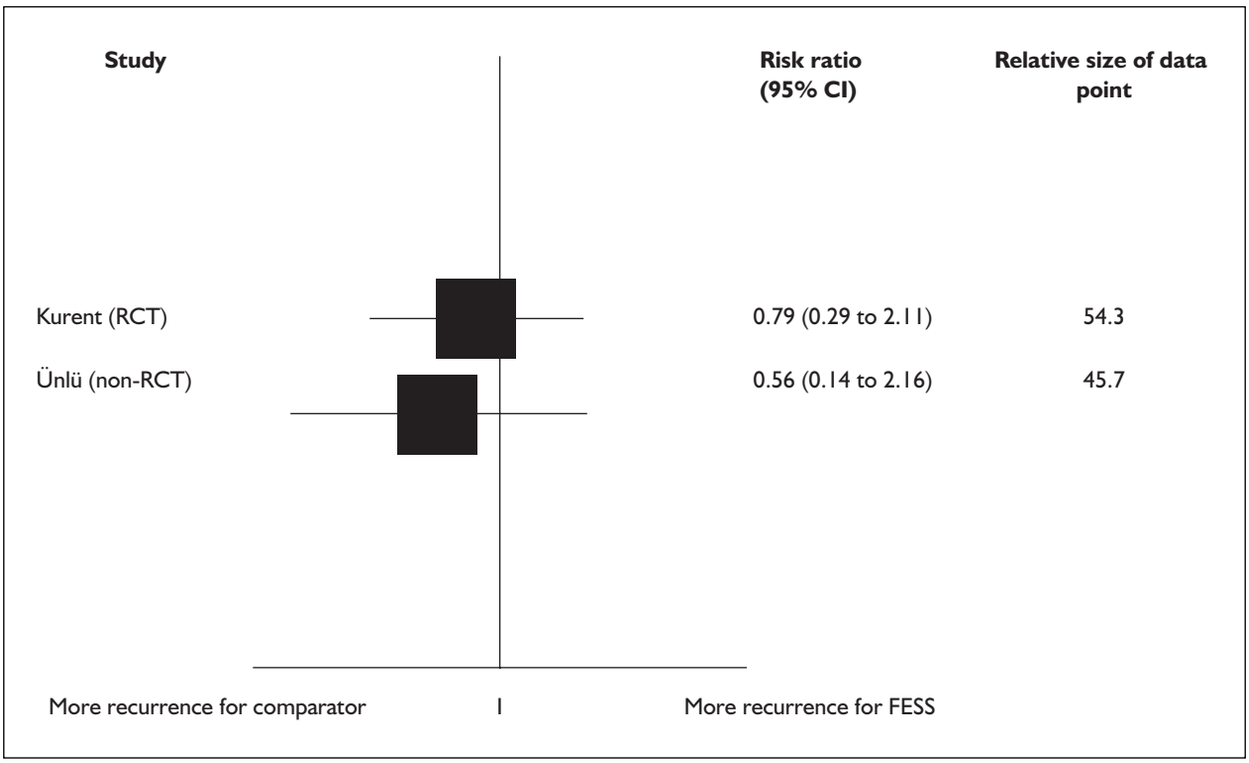


FIGURE 5 *Forest plot showing disease recurrence for RCTs and non-randomised comparative studies*

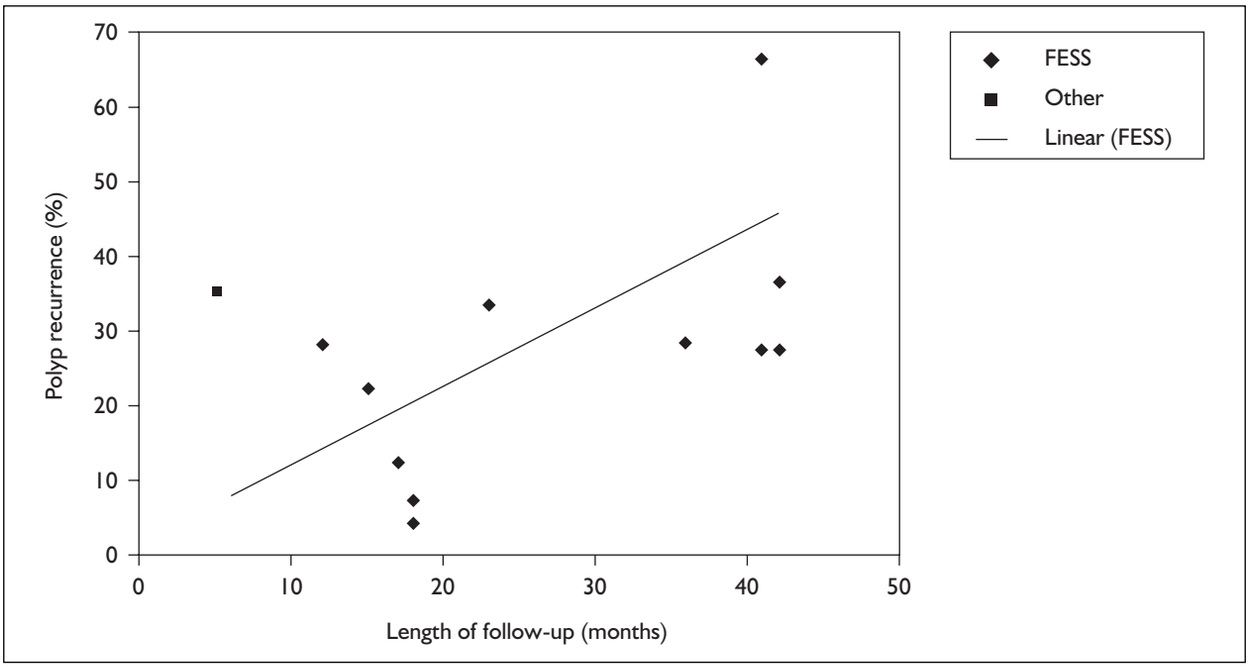


FIGURE 6 *Relationship between polyp recurrence and length of follow-up*

Summary: results for recurrence of polyps/disease

- Comparative studies: two studies reported more recurrence for comparative techniques than for FESS (although neither was statistically significant).
- Case series: for patients with polyps recurrence ranged from 8 to 66%, median 25%.
- Case series: for patients with mixed disease (with and without polyps), recurrence ranged from 4 to 33%, median 22%.
- As would be expected, more recurrence was reported for studies that followed patients for a longer period (significance not tested).

Residual disease

Residual disease refers to disease that has not been removed or has been missed during the FESS procedure (i.e. disease is still present following surgery).

Randomised controlled trials

The studies by Kurent and Zargi,[52] Penttilä and colleagues[44] and Venkatachalam and Bhat[51] did not report residual disease.

Non-randomised comparative studies

Neither the Harkness,[37] Jankowski[41] nor Ünlü studies[45] reported residual disease.

Case series studies

Residual disease was reported in three studies with patients who had polyps. Jacobs[29] reported residual disease for 75% of sides that were operated on, Kennedy[30] reported that 59% of sides operated on had residual disease and Katsantonis and colleagues[23] reported that 12% of patients had residual disease.

Residual disease was reported by three studies with mixed patients groups (patients with and without polyps). Jacobs[29] reported residual disease in 59% of sides, Kennedy[30] in 45% of sides and Levine[32] in 18% of patients.

Summary: results for residual disease

- Comparative studies: no studies reported this outcome.
- Case series: residual disease ranged from 12 to 75% of sides.

Revision surgery

Revision surgery refers to patients requiring a further sinus procedure to address symptoms some time after their initial procedure. Revision surgery does not refer to patients requiring a second procedure to rectify or complete the original FESS procedure (e.g. surgery being stopped owing to excessive bleeding and rescheduled for a future date).

Randomised controlled trials

Kurent and Zargi[52] and Venkatachalam and Bhat[51] did not report the percentage of people requiring revision surgery. Penttilä and colleagues[44] reported that 21% of patients in each of the FESS and CL groups required revision surgery (i.e. difference of 0.2%, 95% CI –14 to 14%) with maximum length of follow-up 108 months.

Non-randomised comparative studies

The studies by Harkness and colleagues[37] and Ünlü and colleagues[45] did not report revision surgery. Jankowski and colleagues[41] reported that 14% of patients receiving functional ethmoidectomy (average follow-up 24 months) required revision surgery compared with 6% in the nasalisation group with average follow-up 34 months (i.e. difference of 8%, 95% CI –7 to 23%).

Figure 7 illustrates revision surgery for the RCTs and non-randomised comparative studies that reported this outcome. The size of each data point represents the sample size of the study. Both studies indicate more revision surgery for comparison groups but both cross the line, indicating no statistically significant difference between groups. It should be noted that the comparison group for the Jankowski study is radical nasalisation. The study results have not been statistically combined owing to the heterogeneity of studies and the fact that they are not both randomised trials.

Case series studies

Four studies reported the percentage of patients requiring revision surgery for patients with polyps. Massegur and colleagues[42] report 6% revision (follow-up 1–4 years) and Jakobsen and Svendstrup[40] 10% (follow-up 1 year). Moses and colleagues[33] studied only patients who had previous sinus surgery and report 42% of patients required revision surgery (average follow-up 23 months) and Wolf and colleagues[43] studied revision in children undergoing ESS and report rates of 34% (follow-up not stated).

Nine studies reported the percentage of mixed patients (polyps and non-polyps) who underwent revision surgery (average follow-up 12 months, range 6–41 months). The study results ranged from 3 to 9%, with a median percentage of 5%. Friedman and colleagues[25] report that 6% of patients undergoing frontal sinus surgery required

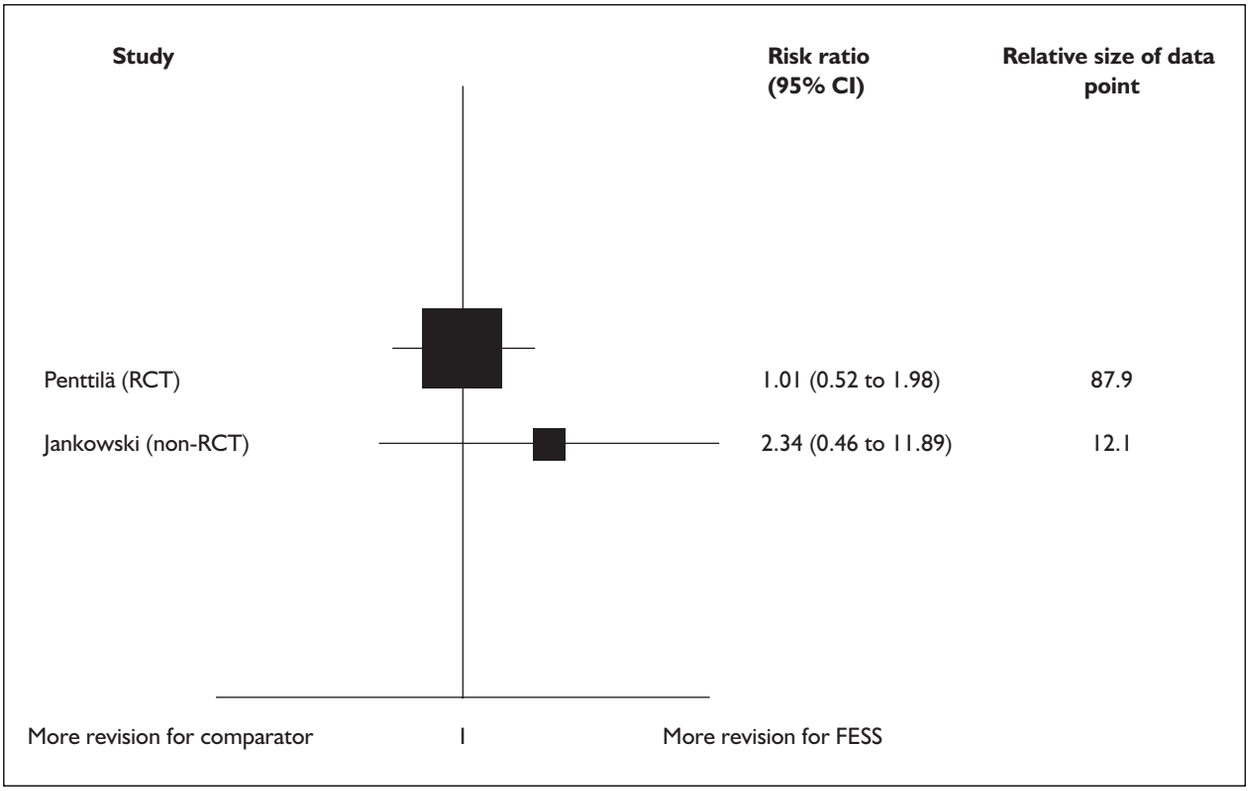


FIGURE 7 *Forest plot showing revision surgery for RCTs and non-randomised comparative studies*

revision surgery within the mean follow-up period of 12 months.

Summary: results for revision surgery

- Comparative studies: one study reported no difference between FESS and the comparative technique, another reported that the functional ethmoidectomy group required more revision than the nasalisation group (although not statistically significant).
- Case series: for patients with polyps, revision ranged from 6 to 42%, median 22%.
- Case series: for patients with mixed disease (with and without polyps), revision ranged from 3 to 9%, median 5%.

Other outcomes

There were a number of other patient-relevant outcomes that were reported in relatively few studies. These have not been summarised in tables but results are described below.

Sense of smell

Pre- and postoperative anosmia/smell disturbance is summarised in *Figure 8*.

Jankowski and colleagues[41] compared sense of smell in patients undergoing ethmoidectomy with those undergoing nasalisation. Both groups had similar scores preoperatively (a higher score indicates better sense of smell with 10 representing a normal-functioning nose). Improvement in sense of smell was similar in both groups 6 months after surgery. At 24 months the mean visual analogue score (for sense of smell) for the ethmoidectomy group was 4.23 ± 1.01 compared with 6.57 ± 0.69 for the nasalisation group. Olfaction improvement was steady in the nasalisation group but decreased rapidly after 6 months in the ethmoidectomy group.

Klossek and colleagues[55] reported that preoperatively 100% of their sample had anosmia for at least 6 months per year. At 3 months follow-up 70% of patients reported marked improvement in the symptom anosmia, at 1-year follow-up 60% maintained marked improvement and at 3 years follow-up 58% reported marked improvement in anosmia.

Anosmia was reported by 48% of patients with nasal polyps/polyposis preoperatively compared with 21% at 1-year postoperative follow-up in a study by Jakobsen and Svendstrup.[40]

After a mean follow-up of 17 months, 3% of patients reporting having anosmia compared with 16% prior to surgery in a study by Levine.[32]

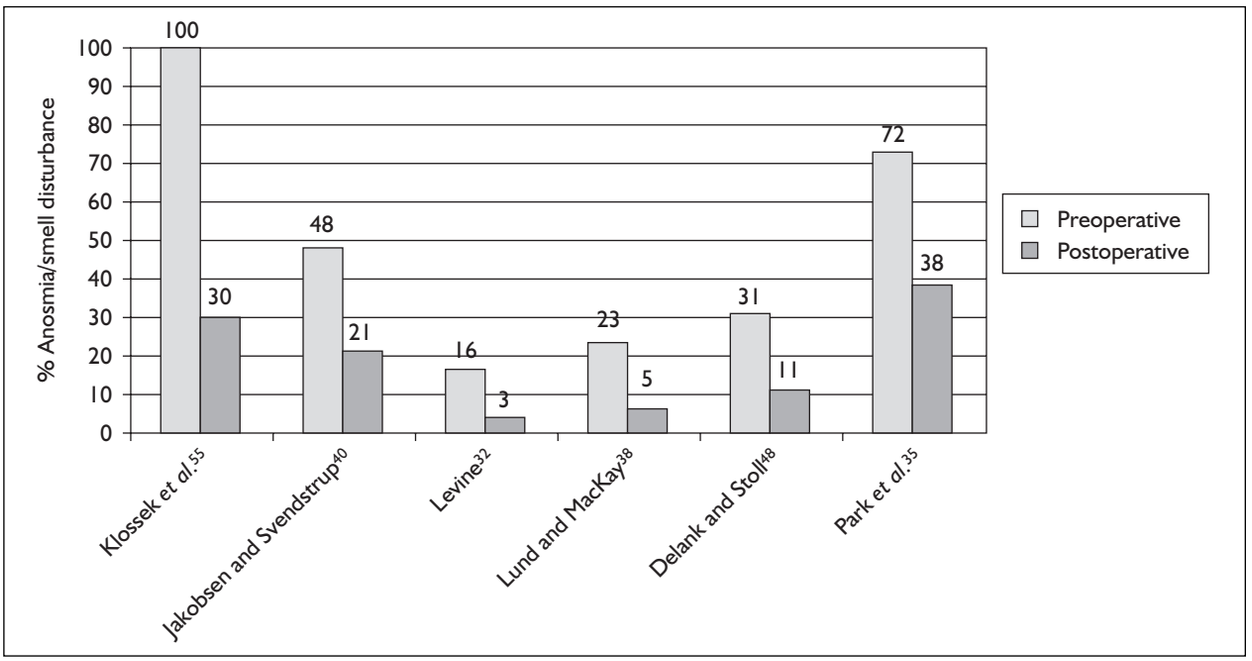


FIGURE 8 *Summary of pre- and postoperative anosmia/smell disturbance*

Lund and MacKay[38] report that 23% of patients had preoperative symptoms involving smell. Six months after ESS 79% of patients reported improved smell, 12% reported being cured, 21% reported being the same and none reported that they were worse.

Olfactory function was the focus of a study by Delank and Stoll.[48] Olfaction was measured by self-rating questionnaires and olfactory tests. Preoperatively, olfactory tests found anosmia (absence of smell) in 31% of patients, hyposmia (diminished smell) in 52% and normosmia (normal smell) in 17% (preoperative self-ratings reported smell to be normal in 42% of patients, reduced in 34% and absent in 24%). Following FESS (length of follow-up not reported) olfactory tests found anosmia in 11% of patients, hyposmia in 57% and normosmia in 31%. Improvement occurred for 70% of hyposmic or anosmic patients. Postoperative improvement was greatest for the patients who were originally hyposmic. Normosmia was achieved in 25% of patients who were hyposmic prior to surgery and in 5% of patients who were anosmic prior to surgery. Olfaction worsened following 8% of FESS procedures. The extent of sinus disease/degree of polyposis correlated with olfactory dysfunction.

Smell disturbance was reported in 72% of patients preoperatively in a study by Park and colleagues[35] compared with 38% (average follow-up 19 months) following FESS ($p < 0.0001$).

All studies that reported sense of smell stated overall postoperative improvement compared with preoperative symptoms. The range of improvement compared with preoperative scores ranged from 13 to 91% with a median of 31% (follow-up ranged from an average of 3 to 19 months, median 12 months).

Nasal obstruction

Pre- and postoperative nasal obstruction is summarised in *Figure 9*.

Harkness and colleagues[37] reported that 70% of patients undergoing conventional surgery were asymptomatic or improved at 6 months for the symptom of nasal obstruction, compared with 84% of patients undergoing FESS.

Klossek and colleagues[55] reported that 50% of patients had bilateral nasal obstruction preoperatively. At 3 months follow-up 100% had shown marked improvement in nasal obstruction, at 1 year 92% still showed marked improvement and by 3 years follow-up 92% had maintained marked improvement.

After a mean follow-up of 17 months 3% of patients had nasal obstruction, compared with 32% prior to surgery in a study by Levine.[32]

Lund and MacKay[38] reported that 70% of patients had nasal blockage prior to surgery. Six months after ESS 92% were improved (23% were cured), 6% were the same and 2% were worse.

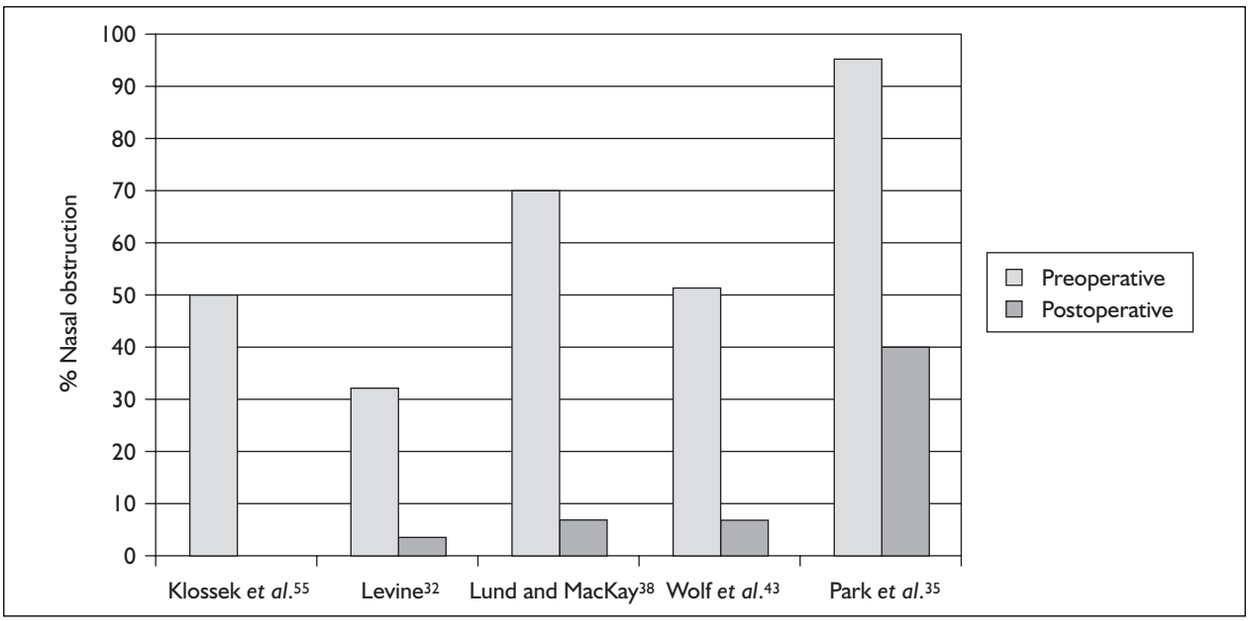


FIGURE 9 *Summary of pre- and postoperative nasal obstruction*

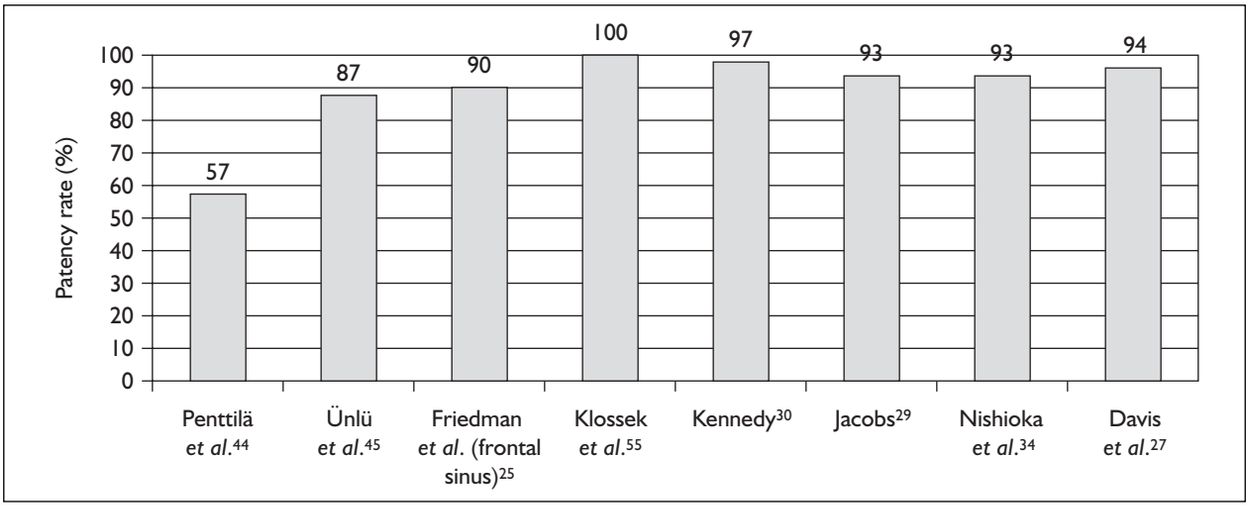


FIGURE 10 *Summary of patency rates*

Nasal obstruction was seen preoperatively in 51% of children in a study by Wolf and colleagues.[43] Nasal obstruction was completely relieved following ESS in 31% of children, improved in 57%, no different in 10% and worse in 2% (follow-up period not stated).

Nasal congestion was 95% prior to FESS and 40% ($p < 0.0001$) following surgery (average follow-up 19 months) in a study by Park and colleagues.[35]

All studies that recorded nasal obstruction symptoms reported postoperative improvement following FESS. Overall improvement in nasal congestion postoperatively compared with preoperative symptoms ranged from 29 to 100% with a median of 72% (follow-up ranged from 3 to 19 months, median 17 months).

Patency

Patency refers to the openness of various areas within the sinuses and overall rates are summarised in *Figure 10*.

The randomised study by Penttilä and colleagues[44] reported that after a maximum of 108 months follow-up the middle meatus was open in 19% of the CL group and in 57% of the FESS group. The inferior middle meatal windows were fully patent in 48% of the CL group and 67% in the FESS group.

TABLE 17 *Summary of rate of complications from randomised controlled trials*

Author/date	Study group	No. of patients (no. with polyps)	Total complications (%)	Major complications (%)	Minor complications (%)
Kurent and Zargi, 1998[52]	Endoscopic ethmoidectomy	20 (20)	–	–	–
	Endoscopic polypectomy	20 (20)	–	–	–
Penttilä *et al.*, 1997[44]	FES	75 (52)	–	0	–
	CL	75 (45)	–	0	–
Venkatachalam and Bhat, 1998[51]	FESS	25 (25)	–	–	–
	Conventional techniques	25 (25)	–	–	–

In the comparative study by Ünlü and colleagues,[45] patency of the maxillary sinus windows was reported in 58% of CL sides and in 87% of ESS sides ($p \leq 0.05$).

The study by Friedman and colleagues[25] assessed frontal sinus patency using transillumination and found that 90% of all frontal sinuses were patent postoperatively (mean follow-up 12 months). In the patients with polypoid disease, postoperative patency was also 90%.

Klossek and colleagues[55] reported that at postoperative 3 years follow-up the middle meatal antrostomies had an overall patency rate of 100%.

The overall postoperative patency rate for the middle meatal antrostomies in a study by Kennedy[30] was 97% (mean follow-up 18 months).

Jacobs[29] reports that postoperatively in his study the middle meatal antrostomies had an overall patency of 93% (follow-up 16 months).

Middle meatal patency for patients was 94% in the non-allergic group and 92% for the allergic group postoperatively in a study by Nishioka and colleagues[34] (mean follow-up 15 months).

Davis and colleagues[27] report that during follow-up to 36 months patency of the surgical meatus overall was 94%. The cumulative actual patency rate up to 36 months was 88% for all sides. For patients with nasal polyps patency was 91%.

Overall postoperative patency ranged from 57 to 100% with a median of 93% (follow-up ranged from 12 to 36 months, median 17 months).

Summary: results for other outcomes

- Improved sense of smell decreased rapidly after 6 months in the ethmoidectomy group compared with nasalisation in one comparative study. Overall improvement compared with preoperative scores ranged from 13 to 91% with a median of 31% (six studies).
- Improvement in nasal obstruction postoperatively (compared with preoperative scores) ranged from 29 to 100% with a median of 72% (six studies).
- Overall postoperative patency from the studies ranged from 57 to 100% with a median of 93% (seven studies).

Complications

There are a number of potential complications with FESS. The frequency of various complications varies between FESS and some comparative techniques. Nasal polyps by their nature tend to develop close to the orbit and anterior cranial fossa. Revision surgery for nasal polyps comes with additional risks as important anatomical landmarks may have been previously removed.

Randomised controlled studies

Total reported complications and major and minor complications are summarised in *Table 17*. Kurent and Zargi[52] and Venkatachalam and Bhat[51] did not report complications, and Penttilä and colleagues[44] reported that there were no major complications in either the FESS or CL groups.

Non-randomised comparative studies

Total complications and major and minor complications are summarised in *Table 18*. Harkness and colleagues[37] reported a complication rate of 0.8% for conventional procedures compared with 1.4% for FESS. Jankowski and colleagues[41] reported no complications for the functional

TABLE 18 *Summary of rate of complications from non-randomised comparative studies*

Author/date	Study group	No. of patients (no. with polyps)	Total complications (%)	Major complications (%)	Minor complications (%)
Harkness *et al.*, 1997[37]	Conventional procedures	1459	0.8	–	–
	FESS	1064	1.4	–	–
Jankowski *et al.*, 1997[41]	Functional ethmoidectomy	37 (37)	–	–	–
	Radical nasalisation	39 (39)	7.7	–	–
Ünlü *et al.*, 1994[45]	ESS	50 (14)	–	–	–
	CL	50 (8)	–	–	–

TABLE 19 *Summary of complication rates from case series studies*

Author/date	No. of patients (no. with polyps)	Total complications (%)	Major complications (%)	Minor complications (%)
1. Studies in which all patients had polyps				
Klossek *et al.*, 1997[55]	50 (50)	–	0	–
Stoop *et al.*, 1992[46]	72 (72)	–	–	–
Weber *et al.*, 1997[54]	325 (325)	6.0 (650 patients)	–	–
Wigand and Hosemann, 1989[22]	220 (220)	4.3 (600 patients)	0	4.3 (600 patients)
2. Studies in which there were mixed patient groups with results reported separately for polyposis				
Danielsen and Olofsson, 1996[39]	230 (92)	1.7	–	–
Friedman *et al.*, 2000[25]	200 (68)	9.0	1.5	7.5
Jacobs, 1997[29]	112 (51)	4.5	0	4.5
Jakobsen and Svendstrup, 2000[40]	237 (146)	22.4	–	–
Jiang and Hsu, 2001[53]	1112 (499), 1227 procedures	9.9 (procedures)	–	–
Katsantonis *et al.*, 1994[23]	972 (?)	1.2	0.1	1.1
Kennedy, 1992[30]	120 (71)	0.8	0	–
Lawson, 1991[31]	90 (53)	1.1 (1077 patients)	–	–
Levine, 1990[32]	250 (131)	9.2	–	–
Lund and MacKay, 1994[38]	650 (306)	0.3	–	–
Massegur *et al.*, 1995[42]	250 (203)	11.6	–	–
Moses *et al.*, 1998[33]	90 (50)	–	–	–
Nishioka *et al.*, 1994[34]	283 (48–51% of sides)	20.8	–	20.8
Sobol *et al.*, 1998[49]	393 (185)	1.0	–	–
Venkatachalam and Bhat, 1999[50]	210 (66)	15.2	1.0	14.3
Wolf *et al.*, 1995[43]	125 (53)	–	0	–
3. Studies in which there were mixed patient groups with results not reported separately for polyposis				
Davis *et al.*, 1991[27]	200 (103)	13.5	0	13.5
Delank and Stoll, 1998[48]	115 (89)	–	–	–
Friedman *et al.*, 2000[28]	500 (136)	2.8	0.2	2.6
Park *et al.*, 1998[35]	79 (58)	7.6	–	–
Schaefer, 1998[36]	509 (139)	1.0	–	–
Stammberger and Posawetz, 1990[21]	500 (246)	18.6	–	–
Wigand *et al.*, 1978[47]	315 (?)	–	–	–

ethmoidectomy group and 7.7% for the radical nasalisation group. Neither study gave a breakdown of the percentage of complications that were classified as major or minor. Ünlü and colleagues[45] did not report complications.

Case series studies

Total complications and major and minor complications from the included case series studies are summarised in *Table 19*. All but four studies[33,46–48] reported complications. The total percentage of complications ranged from 0.3 to 22.4%; however, there was much variability in the severity of complications reported. The median from the studies for total complications was 6%. Some studies categorised complications as major and minor, with 10 studies reporting major complications[22,23,25,27–30,43,50,55] which ranged from 0 to 1.5% with a median of zero, and eight studies reporting minor complications[22,23,25,27–29,34,50] which ranged from 1.1 to 20.8% with a median of 6%.

Complications in patients with polyps

Few studies reported complications separately for patients with polyps. Four studies enrolled only patients with polyps. Klossek and colleagues[55] reported that no major complications were encountered. Weber and colleagues[54] reported a complication rate of 6%. Wigand and Hosemann[22] reported 4.3% complications, which were all minor. Stoop and colleagues[46] failed to report complications.

The study by Danielson and Olofsson[39] enrolled a mixed group of people with and without polyps but reported complications separately for those with polyps. They reported that 3.3% of people with polyps experienced postoperative scarring.

Haemorrhagic complications

Haemorrhagic complications for included studies are presented in *Table 20*. One randomised trial,[51] one comparative study[37] and eight case series studies[25,28,29,31,35,39,40,50] reported haemorrhage or bleeding (primary or secondary). Venkatachalam and Bhat[51] reported 12% bleeding in the FESS group compared with 8% in the conventional procedures group. Harkness and colleagues[37] reported 0.07% haemorrhage in the conventional procedures group compared with 0.2% in the FESS group. The range for bleeding from case series studies was 0.2–21.1% with a median of 2.5%. Severe bleeding or bleeding requiring packing or readmission was reported by three case series studies[21,32,54] and percentages were 1.2, 2.2 and 4.6%, respectively. Blood transfusion was reported in five case series studies[21,27,53–55] and ranged from 0 to 3.7% with a median of 0.2%.

Harkness and colleagues[37] report that the percentage of eye ecchymoses/periorbital bruising/periorbital ecchymoses was 0.1% in the group undergoing conventional procedures compared with 0.2% in the group undergoing FESS. Four case series studies[29,32,40,43] reported eye ecchymoses/periorbital bruising/periorbital ecchymoses and the percentages ranged from 0 to 1.2% with a median of 0.5%.

The randomised trial by Venkatachalam and Bhat[51] reported no orbital haematomas in the FESS group and 8% in the conventional procedures group. Four case series studies[23,31,38,43] reported on orbital haematomas, which ranged from 0 to 0.2% with a median of 0.2%.

Sphenopalatine haemorrhage was only reported in the comparative study by Harkness and colleagues[37] and a rate of 0.09% was noted in the FESS group (but not for conventional procedures).

Epistaxis was reported by five case series studies[23,36,42,53,55] and ranged from 0 to 2.4% with a median of 0.6%.

Four case series studies[25,28,36,42] reported preseptal haemorrhage (into eyelid)/palpebral haematoma/septal haematoma, which ranged from 0.2 to 2% with a median of 1.5%.

Infection complications

The reports of infection from the included studies are summarised in *Table 21*. Wound infection was reported for 16% of FESS procedures and 28% of conventional procedures in the randomised trial by Venkatachalam and Bhat.[51] Infection complications were not reported in other comparative studies. The study by Lund and MacKay[38] reported no cases of meningitis. Sobol and colleagues[49] reported 0.3% meningitis and 0.5% orbital cellulitis. Wigand and Hosemann[22] reported complications based on a group of 600 people undergoing sinus surgery and reported a rate of 0.5% for meningitis.

Intranasal complications

Intranasal complications for included studies are presented in *Table 22*. Middle meatal stenosis/closure/partial closure was reported by three case series studies[32,34,42] with rates of 6.8, 4.0 and 6.7%, respectively. Stammberger and Posawetz[21] were the only authors to report maxillary sinus ostium stenosis at a rate of 1.6%.

TABLE 20 *Results from studies that reported haemorrhage complications*

Author/date	No. of patients (no. with polyps)	Eye ecchymoses/ periorbital bruising/ periorbital ecchymoses	Orbital haematomas	Sphenopalatine haemorrhage	Haemorrhage/ bleeding (primary or secondary)/ persistent bleeding/ annoying bleeding	Epistaxis	Preseptal haemorrhage/ palpebral haematoma/ septal haematoma	Blood transfusion	Bleeding requiring packing/ severe bleeding/ bleeding requiring readmission
Randomised controlled trials									
Venkatachalam and Bhat, 1998[51]									
FESS	25 (25)	–	0	–	12	–	–	–	–
Conventional procedures	25 (25)	–	8	–	8	–	–	–	–
Non-randomised comparative studies									
Harkness *et al.*, 1997[37]									
Conventional procedures	1459	0.1	–	–	0.07	–	–	–	–
FESS	1064	0.2	–	0.09	0.2	–	–	–	–
Case series studies									
Danielsen and Olofsson, 1996[39]	230 (92)	–	–	–	4.3				
Davis *et al.*, 1991[27]	200 (103)	–	–	–	–	–	–	0	–
Friedman *et al.*, 2000[25]	200 (68)	–	–	–	2.5	–	2.0	–	–
Friedman *et al.*, 2000[28]	500 (136)	–	–	–	1.6	–	1.0	–	–
Jacobs, 1997[29]	112 (51)	0.9	–	–	0.9	–	–	–	–
Jakobsen and Svendstrup, 2000[40]	237 (146)	0	–	–	21.1	–	–	–	–
Jiang and Hsu, 2001[53]	1112 (499), 1227 procedures	–	–	–	–	2.1 (procedures)	–	2.4	–
Katsantonis *et al.*, 1994[23]	972 (?)	–	0.1	–	–	0.2	–	–	–
Klossek *et al.*, 1997[55]	50 (50)	–	–	–	–	0	–	0	–
Lawson, 1991[31]	90 (53)	–	0.2	–	0.2	–	–	–	–
Levine, 1990[32]	250 (131)	1.2	–	–	–	–	–	–	1.2
Lund and MacKay, 1994[38]	650 (306)	–	0.2	–	–	–	–	–	–
Massegur *et al.*, 1995[42]	250 (203)	–	–	–	–	2.4	2.0	–	–

continued

TABLE 20 *Results from studies that reported haemorrhage complications (cont'd)*

Author/date	No. of patients (no. with polyps)	Eye ecchymoses/ periorbital bruising/ periorbital ecchymoses	Orbital haematomas	Sphenopalatine haemorrhage	Haemorrhage/ bleeding (primary or secondary)/ persistent bleeding/ annoying bleeding	Epistaxis	Preseptal haemorrhage/ palpebral haematoma/ septal haematoma	Blood transfusion	Bleeding requiring packing/ severe bleeding/ bleeding requiring readmission
Park *et al.*, 1998[35]	79 (58)	–	–	–	2.5	–	–	–	–
Schaefer, 1998[36]	509 (139)	–	–	–	–	0.6	0.2	–	–
Stammberger and Posawetz, 1990[21]	500 (246)	–	–	–	–	–	–	0.2	2.2
Venkatachalam and Bhat, 1999[50]	210 (66)	–	–	–	5.7	–	–	–	–
Weber *et al.*, 1997[54]	325 (325)	–	–	–	–	–	–	3.7	4.6
Wolf *et al.*, 1995[43]	125 (53)	0	0	–	–	–	–	–	–

TABLE 21 *Results from studies that reported infection complications*

Author/date	No. of patients (no. with polyps)	Meningitis	Wound infection	Orbital cellulitis
Randomised controlled trials				
Venkatachalam and Bhat, 1998[51]				
FESS	25 (25)	–	16	–
Conventional procedures	25 (25)	–	28	–
Case series studies				
Lund and MacKay, 1994[38]	650 (306)	0		–
Sobol *et al.*, 1998[49]	393 (185)	0.3		0.5
Wigand and Hosemann, 1989[22]	220 (220)	0.5 (600 patients)		–

TABLE 22 *Results from studies that report intranasal complications*

Author/date	No. of patients (no. with polyps)	Synechiae formation	Middle meatal stenosis/ closure/partial closure	Maxillary sinus ostium stenosis	Loss of olfactory sensation	Obstruction of lacriminal duct	Lamina papyracea/ perforation of lamina papyracea	Crusting	Septal perforation	Middle turbinate lateralisation
Randomised controlled trials										
Venkatachalam and Bhat, 1998[51]										
FESS	25 (25)	20	–	–	–	–	4	–	–	–
Conventional procedures	25 (25)	52	–	–	–	–	8	–	–	–
Non-randomised comparative studies										
Harkness *et al.*, 1997[37]										
Conventional procedures	1459	–	–	–	–	–	–	0.07	0.07	0.07
FESS	1064	–	–	–	–	–	–	–	–	–
Case series studies										
Danielsen and Olofsson, 1996[39]	230 (92)	–	–	–	–	–	2.6	–	–	–
Davis *et al.*, 1991[27]	200 (103)	10	–	–	–	–	–	–	–	–
Friedman *et al.*, 2000[25]	200 (68)	–	–	–	–	–	–	–	–	3.0
Katsantonis *et al.*, 1994[23]	972 (?)	–	–	–	–	–	–	0.4	–	–
Levine *et al.*, 1990[32]	250 (131)	–	6.8	–	–	–	–	–	–	–
Massegur *et al.*, 1995[42]	250 (203)	–	4.0	–	–	–	–	–	–	
Nishioka *et al.*, 1994[34]	283 (48–51% sides)	14.1	6.7	–	–	–	–	–	–	–
Stammberger and Posawetz, 1990[21]	500 (246)	8.0	–	1.6	–	–	1.8	–	–	–
Venkatachalam and Bhat, 1999[50]	210 (66)	8.6	–	–	–	–	1.0	–	–	–
Wigand and Hosemann, 1989[22]	220 (220)	–	–	–	3.0 (600 patients)	0.5 (600 patients)	–	–	–	–

Middle turbinate lateralisation was reported in the study by Harkness and colleagues[37] and was found in 0.07% of the conventional procedures group (but not for FESS). Friedman and colleagues[25] reported 3.0% middle turbinate lateralisation in their case series study of frontal sinus surgery. Obstruction of the lacrimal duct was reported in 0.5% of 600 patients in the study by Wigand and Hosemann.[22]

Lamina papyracea/perforation of lamina papyracea was reported in 4% of the FESS group and 8% of the conventional procedures group in the randomised trial by Venkatachalam and Bhat.[51] It was also reported by three case series studies and rates were 2.6,[39] 1.8[21] and 1.0%.[50] Septal perforation was recorded for 0.07% of people in the conventional procedures group in the study by Harkness and colleagues (but not for FESS).

Loss of olfactory sensation was reported for 3.0% of people undergoing sinus surgery in the study by Wigand and Hosemann.[22] Harkness and colleagues[37] reported that 0.07% of people in the conventional procedures group experienced postoperative crusting (but not for FESS), as did 0.4% in the case series study by Katsantonis and colleagues.[23]

Venkatachalam and Bhat[51] reported 20% synechiae formation in the FESS group compared with 52% in the conventional procedures group. Synechiae formation was reported by four case series studies[21,27,34,50] and ranged from 8.0 to 14.1%, with a median of 9.3%.

Orbital/ocular complications

A range of orbital and ocular injuries were reported in the studies and are summarised in *Table 23*. Periorbital/orbital fat exposure was reported by Harkness and colleagues[37] and was 0.07% for the conventional procedures group compared with 0.5% for the FESS group. A further six case series studies[25,27,29,40,43,53] reported fat exposure and ranged from no patients to 3.6% of procedures, with a median of 2.1%.

Orbital emphysema was reported in 0.09% of people in the FESS group of the comparative study by Harkness and colleagues (but not for conventional procedures).[37] Studies by Jakobsen and Svendstrup[40] and Wolf and colleagues[43] each reported no cases or orbital emphysema. Periorbital ecchymosis and emphysema were reported in no cases by Wolf and colleagues[43] and in 0.3% of procedures by Lawson.[31]

Diplopia or temporary diplopia was reported in 0.07% of the conventional procedures group (but not for FESS) in the comparative study by Harkness and colleagues.[37] In five case series studies[27,28,35,42,53] diplopia ranged between 0 and 1.3% (median 0.3%). Nasolacriminal duct injury was reported in two studies, occurring in 0.5% of procedures by Jiang and Hsu[53] and among 1.3% of people by Park and colleagues.[35] Stammberger and Posawetz[21] were the only authors to report orbital penetration, which occurred in 1.8% of those undergoing sinus surgery.

Weber and colleagues[54] reported that lesion of the periorbit occurred in 1.4% of 650 people undergoing sinus surgery. Epiphora was reported in three case series studies[27,31,42] with rates of 0.5, 0.8 and 0.2% of procedures, respectively. Katsantonis and colleagues[23] were the only authors to report periorbital oedema, which occurred in 0.1% of people.

Pharyngeal/mouth complications

Few studies reported pharyngeal or mouth injuries (*Table 24*). Hypesthesis of teeth, lip or cheek was reported for 49% in the CL group compared with 3% in the FESS group by Penttilä and colleagues.[44] Harkness and colleagues[37] reported no cases of numbness of teeth or lips in the conventional procedures group compared with 0.2% in the FESS group. The same study reported 0.09% sphenopalatine adhesions and 0.09% palatal ulceration in the FESS group (but not for conventional procedures). Weber and colleagues[54] reported that 0.3% of people who underwent FESS experienced numbness of teeth or upperlip.

Intracranial complications

Cases of intracranial injury are summarised in *Table 25*. Venkatachalam and Bhat[51] in their randomised trial reported no cases of CSF rhinorrhea in either the FESS or conventional procedures groups. Twelve case series studies[27,28,22,31,35,36,38,42,43,49,53,54] reported CFS leak, which ranged from 0 to 2.3%, with a median of 0.3%. Jiang and Hsu[53] reported dural exposure in 0.2% of procedures they performed. Weber and colleagues[54] reported that 0.3% of people undergoing ESS experienced injury of the internal carotid artery.

Systemic complications

Systemic complications were reported in four studies[23,30,35,42] and are summarised in *Table 26*. No systemic complications were reported in the comparative studies. Mild bronchospasm was reported in the Katsantonis,[23] Kennedy[30] and

TABLE 23 *Results from studies that report orbital/ocular complications*

Author/date	No. of patients (no. with polyps)	Periorbital/ orbital fat exposure	Orbital emphysema	Periorbital ecchymosis and emphysema	Diplopia/ temporary diplopia	Nasolacriminal duct injury	Orbital penetration	Lesion of periorbit	Epiphora	Periorbital oedema
Non-randomised comparative studies										
Harkness *et al.*, 1997[37]										
Conventional procedures	1459	0.07	–	–	0.07	–	–	–	–	–
FESS	1064	0.5	0.09	–	–	–	–	–	–	–
Case series studies									–	
Davis *et al.*, 1991[27]	200 (103)	3.0	–	–	0	–	–	–	0.5	–
Friedman *et al.*, 2000[25]	200 (68)	1.5	–	–	–	–	–	–	–	–
Friedman *et al.*, 2000[28]	500 (136)	–	–	–	0	–	–	–	–	–
Jacobs, 1997[29]	112 (51)	2.7	–	–	–	–	–	–	–	–
Jakobsen and Svendstrup, 2000[40]	237 (146)	0	0	–	–	–	–	–	–	–
Jiang and Hsu, 2001[53]	1112 (499), 1227 procedures	3.6 (procedures)	–	–	0.3	0.5 (procedures)	–	–	–	–
Katsantonis *et al.*, 1994[23]	972 (?)	–	–	–	–	–	–	–	–	0.1
Lawson, 1991[31]	90 (53)	–	–	0.3 (1077 procedures)	–	–	–	–	0.2 (1077 procedures)	–
Massegur *et al.*, 1995[42]	250 (203)	–	–	–	0.8	–	–	–	0.8	–
Park et al., 1998[35]	79 (58)	–	–	–	1.3	1.3	–	–	–	–
Stammberger and Posawetz, 1990[21]	500 (246)	–	–	–	–	–	1.8	–	–	–
Weber *et al.*, 1997[54]	325 (325)	–	–	–	–	–	–	1.4 (650 patients)	–	–
Wolf *et al.*, 1995[43]	125 (53)	0	0	0	–	–	–	–	–	–

TABLE 24 *Results from studies that report pharyngeal/mouth complications*

Author/date	No. of patients (no. with polyps)	Palatal ulceration	Sphenopalatine adhesions	Numbness of teeth or lips/cheek
Randomised controlled trial				
Penttilä *et al.*, 1997[44]				
FESS	75 (52)	–	–	3
CL	75 (45)	–	–	49
Non-randomised comparative studies				
Harkness *et al.*, 1997[37]				
Conventional procedures	1459	–	–	0
FESS	1064	0.09	0.09	0.2
Case series studies				
Weber *et al.*, 1997[54]	325 (325)	–	–	0.3 (650 patients)

TABLE 25 *Results from studies that report intracranial complications*

Author/date	No. of patients (no. with polyps)	CSF leaks/CFS rhinorrhea	Dural exposure	Injury of internal carotid artery
Randomised controlled trials				
Venkatachalam and Bhat, 1998[51]				
FESS	25 (25)	0	–	–
Conventional procedures	25 (25)	0	–	–
Case series studies				
Davis *et al.*, 1991[27]	200 (103)	0	–	–
Friedman *et al.*, 2000[28]	500 (136)	0.2	–	–
Jiang and Hsu, 2001[53]	1112 (499), 1227 procedures	0.2 (procedures)	0.2 (procedures)	–
Lawson, 1991[31]	90 (53)	0.3	–	–
Lund and MacKay, 1994[38]	650 (306)	0.2	–	–
Massegur *et al.*, 1995[42]	250 (203)	0.4	–	–
Park *et al.*, 1998[35]	79 (58)	1.3	–	–
Schaefer, 1998[36]	509 (139)	0.2	–	–
Sobol *et al.*, 1998[49]	393 (185)	0.3	–	–
Weber *et al.*, 1997[54]	325 (325)	2.3 (650 patients)	–	0.3 (650 patients)
Wigand and Hosemann, 1989[22]	220 (220)	0.3 (600 patients)	–	–
Wolf *et al.*, 1995[43]	125 (53)	0	–	–

TABLE 26 *Results from studies that report systemic complications*

Author/date	No. of patients (no. with polyps)	Mild bronchospasm/asthma attack	Cardiac arrest	Cardiac ischaemia
Case series studies				
Katsantonis *et al.*, 1994[23]	972 (?)	0.4	–	–
Kennedy, 1992[30]	120 (71)	0.8	–	–
Massegur *et al.*, 1995[42]	250 (203)	0.8	0.4	–
Park *et al.*, 1998[35]	79 (58)	–	–	1.3

TABLE 27 *Results from studies that report non-specific or other complications*

Author/date	No. of patients (no. with polyps)	Postoperative headache	Pain	Unremoved nasal pack/ sponge	Repeat surgery required	Cheek oedema	Atrophic rhinitis	Unspecified	Anosmia	Soft tissue infiltration
Randomised controlled trial										
Penttilä *et al.*, 1997[44]										
FESS	75 (52)	–	4	–	–	–	–	–	–	–
CL	75 (45)	–	76	–	–	–	–	–	–	–
Non-randomised comparative studies										
Harkness *et al.*, 1997[37]										
Conventional procedures	1459	–	–	–	–	0.07	–	0.07	0.07	–
FESS	1064	–	–	–	–	–	–	–	–	–
Jankowski *et al.*, 1997[41]										
Functional ethmoidectomy	37 (37)	–	–	–	–	–	–	–	–	–
Radical nasalisation	39 (39)	7.7	–	–	–	–	–	–	–	–
Case series studies										
Jiang and Hsu, 2001[53]	1112 (499), 1227 procedures	–	0.7 (procedures)	0.08 (procedures)	–	–	0.08 (procedures)	–	–	–
Stammberger and Posawetz, 1990[21]	500 (246)	–	–	0.2	2.0	–	–	–	–	1.8

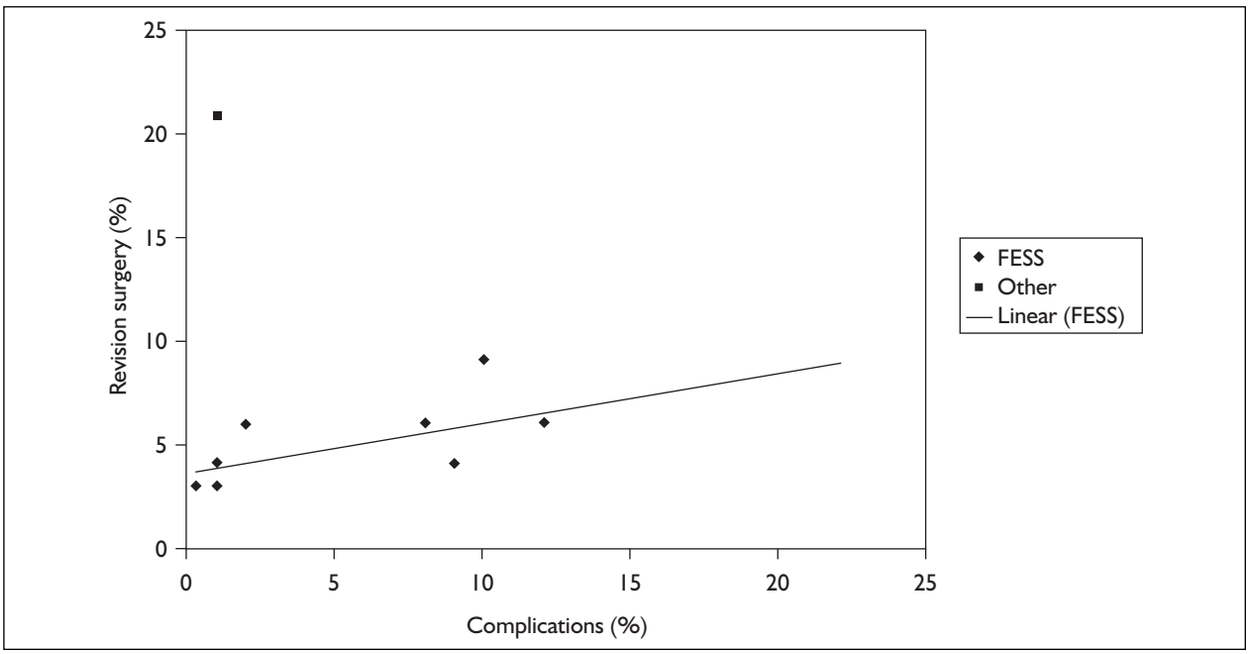


FIGURE 11 *Relationship between rate of complications and revision surgery*

Massegur[42] studies and the rates were 0.4, 0.8 and 0.8%, respectively. Massegur and colleagues[42] reported that 0.4% of people undergoing ESS experienced cardiac arrest, although they did not explain whether the arrest was caused by the ESS procedure. Park and colleagues[35] reported that 1.3% of people undergoing ESS experienced cardiac ischaemia.

Non-specific or other complications

A variety of non-specific and other complications are presented in *Table 27*. Jankowski and colleagues[41] report that 7.7% of people undergoing radical nasalisation experienced postoperative headache and that no cases were reported in the functional ethmoidectomy group. Cheek pain/tenderness was 76% for the CL group and 4% for the FESS group in a study by Penttilä and colleagues.[44]

Pain was reported for 0.7% of procedures in the study by Jiang and Hsu.[53] In the same study an unremoved nasal pack or sponge was reported for 0.08% of procedures. An unremoved nasal pack or sponge was also reported in 0.2% of people in a study by Stammberger and Posawetz.[21]

Repeat surgery to complete the procedure was required for 0.2% of people undergoing ESS in the study by Stammberger and Posawetz. Harkness and colleagues[37] reported that 0.07% of the conventional procedures group had cheek oedema, 0.07% had unspecified complications and 0.07% had anosmia. Jiang and Hsu[53] reported atrophic rhinitis for 0.08% of procedures and Stammberger and Posawetz[21] soft tissue infiltration for 1.8% of people.

We explored the relationship between complication rates and rates of revision surgery as it is often felt that revision surgery is more risky owing to the removal of landmarks within the sinuses (*Figure 11*). The trendline suggests a relationship between increasing rates of complications and revision surgery, although there are few data points and the relationship may not be statistically significant.

Summary: results for complications

- Comparative studies: reported more complications for FESS than comparative techniques (one study) and more complications for nasalisation than ethmoidectomy (one study).
- Case series: total complications ranged from 0.3 to 22.4% with a median of 6% (23 studies).
- Haemorrhage was reported in 18 studies and ranged from 0 to 21%, median 0.9%.
- Infection complications were reported in four studies and ranged from 0 to 16%, median 0.5%.
- Intranasal complications were reported in 12 studies and ranged from 0.4 to 20%, median 3.5%.
- Orbital/ocular complications were reported in 11 studies and ranged from 0 to 3.6%, median 0.4%.

TABLE 28 *Number and type of studies identified for each subgroup of the assessment*

	No. of non-randomised comparative studies identified	No. of case series studies identified	No. of case reports identified	Unknown/other study design	Total no. of studies
Specific patient groups					
Allergic fungal sinusitis	0	3	2	0	5
Allergy	0	1	0	1	2
Aspirin intolerance/ASA/Samter's triad	0	1	1	1	3
Asthma	0	4	0	1	5
Children	0	12	0	2[a]	14
Cystic fibrosis (CF)	1	10	0	1	12
Other patient groups	0	2	2	0	4
Specific types of polyps					
Antrochoanal polyps	0	10	1	4	15
Sphenochoanal polyps	0	1	6	0	7
Specific techniques/technology					
Computer-aided surgery (CAS)	1	2	0	3	6
Frontal sinus surgery	0	4	0	0	4
Intra-operative imaging	0	3	0	1	4
Laser-assisted surgery	0	4	0	5	9
Microdebriders	0	2	0	1	3
Microscopic surgery	0	3	0	1	4
Other techniques/concurrent surgery	1	5	0	1	7
Revision surgery	0	1	0	0	1
Sphenoid surgery	0	5	0	0	5
Total	3	76	12	22	110

[a] One publication was a review article.

- Pharyngeal/mouth complications were reported in three studies and ranged from 0 to 3% for FESS.
- Intracranial complications were reported in 10 studies and ranged from 0 to 2.3%, median 0.2%.
- Systemic complications were reported in four studies and ranged from 0.4 to 1.3%, median 0.8%.
- Non-specific/other complications were reported in five studies and ranged from 0.1 to 4%, median 0.7% for FESS.
- There was a relationship between increasing rates of complications and revision surgery (although not statistically tested).

Future research priorities

Studies excluded from systematic review

A total of 110 articles have been described that were excluded from the systematic review on the basis of study sample size (or number of patients with polyps). In contrast to the included studies, which examined FESS in general terms, these studies focused on aspects of FESS or specific patient groups, which in part, accounts for this smaller size. These studies all focus on FESS for nasal polyps and are categorised as a specific subgroup of FESS for nasal polyps (a specific patient group, type of polyp or technique/technology; *Table 28*).

Description of studies

The citations and abstracts of these articles are presented by subgroup and can be found in Appendix 11. Eighteen subgroups, broken down under the headings 'specific patient groups', 'specific types of polyps' and 'specific techniques/technologies', are presented.

Specific patient groups

Allergic fungal sinusitis

We identified five primary research articles that focused on AFS. Three of these were case series[56–58] and two were case reports.[59,60] Studies were published between 1994 and 1999. The study sample sizes ranged from 1 to 26. Kinsella and colleagues[56] reported follow-up for the majority of patients at 6 months and Kupferberg and Bent[57] reported mean follow-up of 14.5 months.

Allergy
Two studies focused on FESS for removal of nasal polyps associated with allergy, one was of unknown study design[61] and Nishioka and colleagues[34] reported the results of their case series, which included 72 patients with allergy undergoing FESS.

Aspirin intolerance/ASA/Samter's triad
A study by Hosemann[62] of unknown design reported on surgery for nasal polyps in patients with aspirin intolerance or Samter's triad, as did one case report by Amar and colleagues[63] and one case series study by Dias and Biedlingmaier.[64] The studies were published in 2000, 2000 and 1997, respectively. The case series study included 18 patients with Samter's triad and 22 with chronic rhinosinusitis who had undergone ESS.

Asthma
Five studies were identified that assessed FESS in patients with asthma, four of which were case series[31,35,65,66] and one of unknown study design.[67] Studies were published between 1991 and 1999.

The study sample sizes ranged from 43 to 90 patients. The studies by Dinis and Gomes[65] and Dunlop and colleagues[66] each followed patients for 1 year. Lawson[31] followed patients for an average of 3.5 years and the other studies did not report length of follow-up.

Children
Twelve case series studies,[43,68–78] a review article[79] and a study of unknown design[80] were identified that focused on ESS for children. Publication dates ranged from 1994 to 2000. The review by Hebert and Bent[79] has been assessed by the Centre for Reviews and Dissemination (CRD) reviewers and presents a review of the literature (nine studies identified) for FESS in children up until 1996 and was published in 1998. The study by Jiang and Hsu[72] compares the results for 104 children with those for 1008 adults undergoing FESS.

The number of patients included in the case series studies ranged from 4 to 173. The children in the studies had a range of the following conditions: nasal polyps, allergy, antrochoanal polyps, cystic fibrosis, acute rhinosinusitis, asthma, rhinosinusitis and sphenochoanal polyps. The studies by Bolt and colleagues,[69] Triglia,[77] Venkatachalam[78] and Stankiewicz[76] reported mean follow-up periods of 2+ years, 3.7 years, 18.3 months and 3.5 years, respectively. Manning and colleagues[73] reported a 12-month follow-up. None of the other studies reported the length of follow-up.

Cystic fibrosis
A total of 12 studies were identified of endoscopic sinus surgery for patients with cystic fibrosis (CF). A study by Moss and King[81] compared ESS in conjunction with serial antimicrobial lavage (n = 32) with ESS alone (n = 19). Ten studies were case series studies[82–91] with sample sizes ranging from 15 to 248 patients. A further study was of unknown study design.[92] The studies were published between 1989 and 2001 and one study remains unpublished.

Four of the studies were conducted in children, two in adults and two in a combination of adults and children, with the other studies not stating the age of the participants.

Other patient groups
A number of studies reported on a single unique patient group. Jiang and Hsu[53] report a series of 171 geriatric patients, Rossie and colleagues[93] a series of five patients with HIV, Ku and colleagues[94] two cases of extranodal Rosai–Dorfman disease and Emery and colleagues[95] a case of *Schizophyllum commune* sinusitis. The studies were published between 1995 and 2001. No follow-up periods were reported.

Specific types of polyps

Antrochoanal polyps
A total of 15 studies were identified that specifically reported on ESS for antrochoanal polyps and their study designs were as follows: 10 case series studies,[96–105] one case report[106] and four studies of unknown design.[107–110] Studies were published between 1990 and 2001.

The study sample sizes ranged from 1 to 33 patients. The period of follow-up was reported in seven studies and ranged from a minimum of 8 to almost 27 years.

Sphenochoanal polyps
Seven studies were identified that were primary research of sphenochoanal polyps; six of these are case reports[111–116] and one is a case series study.[117] The studies were published between 1995 and 2001. The six case reports each present results for one or two patients. The case series study by Sethi and colleagues[117] presents results for six patients who had sphenoethmoid recess polyps. No follow-up period was specified.

Specific techniques/technologies

Computer-aided surgery
Six studies reported on computer-assisted FESS procedures. A study by Caversaccio and colleagues[118] compared a frameless optical

computer-aided surgery (CAS) system for revision endoscopic surgery (n = 25) with the results of a group of patients who underwent ESS without CAS (n = 10). Gibbons and colleagues[119] presented a cost analysis of computer-aided FESS compared with conventional FESS. Olsen and Citardi[120] presented the results of using CAS in FESS for a series of 61 patients. The Nicolet electronic navigation (NEN) system was used in 20 patients who underwent microendoscopic surgery in a study by Sedlmaier and colleagues.[121] The remaining two studies are of unknown design.[122,123] Studies on CAS were published between 1994 and 2001. The length of patient follow-up was not reported.

Frontal sinus surgery

Four case series studies reported results for frontal sinus surgery.[25,124–126] The studies were published between 1990 and 2001 and the number of patients included in each study ranged from 15 to 200. Average length of follow-up was 12.2 months in the study by Friedman and colleagues[25] and was not reported in the other studies. None of the studies specifically state that the surgery was for nasal polyps but rather that it was for frontal sinus disease in general.

Intra-operative imaging

Four studies reported on ESS techniques involving intra-operative imaging. The study by Cartellieri compared ESS using an intraoperative CT scanning procedure updating the three-dimensional navigation system (n = 6) with conventional ESS.[127] Two case series studies (n = 90[128] and 12[129]) and one study of unknown design were also identified.[130] The studies were published between 1992 and 2000. The technology involved use of the ISG Viewing Wand intraoperative three-dimensional navigation device in the Freysinger study[128] and a vertically open intraoperative MRI system in the Hsu study.[129] No follow-up periods were reported.

Laser-assisted surgery

A total of nine primary studies were identified that reported the use of laser-assisted ESS. Four studies were case series[131–134] and five were of unknown study design.[135–139] The following types of lasers were used: functional aqualaser [yttrium aluminium garnet (YAG)],[133,137] neodymium (Nd) YAG laser,[134,136] holmium (Ho) YAG laser[131,138] and the KTP/532 laser.[132,135] The studies were published between 1989 and 1999. The sample sizes in these studies ranged from 37 to over 2000. The main patient groups included in these studies were nasal polyposis and chronic rhinosinusitis. Westhofen and colleagues[134] followed patients for more than 6 months and the other studies did not report length of follow-up.

Microdebriders

A case series study by Ikui[140] specifically reports on the use of microdebriders in endoscopic sinus surgery. In addition, a study by Hamels and colleagues[141] was also identified although it is of unknown design. The studies were published in 1999 and 1997, respectively. The Ikui study included five children and the study by Hamels and colleagues did not report the number of patients studied. Neither study reported length of follow-up.

Microscopic surgery

Microscopic surgery was reported in four studies, three of which were case series[54,142,143] and the other of unknown study design.[144] The patients included those with severe diffuse polyposis, chronic polypoid rhinosinusitis and chronic rhinosinusitis. The studies were published between 1990 and 2000. The studies by Ohnishi[142] and Weber and colleagues[54] included 30 and 170 patients, respectively. The follow-up period in the retrospective study by Weber and colleagues ranged from 20 months to 10 years after the initial surgery.

Other techniques/concurrent surgery

A number of studies reported on a single unique technique or type of surgery performed concurrent with ESS. Burgess and colleagues[145] compared teleproctored ESS (n = 45) with conventional surgical instruction to trainees (n = 42). Fortune and Duncavage[146] performed partial middle turbinate resection as an adjunct to ESS in 155 patients. Mendelsohn[147] combined rhinoseptoplasty with sinus surgery in a series of 74 patients. Vanclooster[148] combined endoscopic septal spur resection with ESS in 40 patients. el Guindy[149] evaluated an endoscopic trans-septal approach of vidian neurectomy in 11 patients and el Shazly[150] performed endoscopic vidian neurectomy in 12 patients. In addition, a study by Gross was of unknown study design.[151] The studies were published between 1991 and 2002.

Revision surgery

One case series study was identified that focused on revision endoscopic surgery. The study by Wreesmann and colleagues[152] was published in 2001 and included 82 patients with chronic rhinosinusitis/polyposis. No follow-up period was specified.

TABLE 29 *List of future research questions generated by experts*

Question
1. Extent of FESS
What are the long-term effectiveness and cost-effectiveness of FESS versus simple polypectomy?
What are the long-term effectiveness and cost-effectiveness of FESS versus conventional (non-endoscopic) ethmoidectomy?
What are the effectiveness and cost-effectiveness of extensive FESS (i.e. including anterior/posterior ethmoidectomy) compared with conservative FESS (middle meatus/uncinectomy) for sinus disease (chronic rhinosinusitis and/or nasal polyps)?
What are the effectiveness and cost-effectiveness of combinations of surgical management (varying extensiveness) and medical management (varying drugs, doses and length of treatment)?
What are the effectiveness and cost-effectiveness of FESS compared with medical treatment alone in the management of nasal polyposis?
2. Use of accessory technologies
What are the effectiveness (including safety) and cost-effectiveness of microdebriders in FESS for sinus disease compared with conventional equipment?
What are the effectiveness and cost-effectiveness of the use of intra-operative computer/image-guided FESS for sinus disease?
What are the effectiveness and cost-effectiveness of medical treatment (antibiotic sprays, steroids, drops and cleaning) following FESS?
What is optimal preoperative medical treatment before FESS is considered?
What are the effectiveness and cost-effectiveness of aspirin desensitisation following FESS?
3. Specific patient groups
What are the effectiveness and cost-effectiveness of FESS for people with sinus problems and AFS?
What are the effectiveness and cost-effectiveness of FESS for people with sinus problems and cystic fibrosis?
What are the effectiveness and cost-effectiveness of FESS for people with sinus problems and Samter's triad?
What are the effectiveness and cost-effectiveness of FESS for people with sinus problems and asthma?
What are the effectiveness and cost-effectiveness of FESS for people with frontal sinus problems?
4. Aetiology
What is the role of fungal infections in the development and recurrence of nasal polyposis?
5. Imaging
What is the relationship between CT images and clinical outcomes?
What is the relationship between CT images and the surgical procedure performed?
What are the long-term effects of CT scan radiation in people with sinus disease?

Sphenoid surgery

Sphenoid surgery was reported in five primary studies, all of which are case series.[23,55,153–155] The studies were published between 1990 and 1997 and sample sizes ranged from 12 to nearly 2000. Sphenoethmoidectomies were performed in three studies and sphenoidotomies in two. Mean follow-up was 26 months in the study by Gilain and colleagues[154] and follow-up was 2–3 years in the Klossek study.[55]

Future research priorities

The group of expert ENT surgeons used the summary of existing evidence combined with clinical experience to generate future research questions (*Table 29*). The following list of potential research priorities for FESS has been developed from the list of initial questions posed by selected ENT surgeons.

Several methodological issues were uncontentious:

- Outcomes should be measured after a sufficient period from the intervention to be able to draw conclusions on the risk of relapse and revision following surgery.

TABLE 30 *Future research questions in order from highest vote assigned to lowest*

Future research question	Total points assigned
What are the long-term effectiveness and cost-effectiveness of FESS versus simple polypectomy?	13
What are the effectiveness and cost-effectiveness of FESS compared with medical treatment alone in the management of nasal polyposis?	10
What is optimal preoperative medical treatment before FESS is considered?	7
What is the role of fungal infections in the development and recurrence of nasal polyposis?	7
What are the effectiveness and cost-effectiveness of extensive FESS (i.e. including anterior/posterior ethmoidectomy) compared with conservative FESS (middle meatus/uncinectomy) for sinus disease (chronic rhinosinusitis and/or nasal polyps)?	6
What are the effectiveness and cost-effectiveness of medical treatment (antibiotic sprays, steroids, drops and cleaning) following FESS?	5
What are the effectiveness and cost-effectiveness of the use of intra-operative computer/image guided FESS for sinus disease?	3
What are the effectiveness and cost-effectiveness of FESS for people with sinus problems and asthma?	3
What are the effectiveness and cost-effectiveness of combinations of surgical management (varying extensiveness) and medical management (varying drugs, doses and length of treatment)?	2
What are the relationship between CT images and the surgical procedure performed?	2
What are the long-term effectiveness and cost-effectiveness of FESS versus conventional (non-endoscopic) ethmoidectomy?	1
What are the relationship between CT images and clinical outcomes?	1
What are the effectiveness and cost-effectiveness of aspirin desensitisation following FESS?	1
What are the effectiveness and cost-effectiveness of FESS for people with sinus problems and Samter's triad?	1
What are the effectiveness and cost-effectiveness of FESS for people with frontal sinus problems?	0
What are the effectiveness (including safety) and cost-effectiveness of microdebriders in FESS for sinus disease compared with conventional equipment?	0
What are the effectiveness and cost-effectiveness of FESS for people with sinus problems and AFS?	0
What are the effectiveness and cost-effectiveness of FESS for people with sinus problems and CF?	0
What are the long-term effects of CT scan radiation in people with sinus disease?	0

- Cost-effectiveness should be addressed in future research into FESS.
- Patient groups should include people with sinus disease but be powered to demonstrate differences according to whether the predominant picture is polyps or chronic rhinosinusitis.
- Outcomes should include, at least, symptomatic improvement, complications and quality of life.

All nine ENT experts who agreed to participate provided their future research priority votes (although one expert only used six out of the seven available votes). The results of the ranking exercise and questions are presented in *Table 30* in order from highest vote assigned to lowest.

Research in progress

We identified five studies of FESS currently in progress (*Table 31*). These studies will provide valuable information and may fill some of the gaps in the evidence base that this review has identified.

The National Sino-Nasal Surgery Cohort Study will provide useful local information in a large number of patients. It will provide extensive outcomes (such as extensiveness of surgery and Sino-Nasal Outcome Test scores) that have not been reported elsewhere.

The RCT by Ragab (see *Table 31*) will also provide useful insight into the questions posed in the

TABLE 31 *Summary of FESS research in progress*

Study/question	Authors	Organisation	Expected completion date	Study design	Patients	Methodology
National Sino-Nasal Surgery Cohort Study	Royal College of Surgeons	162 NHS Trusts in England and Wales	June 2002. Preliminary results presented to the British Association of Otorhinolaryngologists and Head and Neck Surgeons	Multi-centre prospective cohort study	All patients over 15 years of age listed for primary sinus surgery or surgery for simple nasal polyposis	Extensive information on pre- and postoperative care. The procedure and imaging one being collected along with the following outcomes: length of stay, adverse events, sino-nasal symptoms, activities of daily living, health service utilisation, medication use and patient satisfaction. Risk adjustment of outcomes will be carried out to take into account the influence of case mix. The main case mix variable will be the preoperative Sino-Nasal Outcome Test score. Other important case-mix variables will be (i) co-existing medical conditions, (ii) disease staging scores and (iii) patient sociodemographic variables. Comparison of risk-adjusted outcomes will be made (i) between Trusts and (ii) between individual surgeons. Analyses will take account of the 'hierarchy of care' wherever possible.
Long-term effect of ESS for chronic rhinosinusitis (does ESS improve clinical/objective parameters in the long term?)	Prof. V Lund	Royal Free Hampstead NHS Trust	May 1999	Not stated	Those with chronic rhinosinusitis undergoing ESS	Long-term follow-up (4 years)
The role of FESS after heart–lung transplant in CF patients	Mr Peter Clarke	Southampton General Hospital (part of a multi-centre study)	December 1999	Not stated	CF patients who had undergone heart–lung transplant	Not stated
Xomed sling-shot versus conventional endoscopic surgery for nasal polyps	Mr Grant Bates	Radcliffe Infirmary, Oxford	January 1999	Not stated	Patients with nasal polyps	Not stated
Evaluation of the medical and surgical treatment of chronic rhinosinusitis and nasal polyposis and its effect upon the lower airways	Dr S Ragab	University of London	MD thesis submitted May 2002	Prospective randomised comparative trial	Patients with chronic rhinosinusitis and nasal polyposis	Not stated

future research priorities section of this report (see previous section), that of medical compared with surgical intervention.

Summary: future research priorities

- A total of 110 articles that were excluded from the systematic review have been categorised into 18 subgroups and described.
- Using the literature and their own experience, a group of ENT experts generated a list of 19 future research questions.
- Experts assigned votes to these questions and the highest votes were assigned to the following research question: What are the long-term effectiveness and cost-effectiveness of FESS versus simple polypectomy?
- Five studies currently in progress were identified and described. These studies will address some of the questions posed.

Economic evaluation of FESS

Existing economic studies

The search strategy identified no economic evaluations that compare FESS with simple polypectomy or any other conventional surgery. The only two economic studies of FESS that were identified are peripheral but are described below. A study by Gibbons and colleagues[119] compared the cost of computer-aided FESS with conventional FESS and a study by Stewart and colleagues[156] compared the cost of ESS with a practice guideline to ESS without a practice guideline.

Both studies are basic cost analyses in that they provide the comparative costs of the alternative groups. They were both conducted in the USA. The results of the Stewart study are presented in *Table 32*.

The Stewart study compared hospital costs and charges for patients undergoing ESS. The study did not link the costs of the guideline to patient outcomes. The viewpoint of the study was the hospital. The two groups were self-selected health professionals who chose to use the guideline compared with those who chose not to use it on an individual patient. This leads to a number of potential biases as the two groups may have differed in many ways other than the practice guideline and these differences could impact on costs. It is unclear whether the difference in cost was 'caused' by the guideline or by other factors. A number of relevant costs were omitted, such as overhead costs, cost of complications and complications avoided and costs to the patients. The amount charged to patients or third-party payers was used, but this may not be an accurate reflection of the actual costs incurred. Likewise, the cost obtained from the hospital database is unlikely to be reflective of exact costs owing to the problems inherent with such costing systems. Incremental analyses were not performed. No allowance for uncertainty was made in the estimates.

Gibbons and colleagues reported that computer-assisted FESS was 6.7% more expensive than conventional FESS and that the difference was statistically significant ($p = 0.01$).

The cost analysis in the Gibbons study compared the cost of staff time (based on operative time), cost of the disposable headset, suction and aspirator, cost of the CAS system, CT reformatting and a hospital-shared resource fee for computer-assisted FESS compared with conventional FESS. The study did not consider the benefits or effects of the procedure and did not link effectiveness and costs. The viewpoint of the study was the hospital. The two groups were historical groups and the study is therefore subject to biases. It is possible that there were differences other than the equipment used during the two different study periods and that these differences may also have affected costs. Costs were incurred during different time periods but were not adjusted for differential timing. The costs of the procedure were considered, but costs associated with postoperative care, cost of complications and inpatient stays were omitted. It is uncertain what method was used to value the shared resource cost. No allowance was made for uncertainty.

Table 32 *Costs of endoscopic surgery with and without a practice guideline*

Stewart et *al.*, 1997	Median total costs (US$)	Median total charges (US$)
ESS with practice guideline	2479	3174
ESS without practice guideline	2985	3730

Cost description

Direct costs associated with FESS

Equipment

Table 33 contains a list of costs associated with various telescopes that may be used in endoscopic surgery. *Table 34* contains the list of a standard ENT equipment set from Storz (Karl Storz Endoscopy UK Ltd) that would be required to perform FESS by many ENT surgeons. *Table 35* contains the list of extra equipment that may be required to perform FESS from Storz. *Table 36* contains the cost of a microdebrider that may be required to perform FESS from Storz. All costs were current in May 2002.

In addition, the following standard ENT equipment may be required but for which we were unable to obtain costs: Grunwald turbinate forceps, dressing scissors 12.5 cm, Tilley nasal dressing forceps, Zoellner suction tube fenestrated with stilette 178 mm, Yankauer suction tube, Portex connection Code 633, 40 cm length of silicone tubing 6 mm bore × 2 mm, Rowbotham suction tube, receiver, blue Gallipots 60 ml, beaker 50 ml, Backhaus towel clips, serrated clip, Code D bag.

In addition, a drum elevator may also be required, for which we were unable to obtain a cost.

Additional shaver blades may also be required with concave, oblique and or smooth cutting edges. Each of these blades costs £383.

Further disposable equipment and consumables may also be required although costs for these have not been described.

TABLE 33 *Cost of telescopes that may be used in FESS*

Telescopes	Cost (£)
Telescope 18 cm long, 4 mm, 0°	1733
Telescope 18 cm long, 4 mm, 30°	1838
Telescope 18 cm long, 4 mm, 45°	1796
Telescope 18 cm long, 4 mm, 70°	1838

TABLE 34 *Standard ENT equipment and costs*

Equipment (each)	Cost (£)
Sickle knife, sharp	55
Sickle knife, blunt	55
Freer elevator, sharp edge 19 cm	30
Halle antrum curette, size 2	49
J curette	90
Nasal scissors, right	383
Nasal scissors, left	383
Blakesley–Wilde forceps 0	200
Blakesley–Wilde forceps 1	200
Blakesley–Wilde forceps up 1	233
Right-angled ethmoid forceps	288
Antrum punch, right	362
Antrum punch, left	362
Paediatric forceps, straight	238
Paediatric forceps, up	271
Round endoscope handle	65
Eiken suction, straight	20
Eiken suction, curved	20
Giraffe forceps, 70°	379
Killian nasal speculae, 5 cm	124
Killian nasal speculae, 6 cm	124
Killian nasal speculae, 7.5 cm	124
Hill elevator	53
Thudichum nasal speculum, No. 6	29
Zoellner suction tube, plain with stilette, 178 mm	22
Total	4159

TABLE 35 *Extra FESS equipment and costs*

Equipment (each)	Cost (£)
Antrum curette	49
J curette	90
Frontal sinus curette	49
Frontal sinus curette	49
Probe, double-ended	46
Blakesley nasal forceps	360
Strupel forcep	338
Biopsy grasping forceps	284
Heuwieser antrum grasping forceps	300
Grunwald–Henkel nasal forceps	332
Blakesley nasal forceps	329
Stammberger antrum punch	466
Stammberger antrum punch	466
Stammberger antrum punch	427
Stammberger antrum punch	427
Stammberger antrum punch	470
Beyer antrum punch	404
Belucci scissors	265
Stortz suction tube	95
Backward handle instruments	362
Total	5608

TABLE 36 *Cost of microdebrider for FESS*

Equipment	Cost (£)
Sinus shaver, complete with control unit, foot switch and angled handpiece	5952
Shaver blade, autoclavable, with serrated cutting edge, 4 mm, length 12 cm	383
Total	6335

TABLE 37 *Southampton General Hospital numbers for FESS and costs*

HRG	HRG description	Relevant OPCS4 code	OPCS4 code description	Activity 2000–1					Cost per FCE (£)		
				Day case	Elective		Emergency		Day case	Elective	Emergency
					FCE	Bed days	FCE	Bed days			
C02	Nose procedures Category 1	E085	Removal of foreign body from cavity of nose	0	6	6	10	10	457	414	438
C12	Nose procedures Category 2	E082	Extirpation of lesion of internal nose nec	11	2	4	0	0	237	237	372
C22	Nose procedures Category 3	E081	Nasal polypectomy	35	54	92	0	0	279	288	380
		E084	Divis adhesions internal nose	0	4	4	0	0	279	288	380
		E088	Other operation on internal nose OS	6	6	7	4	6	279	288	380
		E089	Close perforation of septum of nose	0	5	6	0	0	279	288	380
C32	Nose procedures Category 4	No relevant OPCS codes	–	0	–	0	0	0	332	348	430
C42	Nose procedures Category 5	E083	Correction of congenital atresia of choana	1	0	0	0	0	300	400	569
C32	Nose procedures Category 4	E142	Intranasal ethmoidectomy	0	47	76	1	1	332	348	430
		E149	Operation on frontal sinus NOS	2	35	55	0	0	332	348	430
		E148	Operation on frontal sinus OS	1	8	13	0	0	332	348	430
C42	Nose procedures Category 5	E146	Trephine of frontal sinus	0	0	0	1	1	300	400	569
C06	Mouth, head neck/ear dx – Cat 1 >70	J330	Polyp of nasal activity	0	0	0	0	0			
C07	Mouth, head neck/ear dx – Cat 1 <70	J330	Polyp of nasal activity	0	0	0	0	0			

FCE, finished consultant episode.

TABLE 38 *Royal Devon and Exeter Hospital costs of FESS*

HRG	HRG description	OPCS4 code	OPCS4 description	Elective cost (£)	National average (£)
C22	Nose procedures Category 3	E088	Other operation on internal nose OS	598	781
C32	Nose procedures Category 4	E142	Intranasal ethmoidectomy	808	968

Depreciation of equipment
It must be taken into consideration that ENT equipment including the microdebrider have a limited life. Annual costs will therefore include an depreciation rate for the equipment used.

Healthcare Resource Groups
HRGs are problematic when used to determine the costs of a procedure. FESS does not have its own Office of Population and Censuses (4th Revision) (OPCS4) code, nor does it fit neatly within HRGs. A number of different codes are used for FESS depending on the extensiveness of the surgery and the area of focus.

It is difficult to separate out procedures used with an endoscope as these are usually coded using a secondary code assigned by local units which in some cases may only be recorded in patients' notes. The figures presented in *Table 37* are an example of how many FESS procedures were performed at the Southampton Trust 2000–1 and will be an overestimate as they also include non-endoscopic procedures. The code J33 is used for a primary diagnosis of nasal polyps but these may or may not be managed surgically. The code J33 maps onto the HRGs C06 and C07 which were not used at all in 2000–1 at Southampton General Hospital. *Table 38* provides costs from the Royal Devon and Exeter Hospital for 2000–1 compared with the national average taking the HRGs used for FESS. Once again these codes will also include other procedures and it is likely that different hospitals will vary in how they code FESS.

It is not possible to calculate the overall costs to the NHS as we are unable to obtain accurate figures for the number of FESS procedures performed for the excision of nasal polyps.

Operating time
The time taken to perform an FESS operation varies according to the patients' characteristics, extent of disease, experience of the surgeon and how meticulous surgeons are in polyp removal. Average time for one UK surgeon is 46 minutes based on a cohort of whom half had polyps [V Lund, Royal National Throat, Nose and Ear Hospital (Royal Free Hospital), London, personal communication, 2002].

Other costs associated with FESS

Extra staff
It is not expected that FESS will incur any additional staffing costs.

Training
There may be extra costs associated with training surgeons in the use of FESS. These costs will vary depending on the amount and level of training required and the sources used, for example, internal training versus external courses.

Table 39 provides a summary of a selection of available courses (and associated costs) available in the UK that may assist in training for FESS. This table does not list all available courses but provides a general guide of costs involved in training.

Potential savings associated with FESS

Percentage day case
FESS may be associated with a high percentage of day-case procedures. Although exact figures are not available to us, it seems that procedures in the UK are either performed as day cases or with short hospital admissions. This has the potential for cost savings associated with a shorter hospital stay and lower accommodation costs than for comparative techniques.

TABLE 39 *Summary of some available training courses for FESS*

Course title	Organisation	Appropriate participants	Cost (£)
Endoscopic Sinus Anatomy Workshop (1 day)	Royal College of Surgeons of England	Surgeons with minimum of 1 year ENT training, HST years 2–4	550
An Endoscopic Approach to Rhinosinusitis (4 days)	Institute of Laryngology and Otology	Surgeons with minimum 1 year ENT training, HST years 2–4	595 (330 without anatomical dissection)
Advanced Endoscopic Surgery – Practical course (5 days)	University of Dundee	Not stated	1400 plus accommodation costs
Functional Endoscopic Sinus Surgery Course and KTP/532 Workshop (4 days)	Tyrone County Hospital, Omaha, Northern Ireland	Not stated	FESS course 300 KTP/532 270 Total 570
Basic Endoscopic Nasal and Sinus Surgery (2 day)	University of Dundee	Otorhinolaryngology trainees	450 plus accommodation costs

These figures are likely to vary between countries, institutions and surgeons. For example, the study by Danielsen and Olofsson[39] in Norway reported that 91% of procedures were performed on a day-care outpatient basis, whereas Harkness and colleagues[37] in a UK study reported that 18% of all procedures were performed as day cases.

Less revisions/follow-up

Few data are available to indicate that patients undergoing FESS require more or less follow-up/revision surgery than patients undergoing comparative techniques. Park and colleagues[35] reported that hospitalisations and emergency visits decreased significantly following FESS in asthmatic patients ($p < 0.05$). The only comparative data for revision surgery did not indicate that FESS was associated with less revision surgery. We are unable to determine from the present evidence the potential costs or cost savings associated with follow-up and revision surgery.

Fewer complications

Evidence is not sufficient to conclude that FESS is associated with fewer complications than comparative techniques. If, however, it does provide a clear view of the anatomical landmarks and leads to fewer complications, then this would represent a cost saving.

Summary: economic evaluation

- Economic evaluations of a practice guideline for FESS and computer-assisted FESS compared with conventional FESS were identified and discussed.
- Costs of an endoscope range from £1733 to £1838, costs of 'typical' ENT equipment may be around £4160, specific equipment for FESS may cost approximately £5600 and a microdebrider may cost around £6300. Depreciation must also be considered.
- Using HRG codes the cost of FESS may range between £237 (day case) and £968 (elective).
- It is not expected that extra staff costs will be incurred, but available training courses range in price from £450 to £1400.
- Potential savings may be realised if FESS results in a greater percentage of day-case procedures, less revision/follow-up or fewer complications.

Chapter 5

Discussion and conclusion

Implications for other parties

The implications of this review are difficult to determine owing to the poor quality of evidence identified and the lack of economic analysis. Nasal polyps, relative to other chronic conditions, do not place a significant burden on carers. The impact of polyposis, and its treatment, on employment appears unknown.

Factors relevant to the NHS

The FESS procedure offers potential benefits to the NHS. The endoscopes and standard ENT equipment are already available in most, if not all, ENT units across the country so there are limited incremental costs associated with performing the procedure. It offers a clearer view of the sinuses during the procedure and so may also be associated with shorter operating times, shorter length of hospital stays and fewer complications (although present results are variable). If realised, the potential benefits of ESS could impact on the health system as a whole and patients. However, the current evidence base is, in the authors' opinion, insufficiently robust to provide a clear guide to policy.

The difficulty locating accurate cost data for FESS is a result of the inconsistencies in hospital coding of the procedure. It would be helpful if authorities worked to clarify the coding of this procedure.

FESS existed in practice without high-quality comparative evidence of effectiveness. The weaknesses of the evidence base are such that policy makers, we believe, are not currently in a position to develop evidence-based policy on the further diffusion of FESS or guidelines on its place in the management of chronic rhinosinusitis or polyposis. If such decisions are to be made, they will be based on factors other than clinical and cost-effectiveness evidence.

Discussion

The endoscope has been used for over 20 years in sinus surgery and is standard equipment in most institutions. The benefits of an enhanced view of the sinuses during surgery is one of the benefits claimed for FESS. From published studies it appears that the majority of patients do benefit from FESS with relatively few complications. There has, however, been little comparative evidence published on the effectiveness and safety of FESS for nasal polyps. It is striking that out of 33 studies including 11,147 patients, only 240 patients were enrolled in RCTs.

Limitations of included studies

Evidence for the effectiveness of FESS in removing nasal polyps comes from three RCTs, three non-randomised comparative studies and 27 case series studies. Comparative studies have compared FESS with conventional procedures and CL and have also compared radical nasalisation with functional ethmoidectomy.

While acknowledging that RCTs are difficult to perform, they are important as they are associated with fewer threats to internal validity when well conducted. They are potentially the best tool for answering questions of effectiveness. The three RCTs identified in this review were, however, subject to a number of major threats to validity, which are summarised as follows:

- inadequate randomisation processes
- lack of blinding
- possible incomparability of groups at baseline
- variations in the intervention given to patients
- loss to follow-up
- potentially inadequate sample sizes
- outcome measurement that was not objective or independently measured.

The RCTs were of limited generalisability to the UK setting. For these reasons, the review also considered non-randomised controlled studies and case series studies. The three additional controlled studies were larger and one was conducted in the UK. There were still, however, major threats to validity, as follows:

- non-random allocation to groups
- lack of blinding

- possible incomparability of groups at baseline
- variations in the intervention given to patients
- significant loss to follow-up and no ITT analysis
- outcome measurement that was not objective or independently measured
- inter-centre variability not assessed.

The generalisability of some of these studies was also low owing to poorly defined patient groups and the use of comparators that do not represent current practice. Case series provide a vast amount of data in a wide range of patient groups, using a range of variations of the procedure. They provide some insight into the efficacy of FESS, based on the assumption that improvement in the absence of surgery is unlikely. However, they do not assist surgeons or patients in deciding which surgical alternative is likely to be most effective. In addition to the intrinsic methodological problem of absence of controls, the case series reported in this review had the following threats to validity:

- many were retrospective
- many did not enroll consecutive patients
- there was variation in the interventions given to patients
- many had significant loss to follow-up
- many did not independently assess outcomes.

In addition, many of the case series had poor external validity with poorly defined patient groups, lack of inclusion and exclusion criteria and little or no description of the intervention.

All included studies lacked long-term follow-up data and detailed descriptions of postoperative medical therapy. There are also problems associated with the outcome measures reported by the included studies. Studies varied in how they defined and assessed outcomes, whether outcome measurement was objective and independent and in timing of follow-up. No relevant health economic studies were identified, which constrains the ability of health policy makers in considering the place of FESS relative to other demands on the limited NHS resources.

Results of systematic review

The RCTs and controlled trials reported overall symptomatic improvement (reported in five studies) that ranged from 78 to 88% for FESS compared with 43–84% for comparative techniques. Disease recurrence was 8% for FESS compared with 14% for CL, and polyp recurrence was 28% for endoscopic ethmoidectomy compared with 35% for polypectomy. Revision surgery (reported in only one study) was the same for FESS and CL. The percentage of overall complications (reported in only one study) was 1.4% for FESS compared with 0.8% for conventional procedures.

The case series studies reported overall symptomatic improvement for patients with nasal polyps that ranged from 37 to 99% (median 89%). For the mixed patient groups (with and without polypoid disease) overall symptomatic improvement ranged from 40 to 98% (median 88%). Total complications in the case series studies ranged from 22.4 to 0.3% (median 6%).

Improved sense of smell decreased rapidly after 6 months in the ethmoidectomy group compared with nasalisation in one comparative study. Overall improvement compared with preoperative scores ranged from 13 to 91% with a median of 31% (six studies). Improvement in nasal obstruction postoperatively (compared with preoperative scores) ranged from 29 to 100% with a median of 72% (six studies). Overall postoperative patency ranged from 57 to 100% with a median of 93% (seven studies).

Assumptions, limitations and uncertainties of this review

The scope of this assessment was limited to one possible treatment for nasal polyps (FESS), and only one possible application of ESS (nasal polyps). There are a number of important treatment options for a person with nasal polyps which include medical management and different surgical techniques. Although we have identified concurrent medical management that was reported in the included studies, this is not a full description, and issues surrounding the interactions between medical and surgical management have not been dealt with in this assessment. Likewise, FESS is used across a spectrum of sinus disease, in which polyposis is only one manifestation. The generalisability of this assessment is therefore limited to FESS for nasal polyps.

This review only included English studies and so may not be representative of the entire literature available. However, we have included a number of studies conducted in non-English-speaking countries. It is possible that some case series may have been missed using the search strategy we have outlined as it is difficult to identify all of these studies. However, given the limited ability of this study design to answer the question, we do not believe that any omissions would have a significant effect on our conclusions.

Appraisal of case series studies is difficult owing to the lack of information as to which characteristics are most important. The relative importance of study characteristics such as prospective design, consecutive selection and sample size is unknown so we were unable to make overall comments about the relative quality of the case series studies and to indicate which of the wide range of possible effects shown might be most valid within the constraints of the case series design.

We have not attempted an economic analysis owing to the lack of comparative effectiveness data to enable such an analysis to be performed.

Need for further research

There is a pressing need for high-quality, local, long-term comparative evidence in the area of FESS. Our review has highlighted a number of uncertainties and has ranked future research questions.

It should be noted that our attempts to prioritise future research questions are the opinions of a small number of ENT surgeons within the UK. One of the future research priorities listed by surgeons was a comparison of medical and surgical interventions for nasal polyps. We identified one existing study by Blomqvist and colleagues[157] that addresses this question, although it was outside the scope of the assessment. Some of the future research questions raised are outside of the scope of this review and therefore relevant literature may already exist.

We have identified important unanswered questions regarding the effectiveness of FESS for nasal polyps. Studies currently under way will answer some of these questions, but there remains a need for comparative evidence (particularly RCTs) in the area of FESS for nasal polyps in order to inform current practice and policy.

Conclusions

Although a large amount of data is available on FESS, only a tiny proportion has come from randomised or otherwise controlled studies. The results of the studies examined suggest that FESS does improve overall and specific symptoms, although the comparative effectiveness of FESS over available alternatives remains unclear. There is therefore some poor-quality evidence for the efficacy of FESS but no robust evidence base on which to judge clinical effectiveness.

This review has focused only on surgery for the excision of nasal polyps. However, it is clear that this represents part of a spectrum of sinus disease for which many surgeons consider FESS appropriate. Future research should therefore consider the place of FESS in polyp and non-polypoid sinus disease and address the key question of cost-effectiveness.

Acknowledgements

We acknowledge Mr Adrian Drake-Lee, Mr Tristam Lesser, Mr Gerald McGarry, Mr Andrew Swift and Mr Ray Rivron (in addition to the expert advisory group) for their involvement in setting future research priorities.

Contributions of authors

Kim Dalziel drafted the protocol and contributed to all sections of the report and drafted the final manuscript. Ken Stein was involved in conception and protocol, supervised the overall process, assessed studies for inclusion/exclusion and edited the manuscript. Ali Round commented on the protocol and edited the final draft. Ruth Garside carried out data extraction. Pam Royle carried out all searches and applied inclusion criteria and commented on the draft report.

Expert advisory group

Mr Robert Slack, Consultant in ENT, Royal United Hospital, Bath
Professor Valerie Lund, Professor of ENT Surgery, Royal National Throat, Nose and Ear Hospital (Royal Free Hospital), London
Dr John Browne, Royal College of Surgeons
Mr Ian MacKay, Consultant in ENT, Charing Cross, Westminster and Royal Brompton Hospitals, London
Mr Dick Garth, Consultant in ENT, Royal Devon and Exeter Hospital.

References

1. Kumar P, Clark M. Clinical medicine. London: W.B. Saunders; 2001.
2. Bernstein JM. Nasal polyps: finding the cause, determining treatment. *J Respir Dis* 1997;**18**:9–856.
3. McClay JE. Nasal polyps. *eMed J* 2001;**2**(12). www.emedecine.com/ped/topic1550.htm
4. Settipane GA, Lund VJ, Bernstein JM, Tos M. Nasal polpys: epidemiology, pathogenesis and treatment. Rhode Island: Oceanside Publications, 1997.
5. The Royal College of Surgeons of England. National comparative audit of surgery for nasal polyposis and rhinosinusitis in England and Wales [protocol]. London: The Royal College of Surgeons of England; 2002.
6. Groves K, editor. Scott-Brown's otolaryngology. 5th ed. London: Butterworth Heinemann; 1988.
7. Greisner WA, Settipane GA. Hereditary factor for nasal polyps. *J Allergy Clin Immunol* 1995;**95**:205.
8. Drake-Lee A. Nasal polyps. In Mygin N, Naclerio RM, editors. Allergic and non-allergic rhinitis. Copenhagen: Munksgaard; 1993.
9. Radenne F, Lamblin C, Vandezande LM, Tillie-Leblond I, Darras J, Tonnel AB, *et al.* Quality of life in nasal polyposis. *J Allergy Clin Immunol* 1999;**104**:79–84.
10. Cunningham JM, Chiu EJ, Landgraf JM, Gliklich RE. The health impact of chronic recurrent rhinosinusitis in children. *Arch Otolaryngol Head Neck Surg* 2000;**126**:1363–8.
11. Damm M, Quante G, Jungehuelsing M, Stennert E. Impact of functional endoscopic sinus surgery on symptoms and quality of life in chronic rhinosinusitis. *Laryngoscope* 2002;**112**:310–5.
12. Folker RJ, Marple BF, Mabry RL, Mabry CS. Treatment of allergic fungal sinusitis: a comparison trial of postoperative immunotherapy with specific fungal antigens. *Laryngoscope* 1998;**108**(11 Pt 1):1623–7.
13. Metson R, Gliklich RE. Clinical outcome of endoscopic surgery for frontal sinusitis. *Arch Otolaryngol Head Neck Surg* 1998;**124**:1090–6.
14. Jones ML, Piccirillo JF, Haiduk A, Thawley SE. Functional endoscopic sinus surgery: do ratings of appropriateness predict patient outcomes? *Am J Rhinol* 1998;**12**:249–55.
15. Rosenfeld RM. Pilot study of outcomes in pediatric rhinosinusitis. *Arch Otolaryngol Head Neck Surg* 1995;**121**:729–36.
16. Winstead W, Barnett SN. Impact of endoscopic sinus surgery on global health perception: an outcomes study. *Otolaryngol Head Neck Surg* 1998;**119**:486–91.
17. Department of Health (England). Hospital inpatient data – based on hospital episode statistics 2000–2001. URL: http://www.doh.gov.uk (accessed 12 March 2002).
18. Department of Health. Compendium of clinical and health indicators 2000. London: Office for National Statistics; 2001.
19. Fageeh NA, Pelsusa EO, Quarrington A. Functional endoscopic sinus surgery: University of Ottawa experience and an overview. *Ann Saudi Med* 1996;**166**(Br95–180).
20. Slack R, Bates G. Functional endoscopic sinus surgery. *Am Fam Phys* 1998;**58**:707–18.
21. Stammberger H, Posawetz W. Functional endoscopic sinus surgery. Concept, indications and results of the Messerklinger technique. *Eur Arch Otorhinolaryngol* 1990;**247**:63–76.
22. Wigand ME, Hosemann W. Microsurgical treatment of recurrent nasal polyposis. *Rhinol Suppl* 1989; 825–9.
23. Katsantonis GP, Friedman WH, Bruns M. Intranasal sphenoethmoidectomy: an evolution of technique. *Otolaryngol Head Neck Surg* 1994; **111**:781–6.
24. Lund VJ, Kennedy DW. Staging for rhinosinusitis. *Otolaryngol Head Neck Surg* 1997;**117**(3 Pt 2):S35–40.
25. Friedman M, Landsberg R, Schults RA, Tanyeri H, Caldarelli DD. Frontal sinus surgery: endoscopic technique and preliminary results. *Am J Rhinol* 2000;**14**:393–403.
26. Gardener SB, Winter PD, Gardener MJ. Confidence interval analysis (CIA). [1.0]. London: British Medical Journal; 1989.
27. Davis WE, Templer JW, Lamear WR, Davis WE, Craig SB. Middle meatus anstrostomy: patency rates and risk factors. *Otolaryngol Head Neck Surg* 1991;**104**:467–72.
28. Friedman M, Landsberg R, Tanyeri H. Middle turbinate medialization and preservation in endoscopic sinus surgery. *Otolaryngol Head Neck Surg* 2000;**123**(1 Pt 1):76–80.
29. Jacobs JB. 100 years of frontal sinus surgery. *Laryngoscope* 1997;**107**(11 Pt 2):1–36.

30. Kennedy DW. Prognostic factors, outcomes and staging in ethmoid sinus surgery. *Laryngoscope* 1992;**102**(12 Pt 2 Suppl 57):1–18.

31. Lawson W. The intranasal ethmoidectomy – an experience with 1,077 procedures. *Laryngoscope* 1991;**101**:367–71.

32. Levine HL. Functional endoscopic sinus surgery: evaluation, surgery, and follow-up of 250 patients. *Laryngoscope* 1990;**100**:79–84.

33. Moses RL, Cornetta A, Atkins JPJ, Roth M, Rosen MR, Keane WM. Revision endoscopic sinus surgery: the Thomas Jefferson University experience. *Ear Nose Throat J* 1998;**77**:190,193–202.

34. Nishioka GJ, Cook PR, Davis WE, McKinsey JP. Immunotherapy in patients undergoing functional endoscopic sinus surgery. *Otolaryngol Head Neck Surg* 1994;**110**:406–12.

35. Park AH, Lau J, Stankiewicz J, Chow J . The role of functional endoscopic sinus surgery in asthmatic patients. *J Otolaryngol* 1998;**27**:275–80.

36. Schaefer SD. An anatomic approach to endoscopic intranasal ethmoidectomy. *Laryngoscope* 1998; **108**(11 Pt 1):1628–34.

37. Harkness P, Brown P, Fowler S, Topham J. A national audit of sinus surgery. Results of the Royal College of Surgeons of England comparative audit of ENT surgery. *Clin Otolaryngol* 1997;**22**:147–51.

38. Lund VJ, MacKay IS. Outcome assessment of endoscopic sinus surgery. *J R Soc Med* 1994; **87**:70–2.

39. Danielsen A, Olofsson J. Endoscopic endonasal sinus surgery. A long-term follow-up study. *Acta Otolaryngol* 1996;**116**(4):611–19.

40. Jakobsen J, Svendstrup F. Functional endoscopic sinus surgery in chronic sinusitis – a series of 237 consecutively operated patients. *Acta Otolaryngol Suppl* 2000;**543**:158–61.

41. Jankowski R, Pigret D, Decroocq F. Comparison of functional results after ethmoidectomy and nasalization for diffuse and severe nasal polyposis. *Acta Otolaryngol* 1997;**117**:601–8.

42. Massegur H, Adema JM, Lluansi J, Fabra JM, Montserrat JM. Endoscopic sinus surgery in sinusitis. *Rhinology* 1995;**33**:89–92.

43. Wolf G, Greistorfer K, Jebeles JA. The endoscopic endonasal surgical technique in the treatment of chronic recurring sinusitis in children. *Rhinology* 1995;**33**:97–103.

44. Penttilä M, Rautiainen M, Pukander J, Kataja M. Functional vs. radical maxillary surgery. Failures after functional endoscopic sinus surgery. *Acta Otolaryngol Suppl* 1997;(529):173–6.

45. Ünlü HH, Caylan R, Nalca Y, Akyar S. An endoscopic and tomographic evaluation of patients with sinusitis after endoscopic sinus surgery and Caldwell–Luc operation: a comparative study. *J Otolaryngol* 1994;**23**:197–203.

46. Stoop AE, van der Heijden HA, Biewenga J, van der Baan S. Clinical aspects and distribution of immunologically active cells in the nasal mucosa of patients with nasal polyps after endoscopic sinus surgery and treatment with topical corticosteroids. *Eur Arch Otorhinolaryngol* 1992;**249**:313–7.

47. Wigand ME, Steiner W, Jaumann MP. Endonasal sinus surgery with endoscopical control: from radical operation to rehabilitation of the mucosa. *Endoscopy* 1978;**10**:255–60.

48. Delank KW, Stoll W. Olfactory function after functional endoscopic sinus surgery for chronic sinusitis. *Rhinology* 1998;**36**:15–19.

49. Sobol SE, Wright ED, Frenkiel S. One-year outcome analysis of functional endoscopic sinus surgery for chronic sinusitis. *J Otolaryngol* 1998;**27**:252–7.

50. Venkatachalam VP, Bhat A. Functional endoscopic sinus surgery – a newer surgical concept in the management of chronic sinusitis. *Indian J Otolaryngol Head Neck Surg* 1999;**52**:13–16.

51. Venkatachalam VP, Bhat A. Comparative evaluation of endoscopic and conventional surgical techniques in the management of nasal polyposis. *JK Pract* 1998;**5**:295–9.

52. Kurent Z, Zargi M. Endoscopic polypectomy vs. endoscopic ethmoidectomy in combined treatment of massive bilateral nasal polyposis. In ERS & ISIAN Meeting '98. 1998. pp. 187–90.

53. Jiang RS, Hsu CY. Endoscopic sinus surgery for the treatment of chronic sinusitis in geriatric patients. *Ear Nose Throat J* 2001;**80**:230–2.

54. Weber R, Draf W, Keerl R, Schick B, Saha A. Endonasal microendoscopic pansinusoperation in chronic sinusitis. II. Results and complications. *Am J Otolaryngol* 1997;**18**:247–53.

55. Klossek JM, Peloquin L, Friedman WH, Ferrier JC, Fontanel JP. Diffuse nasal polyposis: postoperative long-term results after endoscopic sinus surgery and frontal irrigation. *Otolaryngol Head Neck Surg* 1997;**117**:355–61.

56. Kinsella JB, Bradfield JJ, Gourley WK, Calhoun KH, Rassekh CH. Allergic fungal sinusitis. *Clin Otolaryngol* 1996;**21**:389–92.

57. Kupferberg SB, Bent JP. Allergic fungal sinusitis in the pediatric population. *Arch Otolaryngol Head Neck Surg* 1996;**122**:1381–4.

58. Kupferberg SB, Bent JP, Kuhn FA. Prognosis for allergic fungal sinusitis. *Otolaryngol Head Neck Surg* 1997;**117**:35–41.

59. Fryen A, Mayser P, Glanz H, Fussle R, Breithaupt H, de Hoog GS. Allergic fungal sinusitis caused by

Bipolaris (Drechslera) hawaiiensis. *Euro Arch Otolaryngol* 1999;**256**:330–4.

60. Roth M. Should oral steroids be the primary treatment for allergic fungal sinusitis? *Ear Nose Throat J* 1994;**73**(12):928–30.

61. Endoscopic sinus surgery: sinonasal polyposis and allergy. *Ear Nose Throat J* 1993;**72**:544, 547–50, 553-4.

62. Hosemann W. Surgical treatment of nasal polyposis in patients with aspirin intolerance. *Thorax* 2000;**55**:S87–90.

63. Amar YG, Frenkiel S, Sobol SE. Outcome analysis of endoscopic sinus surgery for chronic sinusitis in patients having Samter's triad. *J Otolaryngol* 2000;**29**:7–12.

64. Dias MA, Biedlingmaier JF. Ketorlac-induced status asthmaticus after endoscopic sinus surgery in a patient with Samter's triad. *Otolaryngol Head Neck Surg* 1997;**117**:S176–8.

65. Dinis PB, Gomes A. Sinusitis and asthma: how do they interrelate in sinus surgery? *Am J Rhinol* 1997;**11**:421–8.

66. Dunlop G, Scadding GK, Lund VJ. The effect of endoscopic sinus surgery on asthma: management of patients with chronic rhinosinusitis, nasal polyposis, and asthma. *Am J Rhinol* 1999;**13**:261–5.

67. Lund VJ. The effect of sinonasal surgery on asthma. *Allergy* 1999;**54**:141–5.

68. Al Ammar AY, Tewfik TL, Mazer BD, Manoukian JJ. Nasal polyps in children. *Can J Allerg Clin Imm* 2000;**5**:123–8.

69. Bolt RJ, de Vries N, Middelweerd RJ. Endoscopic sinus surgery for nasal polyps in children: results. *Rhinology* 1995;**33**:148–51.

70. Dutt SN, Haider AA, Stewart M, Chen J, Morrissey SMC. Outcome analysis of functional endoscopic sinonasal surgery for paediatric rhinosinusitis using the Lund–Mackay–Kennedy scoring system. *Indian J Otolaryngol Head Neck Surg* 1999;**51**(3):16–20.

71. Gordts F, Clement PA. Unusual choanal polyps. *Acta Otorhinolaryngol Belg* 1997;**51**:177–80.

72. Jiang RS, Hsu CY. Functional endoscopic sinus surgery in children and adults. *Ann Otol Rhinol Laryngol* 2000;**109**(12 Pt 1):1113–16.

73. Manning SC, Wasserman Rl, Silver R, Phillips Dl. Results of endoscopic sinus surgery in pediatric patients with chronic sinusitis and asthma. *Arch Otolaryngol Head Neck Surg* 1994;**120**:1142–5.

74. Risavi R, Klapan I, Handzic-Cuk J, Barcan T. Our experience with FESS in children. *Int J Pediatr Otorhinolaryngol* 1998;**43**:271–5.

75. Slapak I. Indications for endonasal surgery in children. In 3rd European Congress of the European Federation of Oto-Rhino-Laryngological Societies Eufos. 2nd Vol. 1996. pp. 107–10.

76. Stankiewicz JA. Pediatric endoscopic nasal and sinus surgery. *Otolaryngol Head Neck Surg* 1995;**113**:204–10.

77. Triglia JM. Nasal polyposis in children. *Pediatr Pulmonol Suppl* 1997;**16**:288.

78. Venkatachalam VP. Functional endoscopic sinus surgery in children. *Indian J Otolaryngol Head Neck Surg* 1999;**51**:28–31.

79. Hebert RL, Bent JP. Meta-analysis of outcomes of pediatric functional endoscopic sinus surgery. *Laryngoscope* 1998;**108**:796–9.

80. Lund VJ. Bacterial sinusitis – etiology and surgical management. *Pediatr Infect Dis J* 1994;**13**:S58–63.

81. Moss RB, King VV. Management of sinusitis in cystic fibrosis by endoscopic surgery and serial antimicrobial lavage. Reduction in recurrence requiring surgery. *Arch Otolaryngol Head Neck Surg* 1995;**121**:566–72.

82. Albritton FD, Kingdom TT. Endoscopic sinus surgery in patients with cystic fibrosis: an analysis of complications. *Am J Rhinol* 2000;**14**:379–85.

83. Brihaye P, Jorissen M, Clement PA. Chronic rhinosinusitis in cystic fibrosis (mucoviscidosis). *Acta Otorhinolaryngol Belg* 1997;**51**:323–37.

84. Cuyler JP, Monaghan AJ. Cystic fibrosis and sinusitis. *J Otolaryngol* 1989;**18**:173–5.

85. Duplechain JK, White JA, Miller RH. Pediatric sinusitis. The role of endoscopic sinus surgery in cystic fibrosis and other forms of sinonasal disease. *Arch Otolaryngol Head Neck Surg* 1991;**117**:422–6.

86. Halvorson DJ, Dupree JR, Porubsky ES. Management of chronic sinusitis in the adult cystic fibrosis patient. *Ann Otol Rhinol Laryngol* 1998;**107**(11 Pt 1):946–52.

87. Jones JW, Parsons DS, Cuyler JP. The results of functional endoscopic sinus (FES) surgery on the symptoms of patients with cystic fibrosis. *Int J Pediatr Otorhinolaryngol* 1993;**28**:25–32.

88. Kerrebijn JD, Poublon RM, Overbeek SE. Nasal and paranasal disease in adult cystic fibrosis patients. *Eur Respir J* 1992;**5**:1239–42.

89. Madonna D, Isaacson G, Rosenfeld RM, Panitch H. Effect of sinus surgery on pulmonary function in patients with cystic fibrosis. *Laryngoscope* 1997;**107**:328–31.

90. Rosbe KW, Jones DT, Rahbar R, Lahiri T, Auerbach AD. Endoscopic sinus surgery in cystic fibrosis: do patients benefit from surgery? *Int J Pediatr Otorhinolaryngol* 2001;**61**:113–19.

91. Rowe-Jones JM, Mackay IS. Endoscopic sinus surgery in the treatment of cystic fibrosis with nasal polyposis. *Laryngoscope* 1996;**106**(12 Pt 1):1540–4.

92. Clarke P. The role of functional endoscopic sinus surgery (FESS) after heart lung transplant in cystic fibrosis patients. Southampton: Southampton General Hospital; 1999.

93. Rossi RM, Wanke C, Federman M. Microsporidian sinusitis in patients with the acquired immunodeficiency syndrome. *Laryngoscope* 1996;**106**(8):966–71.

94. Ku PKM, Tong MCF, Leung CY, Pak MW, van Hasselt CA. Nasal manifestation of extranodal Rosai–Dorfman disease – diagnosis and management. *J Laryngol Otol* 1999;**113**:275–80.

95. Emery BE, Oberle AD, Abreo F, Day TA, Stucker FJ. Schizophyllum commune sinusitis – a case-report and radiologic findings. *Am J Rhinol* 1995;**9**:149–54.

96. Aktas D, Yetiser S, Gerek M, Kurnaz A, Can C, Kahramanyol M. Antrochoanal polyps: analysis of 16 cases. *Rhinology* 1998;**36**:81–5.

97. Basak S, Karaman CZ, Akdilli A, Metin KK. Surgical approaches to antrochoanal polyps in children. *Int J Pediatr Otorhinolaryngol* 1998; **46**:197–205.

98. Cook PR, Davis WE, McDonald R, McKinsey JP. Antrochoanal polyposis: a review of 33 cases. *Ear Nose Throat J* 1993;**72**:401–10.

99. el Guindy A, Mansour MH. The role of transcanine surgery in antrochoanal polyps. *J Laryngol Otol* 1994;**108**:1055–7.

100. Gerek M, Yetiser S, Dundar A, Ozkaptan Y. Transnasal and transcanine endoscopy in management of antrochoanal polyp. In Sydney '97 – XVI World Congress of Otorhinolaryngology Head and Neck Surgery. Tomes 1 and 2. 1996. pp. 1499–503.

101. Hong SK, Min YG, Kim CN, Byun SW. Endoscopic removal of the antral portion of antrochoanal polyp by powered instrumentation. *Laryngoscope* 2001;**111**:1774–8.

102. Kamel R. Endoscopic transnasal surgery in antrochoanal polyp. *Arch Otolaryngol Head Neck Surg* 1990;**116**:841–3.

103. Loury MC, Hinkley DK, Wong W. Endoscopic transnasal antrochoanal polypectomy: an alternative to the transantral approach. *South Med J* 1993;**86**:18–22.

104. Orvidas LJ, Beatty CW, Weaver AL. Antrochoanal polyps in children. *Am J Rhinol* 2001;**15**:321–5.

105. Raji A, Essaadi M, Detsouli M, Chekkoury IA, Benchakroun. The antrochoanal polyp. *Acta Otorhinolaryngol Belg* 2000;**54**:473–8.

106. Myatt HM, Cabrera M. Bilateral antrochonanal polyps in a child: a case report. *J Laryngol Otol* 1996;**110**:272–4.

107. Woolley AL, Clary RA, Lusk RP. Antrochoanal polyps in children. *Am J Otolaryngol Head Neck Med Surg* 1996;**17**:368–73.

108. Deka RC. Antrochoanal polyp: Its pathogenesis origin and management by functional endonasal endoscopic surgery. *Indian J Otolaryngol Head Neck Surg* 1999;**51**:33–5.

109. Sato K, Nakashima T. Endoscopic sinus surgery for chronic sinusitis with antrochoanal polyp. *Laryngoscope* 2000;**110**:1581–3.

110. Vleming M, de Vries N. Endoscopic sinus surgery for antrochoanal polyps. *Rhinology* 1991;**29**:77–8.

111. Crampette L, Mondain M, Rombaux P. Sphenochoanal polyp in children. Diagnosis and treatment. *Rhinology* 1995;**33**:43–5.

112. Dadas B, Yilmaz O, Vural C, Calis AB, Turgut S. Choanal polyp of sphenoidal origin. *Eur Arch Otorhinolaryngol* 2000;**257**:379–81.

113. Eloy P, Evrard I, Bertrand B, Delos M. Choanal polyp of sphenoidal origin. Report of two cases. *Acta Otorhinolaryngol Belg* 1996;**50**:183–9.

114. Ileri F, Koybasioglu A, Uslu S. Clinical presentation of a sphenochoanal polyp. *Eur Arch Otorhinolaryngol* 1998;**255**:138–9.

115. Soh KB, Tan KK. Sphenochoanal polyps in Singapore: diagnosis and current management. *Singapore Med J* 2000;**41**:184–7.

116. Tosun F, Yetiser S, Akcam T, Ozkaptan Y. Sphenochoanal polyp: endoscopic surgery. *Int J Pediatr Otorhinolaryngol* 2001;**58**:87–90.

117. Sethi DS, Lau DP, Chee LW, Chong V. Isolated sphenoethmoid recess polyps. *J Laryngol Otol* 1998;**112**:660–3.

118. Caversaccio M, Bachler R, Ladrach K, Schroth G, Nolte LP, Hausler R. Frameless computer-aided surgery system for revision endoscopic sinus surgery. *Otolaryngol Head Neck Surg* 2000; **122**:808–13.

119. Gibbons MD, Gunn CG, Niwas S, Sillers MJ. Cost analysis of computer-aided endoscopic sinus surgery. *Am J Rhinol* 2001;**15**:71–5.

120. Olson G, Citardi MJ. Image-guided functional endoscopic sinus surgery. *Otolaryngol Head Neck Surg* 2000;**123**:188–94.

121. Sedlmaier B, Schleich A, Hoell T, Ohnesorge I, Jovanovic S. NEN–ENT navigation system – First clinical application. In 4th European Congress of Oto-Rhino-Laryngology Head and Neck Surgery. Vols 1 and 2. 2000. pp. 1247–51.

122. Anon JB, Lipman SP, Oppenheim D, Halt RA. Computer-assisted endoscopic sinus surgery. *Laryngoscope* 1994;**104**:901–5.

123. Gunkel AR, Freysinger W, Thumfart WF, Pototschnig C. Complete sphenoethmoidectomy

and computer-assisted surgery. *Acta Otorhinolaryngol Belg* **49**:257.

124. Iro H, Zenk J. A new device for frontal sinus endoscopy: first clinical report. *Otolaryngol Head Neck Surg* 2001;**125**:613–16.

125. Moriyama H, Fukami M, Yanagi K, Ohtori N, Kaneta K. Endoscopic endonasal treatment of ostium of the frontal sinus and the results of endoscopic surgery. *Am J Rhinol* 1994;**8**:67–70.

126. Schaefer SD, Close LG. Endoscopic management of frontal sinus disease. *Laryngoscope* 1990;**100** (2 Pt 1):155–60.

127. Cartellieri VF. Endoscopic sinus surgery using intraoperative computed tomography imaging for updating a three-dimensional navigation system. *Laryngoscope* 2000;**110**(2 Pt 1):292–6.

128. Freysinger W. Three-dimensional navigation in otorhinolaryngological surgery with the viewing wand. *Ann Otol Rhinol Laryngol* 1998;**107** (11 Pt 1):953–8.

129. Hsu L, Fried MP, Jolesz FA. MR-guided endoscopic sinus surgery. *AJNR Am J Neuroradiol* 1998;**19**:1235–40.

130. Zlomaniec J, Czerwonka R, Bryc S. Nasal–sinusal polyps in the picture of combined radiological–endoscopic technique. *Ann Univ Mariae Curie Sklodowska [Med]* 1992;**47**:137–40.

131. Gleich LL, Rebeiz EE, Pankratov MM, Shapshay SM. The holmium:YAG laser-assisted otolaryngologic procedures. *Arch Otolaryngol Head Neck Surg* 1995;**121**:1162–6.

132. Ikeda K, Takasaka T. Endoscopic laser sinus surgery using KTP/532 laser. *Lasers Med Sci* 1996; **11**:133–8.

133. Schuman DM, Pineyro R. Functional Aqualaser sinuscopy: a safe technique for the treatment of severe nasal polyposis. *J Clin Laser Med Surg* 1994;**12**:333–7.

134. Westhofen M, Ilgner J, Handt S. The neodymium: YAG laser in postoperative follow-up after endonasal pansinus operation. In *Laser Florence '99: a window on the laser medicine world* 1999;**1**(37):218–21.

135. Levine HL. Lasers and endoscopic rhinologic surgery. *Otolaryngol Clin North Am* 1989;**22**:739–48.

136. Ohyama M. Laser polypectomy. *Rhinol Suppl* 1989; **8**:35–43.

137. Schuman DM, Pineyro R. Functional Aqualaser? sinuscopy for nasal polyposis. *Clin Laser Mon* 1994; **12**:23–6.

138. Shapshay SM, Rebeiz EE, Pankratov MM. Holmium:yttrium aluminum garnet laser-assisted endoscopic sinus surgery: clinical experience. *Laryngoscope* 1992;**102**:1177–80.

139. Zickefoose S. Nasal surgery. Using lasers with endoscopy surgery. *AORN J* 1989;**50**:979–88.

140. Ikui A. Dilatation of accessory ostium of maxillary sinus on endoscopic sinus surgery for pediatric sinusitis. *Jibi Inkoka Tokeibu Geka* 1999;**71**:543–6.

141. Hamels K, Morre TD, Clement PA. The hummer, shaver or microdebrider. *Acta Otorhinolaryngol Belg* 1997;**51**:89–91.

142. Ohnishi T. Endoscopic endonasal microsurgery of the ethmoid sinus. *Jibi Inkoka Tokeibu Geka* 1990; **62**:343–9.

143. Teatini GP, Stomeo F, Bozzo C. Transnasal sinusectomy with combined microscopic and endoscopic technique. *J Laryngol Otol* 1991; **105**:635–7.

144. Venkatachalam VP. Role of microrhinoscopic sinus surgery in chronic sinusitis: initial results. *Ind J Otolaryngol Head Neck Surg* 2000;**52**:219–22.

145. Burgess LPA, Syms MJ, Holtel MR, Birkmire-Peters DP, Johnson RE, Ramsey MJ. Telemedicine: teleproctored endoscopic sinus surgery. *Laryngoscope* 2002;**112**:216–19.

146. Fortune DS, Duncavage JA. Incidence of frontal sinusitis following partial middle turbinectomy. *Ann Otol Rhinol Laryngol* 1998;**107**:447–53.

147. Mendelsohn M. Simultaneous rhinoseptoplasty and FESS. *Aust J Otolaryngol* 2001;**4**:118–19.

148. Vanclooster C. Endoscopic septel spur resection in combination with endoscopic sinus surgery. *Acta Otorhinolaryngol Belg* 1998;**52**:335–9.

149. el Guindy A. Endoscopic transseptal vidian neurectomy. *Arch Otolaryngol Head Neck Surg* 1994;**120**:1347–51.

150. el Shazly MA. Endoscopic surgery of the vidian nerve. Preliminary report. *Ann Otol Rhinol Laryngol* 1991;**100**:536–9.

151. Gross WE. Soft-tissue shavers in functional endoscopic sinus surgery (standard technique). *Otolaryngol Clin North Am* 1997;**30**:435–41.

152. Wreesmann VB, Fokkens WJ, Knegt PP. Refractory chronic sinusitis: evaluation of symptom improvement after Denker's procedure. *Otolaryngol Head Neck Surg* 2001;**125**:495–500.

153. Friedman WH, Katsantonis GP. Intranasal and transantral ethmoidectomy: a 20-year experience. *Laryngoscope* 1990;**100**:343–8.

154. Gilain L, Aidan D, Coste A, Peynegre R. Functional endoscopic sinus surgery for isolated sphenoid sinus disease. *Head Neck* 1994; **16**:433–7.

155. Hadar T. Isolated sphenoid sinus changes – history, CT and endoscopic findings. *J Laryngol Otol* 1996; **110**:850–3.

156. Stewart MG, Hillman EJ, Donovan DT, Tanli SH. The effects of a practice guideline on endoscopic sinus surgery at an academic center. *Am J Rhinol* 1997;**11**:161–5.

157. Blomqvist EH, Lundblad L, Anggard A, Haraldsson PO, Stjarne P. A randomized controlled study evaluating medical treatment versus surgical treatment in addition to medical treatment of nasal polyposis. *J Allerg Clin Immunol* 2001;**107**:224–8.

Appendix 1

Research protocol for functional endoscopic sinus surgery (FESS) for nasal polyps

Protocol: functional endoscopic sinus surgery versus traditional methods for nasal polyps

This protocol is provisional and subject to change.

Details of review team

Ms Kim Dalziel, Research Fellow (LEAD), Peninsula Technology Assessment Group. Dr Ken Stein, Senior Lecturer in Public Health, Peninsula Technology Assessment Group. Dr Ali Round, Senior Lecturer in Public Health, Peninsula Technology Assessment Group. Ms Ruth Garside, Research Fellow, Peninsula Technology Assessment Group. Dr Pam Royle, Senior Researcher Information Science, Southampton Health Technology Assessment.

Address for correspondence
Dean Clarke House
Southernhay East
Exeter EX1 1PQ
Tel: 01392 207817
Fax: 01392 687134
Email: kim.dalziel@nedevon-ha.swest.nhs.uk.

Full title of research question

What is the clinical effectiveness of FESS compared with traditional methods for the excision of nasal polyps in patients requiring surgery, in terms of improvement in symptoms, patient satisfaction, complication rates and recurrence rates?

Clarification of research question and scope

Polyps may occur in the context of chronic rhinosinusitis but the degree of polyposis may be unrelated to severity of rhinosinusitis. A spectrum of disease exists between chronic rhinosinusitis without significant polypoid disease through to extensive polyposis without symptoms of rhinosinusitis. The focus of this assessment is on disease involving a significant polyp element. FESS is distinct from polypectomy in that FESS procedures are carried out to improve ventilation and drainage in addition to polyp removal (e.g. widening the maxillary antrum or ethmoidectomy).

Nasal polyps are not associated with increased mortality but do reduce quality of life. Morbidity is usually associated with nasal obstruction, anosmia, chronic rhinosinusitis, headaches, snoring and postnasal drainage. Polyps frequently recur despite medical or surgical intervention.

Oral and topical steroids are the first-line treatments for nasal polyps. Surgical intervention is required when medical therapy fails to control symptoms, when the patient is not suitable for oral steroids, when total nasal obstruction occurs or when there is persistent infection or complications.

Conventional non-endoscopic polypectomy is a technique that has been used to excise nasal polyps. It involves removal of polyps under direct vision and illumination. FESS is a minimally invasive technique that has been used for more than a decade in treating nasal polyps. FESS aims not only to remove the polyp but also to improve sinus drainage and ventilation, which may decrease recurrence rates. Advantages are claimed over conventional surgery: permitting a better view of the surgical field, fewer complications and lower recurrence rates. ENT specialists, aside from removal of polyps, use endoscopes for a variety of procedures.

While FESS is a widely used procedure for nasal polyps there are no RCTs and very few comparisons with conventional surgery. From a preliminary search and perusal of the literature, it appears that many studies of FESS technology were published in the early to mid-1990s.

We propose two major parts to this review, first a systematic review of the best available evidence regarding the effectiveness of FESS and second a description of the numerous smaller case series studies that deal with specific patient subgroups, different types of polyps and variations of the technology.

Systematic appraisal of the best available evidence of FESS for nasal polyps

From preliminary searches no RCTs were identified, therefore comparative studies and case series will be evaluated. Preliminary searches have identified only two studies that directly compare FESS with conventional surgery. Direct comparisons of FESS with conventional non-endoscopic polypectomy will be made where possible.

Preliminary searches have identified a further 67 primary studies that are potentially relevant to the question. When case series are presented we will not attempt to make indirect comparisons between FESS and other techniques owing to expected heterogeneity in patient groups studied and in types of polyps. An indirect comparison of two sets of case series is not likely to be useful unless the underlying populations are similar.

We are also aware of a large national sinonasal audit (prospective cohort study) currently being undertaken in England by the Royal College of Surgeons. The objective of the audit is to compare the outcomes of all surgeons and surgical units in England and Wales carrying out surgery to relieve symptoms associated with rhinosinusitis and nasal polyposis. The main outcome of the study is total symptom score. Data are being collected from patients, surgeons and pathology departments. The study involves 3000 patients and is currently in data collection/analysis stages. We will explore the possibility of the cohort study informing this assessment.

The population of interest for this assessment will include all people with nasal polyps requiring surgery. The following outcomes will be considered:

- improvement in symptoms
- patient satisfaction
- complication rates
- recurrence rates
- health service utilisation
- quality of life.

All relevant comparative studies will be included. Among case series, we will include only the best-quality studies. The inclusion criteria for case series studies will be as follows:

- studies with more than 50 patients with nasal polyps
- studies with prospective data collection
- studies with consecutively enrolled patients
- adequate description of the patient population
- publications structured in a way that enables the results of nasal polyp excision to be isolated from procedures for other conditions (e.g. tumours)
- patient relevant outcomes reported.

The results of the included studies will be presented overall and for subgroups where appropriate.

Description of smaller case series studies of specific subgroups

A preliminary review of the literature suggests that there are different types of patients who require FESS surgery for nasal polyps, there are different types of polyps and there are variations in technology and the FESS procedure itself. FESS is an emerging field and many of the studies exploring these subgroups are small case series that will not be included in the systematic appraisal described above. Some of these subgroups will be present in the literature only as a small group within a larger study. This part of the assessment will describe these primary studies.

Examples of the types of subgroups present in the literature include:

- nasal polyps in children
- nasal polyps in those with asthma
- nasal polyps in those with CF
- antrochoanal/choanal/sphenochoanal polyps
- FESS in those with allergic disease
- FESS with microdebrider
- FESS with microscope.

For each of the subgroups we will present a descriptive summary of the available primary research. We will not limit inclusion by study quality or size. As a follow-up from this description of the available research on subgroups, we will present the evidence to the expert advisory group in writing or via email. We will seek their views on the most pressing areas of uncertainty in the use of FESS to inform the future research section of the assessment.

This feedback from the external advisory group will, not be a formal methodological exercise or comprise a piece of stand-alone work. The group's role will be that of consultation, advice, clinical input and methodological guidance, which is the same role they play for the majority of assessments.

The group in their role as opinion leaders will be asked to identify any additional uncertainties in

the area of FESS for nasal polyps that have not been identified through the literature search and description of research of subgroups. From these combined identified uncertainties we will compile a list of future research priorities for FESS and nasal polyps; we will then recirculate this list asking the external advisory group to rank the research priorities by assigning votes to their highest priorities.

The results of this prioritising exercise will then be presented in the future research section of the assessment.

Report methods

Search strategy

- computerised databases including Medline, Embase, PubMed (previous 6 months), the Cochrane Database of Systematic Reviews, the Cochrane Controlled Trials Register, the NHS CRD databases (DARE, NHS EED and HTA database), Science Citation Index, Web of Science Proceedings, BIOSIS, Conference Proceedings Index, British Library Catalogue;
- bibliographies;
- contacting research groups and industry;
- trial registers, including the National Research Register, the Early Warning System, Current Controlled Trials, Controlled Trials.com, ClinicalTrials.gov.

In addition the following websites will be searched:

- SERNIP: http://www.aomrc.org.uk/sernip.htm
- Medical Devices Agency: http://www.medical-devices.gov.uk/.

Searches will be limited to English language only. Reports published only as meeting abstracts will be excluded.

Inclusion criteria

In the absence of RCTs comparing functional endoscopic sinus surgery (FESS) and traditional surgery for the removal of nasal polyps, we will include controlled trials, comparative studies or case series studies reporting the effectiveness of FESS for the removal of nasal polyps.

Exclusion criteria

- animal models
- preclinical and biological studies
- endoscopy used solely to diagnose nasal polyps
- studies of medical treatment for nasal polyps
- studies assessing the pathology of the nasal polyp
- narrative reviews, editorials, opinions
- studies where surgery was not endoscopic.

Data extraction strategy

Data will be extracted by one researcher and checked by a second researcher.

Quality assessment strategy

Studies identified will be assessed for quality using individual components of methodological quality, for case series studies or randomised studies, taken from the CRD report of systematic reviews No. 4 (4 March 2001). Assessment will be made by one researcher and checked by a second. An extensive appraisal of the quality of case series/case report studies will not be provided for each individual study; instead a generic description of the biases inherent in these study designs will be presented.

Methods of analysis/synthesis

Meta-analysis will not be performed as suitable RCTs are not available. The results of the controlled trials, comparative studies or case series studies will be summarised and described.

Methods for estimating qualify of life, costs and cost-effectiveness and/or cost/quality-adjusted life-years

Cost-effectiveness and cost utility will only be calculated if results from a RCT are available, which is unlikely. Cost-effectiveness and utility evaluations are unlikely to be appropriate owing to the paucity of direct comparisons of FESS with conventional surgery. Comparative cost data of FESS and non-endoscopic polypectomy will be provided to allow an assessment of the costs of providing FESS in addition to other ENT services.

Handling the company submission(s)

Not applicable.

Project management

Timetable/milestones

Submission of:	
Draft protocol:	22 February 2002
Finalised protocol:	15 March 2002
Progress report:	10 May 2002
Draft final report:	26 July 2002

Competing Interests

None.

External reviewers

Expert advisory group

A group is currently being formed. This group will act as an expert resource to guide the progress of the review. This group will be separate to the peer

review group. The people we are approaching to be members of the group are:

- Mr Robert Slack, Consultant in ENT, Royal United Hospital, Bath
- Prof. Valerie Lund, Professor of ENT Surgery, The Royal National Throat, Nose and Ear Hospital, London
- Mr John Topham, Consultant in ENT, Worthing Hospital
- Mr John Browne, Royal College of Surgeons, London
- Mr Ian MacKay, Consultant in ENT, London

Peer review

The rapid review will be subject to external peer review by at least two experts. These reviewers will be chosen according to academic seniority and content expertise and will be agreed with NCCHTA. We will obtain independent methodological review from other members of InterTASC. Comments from external reviewers and our responses to these will be made available to NCCHTA in strict confidence for editorial review and approval.

Appendix 2

Search strategy

Sources of information, including databases searched and search terms used

All searches were limited to English language only. Full details of all searches are available on request.

Clinical effectiveness searches

Cochrane Library (all sections), issue 2, 2002

#1 (ENDOSCOPIC near SURGERY)
#2 ENDOSCOPY*:ME
#3 (NASAL next POLYP*)
#4 (#1 or #2)
#5 (ESS or FESS)
#6 (#4 or #5)
#7 (#3 and #6).

MEDLINE (WebSPIRS), 1966–2002/4

(('Nasal-Polyps'/all subheadings in MIME,MJME) and (explode 'Endoscopy-'/all subheadings in MIME,MJME)) or ((fess or ess or (endoscop* near surg*)) and (polyp* and (nasal or nose or sinus*))).

PubMed, records added from 9/2/02 to 9/5/02

(polyps OR polyp OR polyposis) AND (endoscop* OR fess OR ess).

Embase (WebSPIRS), 1980–2002/3

(('nose-polyp'/all subheadings) and (explode 'endoscopy-'/all subheadings)) or ((polyp* with (nose or nasal or sinus*)) and (fess or ess or (endoscop* near surg*))).

Science Citation Index, 1981–19/5/2002

(endoscop* same surg*) and polyp* and (nasal or nose or sinus).

Web of Science Proceedings, 1981–19/5/2002:

(endoscop* same surg*) and polyp* and (nasal or nose or sinus).

BIOSIS, 1985–19/5/2002

((endoscop* and surg* and sinus)) and (polyp*).

CINAHL(WebSPIRS), 1982–2002/2

endoscopic sinus surgery or fess or ess.

DARE (web version), 9/5/2002

1. endoscop$ and surg$ and sinus
2. endoscop$ and surg$ and nasal
3. endoscop$ and surg$ and polyp$.

HTA Database (web version), 9/5/2002

1. endoscop$ and surg$ and sinus
2. endoscop$ and surg$ and nasal
3. endoscop$ and surg$ and polyp.

National Research Register, issue 1, 2002

#1 (ENDOSCOPIC near SURGERY)
#2 ENDOSCOPY*:ME
#3 (NASAL next POLYP*)
#4 (#1 or #2)
#5 (ESS or FESS)
#6 (#4 or #5)
#7 (#3 and #6).

HMIC (Health Management Information Consortium) databases (WebSPIRS), entire database searched on 9/5/2002

endoscopic sinus surgery or fess or ess.

British Library Catalogue, searched March 2002

endoscopic sinus surgery.

Current Controlled Trials, searched on 9/5/2002

endoscopic sinus surgery.

Clinical Trials.gov, searched on 9/5/2002

endoscopic sinus surgery.

Proceedings – FirstSearch, 1993–9/5/2002

endoscopic sinus surgery.

SERNIP web page, searched on 9/5/2002

endoscopic sinus surgery.

Medical Devices Agency web pages, searched on 9/5/2002

endoscopic sinus surgery.

Cost-effectiveness and quality of life searches

MEDLINE (WebSPIRS), 1966–2002/4

(((explode 'Health-Care-Costs'/all subheadings in MIME,MJME) or (explode 'Economics-'/all subheadings in MIME,MJME) or ('Quality-Adjusted-Life-Years'/all subheadings in MIME,MJME) or (qaly or (quality near3 life)) or (cost* or economic*)) and (((explode 'Endoscopy-'/all subheadings in MIME,MJME) and (sinus or nasal)) or (fess or ess) or ((endoscop* near surg*) and (sinus or nasal or polyp*)))) or (((explode 'Health-Care-Costs'/all subheadings in MIME,MJME) or (explode 'Economics-'/all subheadings in MIME,MJME) or ('Quality-Adjusted-Life-Years'/all subheadings in MIME,MJME) or (qaly or (quality near3 life)) or (cost* or economic*)) and (((nasal or nose or sinus) near polyp*) or ('Nasal-Polyps'/all subheadings in MIME,MJME))).

PubMED, records added from 9/2/02 to 9/5/02

1. (nasal AND (polyps OR polypo* OR polyp)) AND (cost OR costs OR economic* OR quality).
2. (endoscop* AND sinus AND surgery) AND (cost OR costs OR economic* OR quality).

Embase (WebSPIRS), 1980–2002/3

(((explode 'health-economics'/all subheadings) or (explode 'cost-'/all subheadings) or ('quality-adjusted-life-year'/all subheadings) or (qaly or (quality near3 life)) or (cost* or economic*)) and (((explode 'endoscopy-'/all subheadings) and (nasal or nose or sinus*)) or (fess or ess) or ((endoscop* near surg*) and (sinus* or nasal or polyp*)))) or (((explode 'health-economics'/all subheadings) or (explode 'cost-'/all subheadings) or ('quality-adjusted-life-year'/all subheadings) or (qaly or (quality near3 life)) or (cost* or economic*)) and (('nose-polyp'/all subheadings) or ((nasal or nose or sinus*) near polyp*))).

NHS EED (web version), 9/5/2002

1. endoscop$ and surg$ and sinus
2. endoscop$ and surg$ and nasal
3. endoscop$ and surg$ and polyp.

EconLit (WebSPIRS), 1969–2002/3

endoscopic sinus surgery or fess or ess.

Epidemiology searches

Medline, 1966–2002/11 and Embase, 1981–2002/1

nasal polyp* and (epidemiology or incidence or prevalence).

Hospital Inpatient Data – based on Hospital Episode Statistics (HES) (web version) 2000–1

ICD-10 [International Classification of Diseases and Health Related Problems (10th Revision)] code J33 Nasal Polyp and OPCS4 code E01–E17.

Additional searching

Bibliographies

All references to articles for which full papers were retrieved were checked to ensure that no eligible studies had been missed.

Industry submissions

Industry submission to the National Institute of Clinical Excellence (NICE) were examined for any further studies that met the inclusion criteria.

Appendix 3

Excluded studies

Anon. Endoscopic sinus surgery: sinonasal polyposis and allergy. *Ear Nose Throat J* 1993;**72**:544,547–4. [Narrative review/opinion]

Blomqvist EH, Lundblad L, Anggard A, Haraldsson PO, Stjarne P. A randomized controlled study evaluating medical treatment versus surgical treatment in addition to medical treatment of nasal polyposis. *J Allergy Clin Immunol* 2001;**107**:224–8. [<50 patients with polyps]

Burgess LPA, Syms MJ, Holtel MR, Birkmire-Peters DP, Johnson RE, Ramsey MJ. telemedicine: teleproctored endoscopic sinus surgery. *Laryngoscope* 2002; **112**:216–19. [FESS not main focus]

Corey JP, Bumsted R, Panje W, Namon A. Orbital complications in functional endoscopic sinus surgery. *Otolaryngol Head Neck Surg* 1993;**109**:814–20. [Narrative review/opinion]

Cuyler JP, Monaghan AJ. Cystic fibrosis and sinusitis. *J Otolaryngol* 1989;**18**:173–5. [<50 patients with polyps]

Danielsen A. Functional endoscopic sinus surgery on a day case out-patient basis. *Clin Otolaryngol* 1992;**17**:473–7. [<50 patients with polyps]

Dinis PB,.Gomes A. Sinusitis and asthma: how do they interrelate in sinus surgery? *Am J Rhinol.* 1997; **11**:421–8. [<50 patients with polyps]

Drake-Lee A. Magical numbers and the treatment of nasal polyps. *Clin Otolaryngol* 1996;**21**:193–7. [Narrative review/opinion]

Duplechain JK, White JA, Miller RH. Pediatric sinusitis. The role of endoscopic sinus surgery in cystic fibrosis and other forms of sinonasal disease. *Arch Otolaryngol Head Neck Surg* 1991;**117**:422–6. [Narrative review/opinion]

Fang SY. Normalization of maxillary sinus mucosa after FESS. A prospective study of chronic sinusitis with nasal polyps. *Rhinology* 1994;**32**:137–40. [Not patient-relevant outcomes]

Forsgren K, Fukami M, Penttilä M, Kumlien J, Stierna P. Endoscopic and Caldwell–Luc approaches in chronic maxillary sinusitis: a comparative histopathologic study on preoperative and postoperative mucosal morphology. *Ann Otol Rhinol Laryngol* 1995;**104**:350–7. [Not patient-relevant outcomes]

Fortune DS, Duncavage JA. Incidence of frontal sinusitis following partial middle turbinectomy. *Ann Otol Rhinol Laryngol*. 1998;**107**:447–53. [<50 patients with polyps]

Franzen G, Klausen OG. Postoperative evaluation of functional endoscopic sinus surgery with computed tomography. *Clin Otolaryngol* 1994;**19**:332–9. [<50 patients with polyps]

Freysinger W. Three-dimensional navigation in otorhinolaryngological surgery with the viewing wand. *Ann Otol Rhinol Laryngol* 1998;**107**:953–8. [Not patient-relevant outcomes]

Frisch T, Arndal H, Fons M. Outcome for the first 85 patients treated with the functional endoscopic sinus surgery technique. *Rhinology* 1995;**33**:236–9. [<50 patients with polyps]

Gross WE. Soft-tissue shavers in functional endoscopic sinus surgery (standard technique). *Otolaryngol Clin N Am* 1997;**30**:435–41. [Narrative review/opinion]

Hamels K, Morre TD, Clement PA. The hummer, shaver or microdebrider. *Acta Otorhinolaryngol Belg* 1997;**51**:89–91. [Narrative review/opinion]

Hebert RL, Bent JP. Meta-analysis of outcomes of pediatric functional endoscopic sinus surgery. *Laryngoscope* 1998;**108**:796–9. [Outdated review]

Hosemann W, Goertzen W, Wohlleben R, Wolf S, Wigand M. Olfaction after endoscopic endonasal ethmoidectomy. *Am J Rhinol* 1993;**7**:11–15. [Nasal polyps not main focus]

Hosemann W, Gode U, Wagner W. Epidemiology, pathophysiology of nasal polyposis, and spectrum of endonasal sinus surgery. *Am J Otolaryngol* 1994;**15**:85–98. [Narrative review/opinion]

Hosemann W, Kuhnel T, Held P, Wagner W, Felderhoff A. Endonasal frontal sinusotomy in surgical management of chronic sinusitis: a critical evaluation. *Am J Rhinol* 1997;**11**:1–9. [Narrative review/opinion]

Ikeda K, Takasaka T. Endoscopic laser sinus surgery using KTP/532 laser. *Lasers Med Sci* 1996;**11**:133–8. [Nasal polyps not main focus]

Jiang RS, Hsu CY. Endoscopic sinus surgery: analysis of 1500 cases. *J Taiwan Otolaryngol Head Neck Surg* 1999;**34**:292–7. [Duplicate publication]

Jiang RS, Hsu CY. Functional endoscopic sinus surgery in children and adults. *Ann Otol Rhinol Laryngol* 2000;**109**:1113–16. [Duplicate publication]

Ki HH, Sam HK, Sang SJ. The assessment of nasality with a nasometer and sound spectrography in patients with nasal polyposis. *Otolaryngol Head Neck Surg* 1997;**117**:343–8. [Not patient-relevant outcomes]

Loebe LP. Indications for surgical therapy of the paranasal sinuses by means of endoscopical and microscopical endonasal and external approaches a

critical intermediate review. *HNO* 1991;**39**:233–5. [Non-English]

Lund VJ. Bacterial sinusitis – etiology and surgical management. *Pediatr Infect Dis J* 1994;**13**:S58–63. [Narrative review/opinion]

Lund VJ. The effect of sinonasal surgery on asthma. *Allergy* 1999;**54**:141–5. [Narrative review/opinion]

Lund VJ. Evidence-based surgery in chronic rhinosinusitis. *Acta Oto-Laryngol* 2001;**121**:5–9. [Narrative review/opinion]

Maran AG. Endoscopic sinus surgery. *Eur Arch Otorhinolaryngol* 1994;**251**:309–18. [Narrative review/opinion]

Matthews BL, Smith LE, Jones R, Miller C, Brookschmidt JK. Endoscopic sinus surgery: outcome in 155 cases. *Otolaryngol Head Neck Surg* 1991;**104**:244–6. [Nasal polyps not main focus]

Mendelsohn M. Simultaneous rhinoseptoplasty and fess. *Aust J Otolaryngol* 2001;**4**:118–19. [<50 patients with polyps]

Moriyama H, Yanagi K, Ohtori N, Fukami M. Evaluation of endoscopic sinus surgery for chronic sinusitis: postoperative erythromycin therapy. *Rhinology* 1995;**33**:166–70. [FESS not main focus]

Penttilä M. Endoscopic findings after functional and radical sinus surgery – a prospective randomized study. *Am J Rhinol* 1994;**8**:71–6. [Duplicate publication]

Rice DH. Endoscopic sinus surgery: results at 2-year follow-up. *Otolaryngol Head Neck Surg* 1989;**101**:476–9. [<50 patients with polyps]

Rice DH. Endoscopic sinus surgery. *Otolaryngol Head Neck Surg* 1994;**111**:100–10. [Narrative reviews/opinions]

Rosbe KW, Jones DT, Rahbar R, Lahiri T, Auerbach AD. Endoscopic sinus surgery in cystic fibrosis: do patients benefit from surgery? *Int J Pediatr Otorhinolaryngol* 2001;**61**:113–19. [Nasal polyps not main focus]

Roth Y, Shoshan JB, Kronenberg J. Functional endoscopic sinus surgery: experience with the first 100 patients. *Int Surg* 1995;**80**:278–9. [<50 patients with polyps]

Ryan RM, Whittet HB, Norval C, Marks NJ. Minimal follow-up after functional endoscopic sinus surgery. Does it affect outcome? *Rhinology* 1996;**34**:44–5. [<50 patients with polyps]

Sato K, Nakashima T. Endoscopic sinus surgery for chronic sinusitis with antrochoanal polyp. *Laryngoscope* 2000;**110**:1581–3. [<50 patients with polyps]

Schaefer SD, Manning S, Close LG. Endoscopic paranasal sinus surgery: indications and considerations. *Laryngoscope* 1989;**99**:1–5. [<50 patients with polyps]

Schaitkin B, May M, Shapiro A, Fucci M, Mester SJ. Endoscopic sinus surgery: 4-year follow-up on the first 100 patients. *Laryngoscope* 1993;**103**:1117–20. [<50 patients with polyps]

Shapshay SM, Rebeiz EE, Pankratov MM. Holmium:yttrium aluminum garnet laser-assisted endoscopic sinus surgery: clinical experience. *Laryngoscope* 1992;**102**:1177–80. [<50 patients with polyps]

Sipila J, Antila J, Suonpaa J. Pre- and postoperative evaluation of patients with nasal obstruction undergoing endoscopic sinus surgery. *Eur Arch Otorhinolaryngol* 1996;**253**:237–9. [<50 patients with polyps]

Stankiewicz JA. Pediatric endoscopic nasal and sinus surgery. *Otolaryngol Head Neck Surg* 1995;**113**:204–10. [<50 patients with polyps]

Stevens HE, Blair NJ. Intranasal sphenoethmoidectomy: 10-year experience and literature review. *J Otolaryngol* 1988;**17**:254–9. [FESS not main focus]

Stewart MG, Hillman EJ, Donovan DT, Tanli SH. The effects of a practice guideline on endoscopic sinus surgery at an academic center. *Am J Rhinol* 1997;**11**:161–5. [FESS not main focus]

Terris MH, Davidson TM. Review of published results for endoscopic sinus surgery. *Ear Nose Throat J* 1994;**73**:574–80. [Outdated review]

Toffel PH. Simultaneous secure endoscopic sinus surgery and rhinoplasty. *Ear Nose Throat J* 1994;**73**:554–60, 565. [Nasal polyps not main focus]

Varghese G, Murthy PSN. Nasal endoscope and you. *Indian J Otolaryngol Head Neck Surg* 1999;**51**:84–9. [Narrative review/opinion]

Vleming M, de Vries N. Endoscopic sinus surgery for antrochoanal polyps. *Rhinology* 1991;**29**:77–8. [<50 patients with polyps]

Westhofen M, Ilgner J, Handt S. The neodymium:YAG laser in postoperative follow-up after endonasal pansinus operation. *Laser Florence '99: a Window on the Laser Medicine World* 1999;**1**:218–21. [FESS not main focus]

Wreesmann VB, Fokkens WJ, Knegt PP. Refractory chronic sinusitis: evaluation of symptom improvement after Denker's procedure. *Otolaryngol Head Neck Surg* 2001;**125**:495–500. [FESS not main focus]

Appendix 4

Data extraction tables – randomised controlled trials

Reference and design	Intervention	Subjects	Outcome measures
Kurent and Zargi 1998[52] Slovenia *Study design*: randomised controlled trial	*Treatment*: endoscopic polypectomy and endoscopic ethmoidectomy *Postoperative interventions used*: topical steroids and saline physiological solution *Setting/type of anaesthesia*: not stated	*Total number of patients*: ethmoidectomy = 20 polypectomy = 20 *Indications for surgery*: massive bilateral nasal polyposis *Exclusion criteria*: none stated *Participant characteristics*: the two groups were similar for age, sex, presence of asthma, allergy and duration of symptoms *Bilateral disease/surgery*: 100%	*Primary and secondary outcome measures used*: polyp recurrence, success *Method of assessing outcomes*: polyp recurrence measured at endoscopic follow-up *Length of follow-up*: for 3 years

Results

Eleven out of 20 (55%) patients in the polypectomy group had no endoscopic evidence of polyp recurrence at follow-up, in six (30%) nasal polyposis reappeared and three (15%) patients were lost to follow-up. In the ethmoidectomy group there were no endoscopic signs of polyp recurrence in 13/20 (65%) patients, there were five (25%) cases of recidivant polyposis and two (10%) patients were lost to follow-up.

Complications were not stated.

Methodological comments

- Allocation to treatment groups random and secure: probably not random or secure, 'patients were alternatively placed into two groups'.
- Blinding: no.
- Comparability of treatment groups: yes for age, sex, duration of symptoms and presence of asthma and allergy.
- All patients given same intervention?: uncertain, no detailed description of the procedures is provided.
- Loss to follow-up?: yes 3/20 (15%) in polypectomy group and 2/20 (10%) in ethmoidectomy group.
- Sample size: no power calculations were reported.
- Method of data analysis: groups compared using Fisher's exact test; only one arm was reported based on ITT.

General comments

- Generalisability: low, cannot determine details of procedures. Exclusion criteria and patients' characteristics not provided.
- Main outcome measured independently: no.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Penttilä *et al.*, 1997[44] Finland *Study design*: Randomised controlled trial	*Treatment*: Functional middle meatal antrostomy (FESS) or radical CL operation with inferior meatal antrostomy *Postoperative interventions used*: Nasal suction, cleaning, antral irrigation *Setting/type of anaesthesia*: Not stated	*Total number of patients*: FESS = 75 CL = 75 *Indications for surgery*: Rhinogenous chronic maxillary sinusitis (52 FESS patients had polyps and 45 CL patients) *Exclusion criteria*: Patients whose disease had not lasted at least 3 months despite active treatment with repeated antral irrigations and antimicrobial therapy were excluded *Participant characteristics*: Average age of patients was 48 years (range 14–88) in the CL group and 47 years (range 16–84) in the FESS group. The male:female ratio was 36:39 in the CL group and 30:45 for FESS. 20/75 (27%) in the CL group had prior surgery and 18/75 (24%) in the FESS group. Duration of symptoms was not reported. 27% of the CL group and 25% of the FEES group had asthma, 17% and 14% of patients had ASA intolerance, respectively *Bilateral disease/surgery*: 40/75 (53%) in the the CL group and 60/75 (80%) in the FESS group	*Primary and secondary outcome measures used*: Improvement in symptoms, revision surgery, patency, complications *Method of assessing outcomes*: Patients rated symptomatic improvement in an interview as asymptomatic, distinct improvement, slight improvement, unchanged or worse postoperatively *Length of follow-up*: At 1 year and again 5–9 years after surgery

Results

Following surgery 36/71 (51%) of the CL group and 56/72 (78%) of the FESS group reported no symptoms or distinct improvement in their global symptoms. After 5–9 years 50/62 (81%) in the CL group and 50/66 (76%) in the FESS group were asymptomatic or distinctly improved. 10/71 (14%) CL patients reported no benefit at 1-year follow-up, as did 3/72 (4%) in the FESS group. After 5–9 years 6/62 (10%) CL patients and 5/66 (8%) FESS patients reported no benefit.

Revision surgery occurred for 13/62 (21%) in the CL group and 14/66 (21%) in the FESS group during the 7–9-year follow-up period.

At follow-up the middle meatus was open in 19% of the CL and 57% of FESS operations.

There were no major complications in either group.

Methodological comments

- Allocation to treatment groups random and secure: possibly random but not secure 'lots of equal numbers were drawn and a list was created, patients were put on the list in order of recruitment'.
- Blinding: no.
- Comparability of treatment groups: uncertain, similar for age, sex and prior surgery. More of the FESS group had bilateral disease.
- All patients given same intervention?: uncertain, no detailed description of the procedures is provided.
- Loss to follow-up?: yes, 7/150 patients were lost at 1-year follow-up and 22/150 were lost at 5–9-year follow-up. Some of these were lost due to death.
- Sample size: no power calculations were reported.
- Method of data analysis: descriptive statistics only.

General comments

- Generalisability: low, cannot determine details of procedures, and CL only applies to patients who had specific indications.
- Main outcome measured independently: no.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Venkatachalam and Bhat, 1998[51] New Delhi *Study design*: Randomised controlled trial	*Treatment*: FESS using Messerklinger technique. Conventional procedures included simple polypectomy with (5) or without CL (13), intranasal ethmoidectomy (4), external ethmoidectomy (2) *Postoperative interventions used*: Steroid nasal spray (budesonide) 2 puffs twice a day for 6 months *Setting/type of anaesthesia*: FESS 100% local. Conventional procedures local or general	*Total number of patients*: FESS = 25 Conventional techniques = 25 *Indications for surgery*: Nasal polyposis *Exclusion criteria*: Not stated *Participant characteristics*: Most patients were in the age group 20–39 years. The male:female ratio was 35:15. The duration of symptoms varied from 6 to 36 months. Prior surgery was not reported *Bilateral disease/surgery*:14/25 (56%) in the FESS group were bilateral and 11/25 (44%) in the conventional procedures group	*Primary and secondary outcome measures used*: Complications, relief of symptoms *Method of assessing outcomes*: Response to treatment was graded as complete (90–100% relief), good (75–90% relief), fair (50–75% relief) and poor/no response (<50% relief) *Length of follow-up*: Mean follow-up 16.5 months (range 6–30)

Results

In the FESS group 18/25 (72%) showed complete relief of symptoms, 3/25 (12%) good response, 1/25 (4%) fair response and 2/25 (8%) patients had no relief of symptoms. In the conventional procedures group 12/25 (48%) showed complete response 6/25 (24%) had good response, 3/25 (12%) had fair response and 3/25 (12%) had no relief of symptoms.

The following complications were recorded for the FESS group: bleeding 3/25 (12%), synechia 5/25 (20%), wound infection 4/25 (16%), orbital haematoma 0, CSF rhinorrhoea 0, loss of vision 0, lamina papyracea damage 1/25 (4%). In comparison the following complications were noted for the conventional procedures: bleeding 2/25 (8%), synechia 13/25 (52%), wound infection 7/25 (28%), orbital haematoma 2/25 (8%), CSF rhinorrhea 0, loss of vision 0 and lamina papyracea damage 2/25 (8%).

Methodological comments

- Allocation to treatment groups random and secure: uncertain, details not provided.
- Blinding: no.
- Comparability of treatment groups: uncertain, characteristics of each group are not provided.
- All patients given same intervention?: no, extent of surgery varied according to severity of disease.
- Loss to follow-up?: Yes, 2/50 (4%) patients (one from each group).
- Sample size: no power calculations were reported. Possible that study did not have sufficient power to detect a difference between groups.
- Method of data analysis: results reported on ITT basis.

General comments

- Generalisability: low, inclusion/exclusion criteria are not provided and patient characteristics are sparse.
- Main outcome measured independently: uncertain.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Appendix 5

Data extraction tables – non-randomised comparative studies

Reference and design	Intervention	Subjects	Outcome measures
Harkness *et al.*, 1997[37] UK *Study design*: Comparative (historical)	*Treatment*: FESS compared with conventional procedures (including sphenoid sinus drainage, BAWO, frontal sinus drainage, nasal polypectomy, external ethmoidectomy, intra-ethmoidectomy, CL and BINA) *Postoperative interventions used*: None stated. Postoperative steroid use not stated *Setting/type of anaesthesia*: 18% of all procedures were day cases. 6.5% of surgery was performed under local anaesthesia	*Total number of patients*: FESS = 1064 Conventional procedures = 1459 *Indications for surgery*: 46% of patients had chronic rhinosinusitis, 37% polyposis, 10% recurrent sinusitis and 7% miscellaneous *Exclusion criteria*: None stated *Participant characteristics*: Average age of patients was 45 years (range 2–89) and the male:female ratio was 56:44. Duration of symptoms and number of previous sinus procedures were not reported *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: Complications and relief of symptoms *Method of assessing outcomes*: ENT surgeon record of surgical outcomes at follow-up visit *Length of follow-up*: Maximum of 6 months

Results

Percentage of patients asymptomatic/improved at 6 months was as follows:

Primary symptom	Conventional	FESS
Blockage	70	84
Pain	47	75
Discharge	47	76
Polyposis	82	82

Patients diagnosed with nasal polyps reported symptomatic improvements whether having conventional or functional endoscopic surgery.

Complication rates were 0.75% for conventional surgery and 1.41% for FESS. For FESS the following complications were noted: numbness of upper teeth (n = 2), periorbital bruising (n = 2), orbital fat exposure (n = 5) and single complications such as orbital emphysema, secondary haemorrhage, palatal ulceration, sphenopalatine haemorrhage, sphenopalatine adhesions and primary haemorrhage. For conventional surgery the following complications were reported: exposure of periorbital fat (n = 1), periorbital bruising (n = 2), cheek oedema (n = 1), dental infection (n = 1), diplopia (n = 1), anosmia (n = 1), septal perforation (n = 1), secondary haemorrhage (n = 1), nasal crusting (n = 1) plus one unspecified complication.

Methodological comments

- Allocation to treatment groups: historical study, not randomised.
- Blinding: no.
- Comparability of treatment groups: uncertain, no details of baseline characteristics are given.
- All patients given same intervention?: uncertain, no detailed description of what is meant by the term FESS in each institution is provided, many different centres and surgeons were performing the procedure so it is highly likely that it varied.
- Loss to follow-up?: no, owing to retrospective nature of study.
- Sample size: No power calculations were reported although sample appears adequate.
- Method of data analysis: descriptive statistics only.

General comments

- Generalisability: low, inclusion and exclusion criteria were not defined. Cannot determine characteristics of patients or details of procedures.
- Main outcome measured independently: no.
- Inter-centre variability: not assessed; this is a large potential source of bias.
- Conflicts of interest: funded by UK Department of Health.

Reference and design	Intervention	Subjects	Outcome measures
Jankowski *et al.*, 1997[41] France *Study design*: Retrospective comparative	*Treatment*: Functional ethmoidectomy compared to radical ethmoidectomy (nasalisation) *Postoperative interventions used*: All patients received postoperative steroid spray (600 μg beclomethasone/day) and a single dose of depot corticosteroid intramuscularly the day after surgery *Setting/type of anaesthesia*: Not stated	*Total number of patients*: 37 functional ethmoidectomy 39 radical nasalisation *Indication for surgery*: Diffuse nasal polyposis *Exclusion criteria*: None stated *Participant characteristics*: Functional ethmoidectomy group average age 44 years (range 26–65), male:female ratio 20:9, mean duration of symptoms 10.4 years (range 1–40), previous surgery 15/29. For the nasalisation group average age 47.2 years (range 28–71), male to female ratio 24:10, mean duration of symptoms 13.7 years (range 2–40), previous surgery 24/34. *Bilateral disease/surgery*: 100%	*Primary and secondary outcome measures used*: Nasal functional benefit, sense of smell, asthma symptoms, postoperative steroid use, revision surgery and complications *Method of assessing outcomes*: Benefit and smell were measured on a questionnaire including a 10-point visual analogue scale posted to patients (0 = no functional improvement and 10 = recovered a normally functioning nose) *Length of follow-up*: Mean 34 months (range 32–36) for nasalisation group and 24 months (range 18–31) for the functional ethmoidectomy group

Results

Overall functional benefit of surgery mean visual analogue scale score was 8.8 ± 0.22 in the nasalisation group compared with 5.92 ± 0.64 in the ethmoidectomy group ($p = 0.0001$). In the nasalisation group 16/33 patients reported regaining a normally functioning nose compared with 3/29 in the ethmoidectomy group. In the nasalisation group 31/34 patients compared with 23/29 in the ethmoidectomy group reported having a decreased sense of smell. Asthma showed greater improvement at 24 months in the nasalisation than the ethmoidectomy group ($p = 0.04$). In patients with nasal polyposis there was no difference between groups in terms of steroid use. In the nasalisation group 2/34 patients and 4/29 in the ethmoidectomy group required revision surgery within 2 years.

No intra-operative complications were reported for either group. Three patients in the nasalisation group experienced severe postoperative headaches.

Methodological comments

- Allocation to treatment groups: historical study, non-randomised.
- Blinding: no.
- Comparability of treatment groups: similar for age, sex and duration of symptoms. More polyps in the functional ethmoidectomy group, more asthma and prior surgery in the nasalisation group. Patients were enrolled in different time periods.
- All patients given same intervention?: no, the nasalisation procedure was standardised, whereas the ethmoidectomy procedure varied according to extent of disease. Both procedures were performed by single surgeons.
- Loss to follow-up?: yes, 5/34 patients in the nasalisation group and 12/29 were not accounted for at 24 months follow-up.
- Sample size: no power calculations were reported.
- Method of data analysis: chi-squared or Fisher's exact test to compare proportions and Mann–Whitney *U*-test to compare means. No ITT performed.

General comments

- Generalisability: medium, details of patient group and procedures are provided, but few data were available regarding exclusion criteria.
- Main outcome measured independently: yes.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Ünlü *et al.*, 1994[45] Turkey *Study design*: Retrospective comparative	*Treatment*: ESS (Messerklinger techniques preserving maxillary sinus mucosa where possible and middle meatal antrostomy performed). CL (maxillary sinus mucosa removed and inferior metal antrostomy opened) *Postoperative interventions used*: None stated *Setting/type of anaesthesia*: Not stated	*Total number of patients*: ESS = 50 CL = 50 *Indication for surgery*: Chronic/recurring acute rhinosinusitis (8/37 in CL group with polyps and 14/40 in ESS group with polyps) *Exclusion criteria*: Patients either with a mucocele or who had undergone ESS following CL were excluded *Participant characteristics*: Average age of patients was 40 years (range 18–65) in the ESS group. The male:female ratio was 20:17 in the CL group and 20:20 for ESS. Duration of symptoms and number of previous sinus surgery procedures were not reported *Bilateral disease/surgery*: 13/37 (35%) for the CL group and 20/40 (50%) for ESS	*Primary and secondary outcome measures used*: Patency, postoperative relief of symptoms, recurrent residual infection, postoperative sequelae *Method of assessing outcomes*: Follow-up endoscopy; method for assessing symptom improvement not stated *Length of follow-up*: Median CL 18 months (range 5–62) and median ESS 13 months (range 3–36)

Results

Total improvement in symptoms for the CL group was 16/37 (43%) and 34/40 (85%) for the ESS group. Marked improvement occurred in 3/37 (8%) of the CL group compared to 22/40 (55%) in the ESS group. Mild improvement occurred for 13/37 (35%) in the CL group and 12/40 (30%) in the ESS group. There was no change in symptoms for 13/37 (35%) in the CL group and 3/40 (8%) in the ESS group. Symptoms were worse following surgery for 3/37 (8%) in the CL group and none in the ESS group.

Recurrence of disease occurred for 5/37 (14%) of the CL group and 3/40 (8%) of the ESS group. Patency of the middle/inferior meatus occurred in 24/50 (48%) of CL sides and 52/60 (87%) ESS sides.

Methodological comments

- Allocation to treatment groups: historical study, non-randomised, although retrospective cases were randomly selected.
- Blinding: no.
- Comparability of treatment groups: uncertain, similar for age, sex presence of allergy and asthma. A significantly longer period had passes since surgery to time of evaluation for the CL group. More ESS patients had bilateral disease/procedure.
- All patients given same intervention?: no, details of the procedure were not provided. It is likely that procedures varied during the 7-year study inclusion period.
- Loss to follow-up?: yes, 23/100 (23%) did not return to be evaluated.
- Sample size: no power calculations were reported. It is possible that study did not have sufficient power to detect a difference between groups.
- Method of data analysis: groups were compared using Fisher's exact test, chi-squared test and *t*-tests for unpaired groups.

General comments

- Generalisability: low, inclusion and exclusion criteria were not defined. Cannot determine details of procedures. The results of the CL procedure are of limited generalisability.
- Main outcome measured independently: no.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Appendix 6

Data extraction tables – case series studies where all patients have nasal polyps

Reference and design	Intervention	Subjects	Outcome measures
Klossek *et al.*, 1997[55] USA, France and Canada *Study design*: Case series	*Treatment*: Bilateral total sphenoethmoidectomy with wide middle antrostomies and frontal irrigation *Postoperative interventions used*: Topical steroids 2× daily (4 mg prednisolone), long-term topical beclomethasone 2× daily *Setting/type of anaesthesia*: Not stated	*Total number of patients*: 50 *Indication for surgery*: Extensive nasal polyposis with hyperplastic disease involving all sinuses and no response to therapy (stage 4) *Exclusion criteria*: Not stated *Participant characteristics*: mean age 46.7 years (range 18–66), male:female ratio 27:23. Duration of symptoms and previous surgery were not reported. 12/50 patients had asthma alone, 14 had ASA triad and 21 had asthma and allergy *Bilateral disease/surgery*: 100%	*Primary and secondary outcome measures used*: Improvement in symptoms, complications, medication use, polyp recurrence *Method of assessing outcomes*: Clinical symptoms were recorded at each follow-up visit by a subjective questionnaire. Improvement scales were classified as no improvement, mild improvement and marked improvement. Endoscopic examination *Length of follow-up*: For at least 3 years

Results

Overall, 96% of patients reported an improvement in symptoms at the time of their final follow-up visit. At 3-year follow-up 46/50 were free of nasal obstruction, 39/50 retained sense of smell, 14/48 were free of post-nasal discharge. Sixteen of 47 patients with asthma had reductions in their medical therapy for asthma. Polyps recurred in 3% of posterior ethmoids, 23% of anterior ethmoids and 49% of frontal recesses.

No major complications were encountered.

Methodological comments

- Prospective?: yes.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: yes, same surgeon performed all surgeries, all patients received same procedure.
- Loss to follow-up?: no, three patients who received frontal surgery were not able to be reported on objectively as they had a unilateral absence of a frontal sinus.
- Method of data analysis: descriptive data only.

General comments

- Generalisability: low, no exclusion/inclusion criteria provided, only generalisable to patients with extensive nasal polyposis (stage 4).
- Main outcome measured independently: yes.
- Inter-centre variability: not assessed.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Stoop *et al.*, 1992[46] The Netherlands *Study design*: Case series	*Treatment*: Endoscopic sinus surgery *Postoperative interventions used*: Topical corticosteroids (budesonide 400 μg daily) *Setting/type of anaesthesia*: Not stated	*Total number of patients*: 72 *Indication for surgery*: Nasal polyps (extensive polyposis 44%) *Exclusion criteria*: Not stated *Participant characteristics*: mean age 44 years (range 16–72). Male:female ratio, duration of symptoms and previous surgery were not reported. 28% had allergy, 44% asthma/bronchitis/ emphysema, allergy and asthma 18% *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: Polyp recurrence *Method of assessing outcomes*: Not stated *Length of follow-up*: 6–12 months

Results

Polyp recurrence at 6 months was 36/72 (50%) of patients, and at 12 months was 40/72 (56%). Only in patients with extensive polyposis and an IgE-mediated allergy a significantly higher recurrence rate was found at 1 year (9/11, 82%) compared to the remaining group (combinations of polyposis, allergy and asthma; $p = 0.05$).

Methodological comments

- Prospective?: yes.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: uncertain, no details of procedure are provided.
- Loss to follow-up?: no for clinical data.
- Method of data analysis: descriptive data only.

General comments

- Generalisability: low, no exclusion/inclusion criteria provided.
- Main outcome measured independently: uncertain.
- Inter-centre variability: not applicable.
- Conflicts of interest: no, funded by Dutch Asthma Foundation.

Reference and design	Intervention	Subjects	Outcome measures
Ünlü *et al.*, 1994[45] Turkey *Study design*: Retrospective comparative study	*Treatment*: ESS (Messerklinger technique preserving maxillary sinus mucosa where possible and middle meatal antrostomy performed) and CL (maxillary sinus mucosa removed and inferior meatal antrostomy opened) *Postoperative interventions used*: None stated. *Setting/type of anaesthesia*: Not stated	*Total number of patients*: ESS = 50 CL = 50 *Indications for surgery*: Chronic/recurring acute rhinosinusitis (8/37 in CL group with polyps and 14/40 in ESS group with polyps) *Exclusion criteria*: Patients either with a mucocele or who had undergone ESS following CL were excluded *Participant characteristics*: Average age of patients was 40 years (range 18–65) in the CL group and 36 years (range 18–68) in the ESS group. The male:female ratio was 20:17 in the CL group and 20:20 for ESS. Duration of symptoms and number of previous sinus procedures were not reported *Bilateral disease/surgery*: 13/37 (35%) for CL group and 20/40 (50%) for ESS group	*Primary and secondary outcome measures used*: Patency, postoperative relief of symptoms, recurrent residual infection, postoperative sequelae *Method of assessing outcomes*: Follow-up endoscopy, method for assessing symptom improvement not stated *Length of follow-up*: Not stated

Results

Total improvement in symptoms for the CL group was 16/37 (43%) and for the ESS group 34/40 (85%). Marked improvement occurred in 3/37 (8%) of CL patients compared with 22/40 (55%) in the ESS group. Mild improvement occurred for 13/37 (35%) in the CL group and 12/40 (30%) in the ESS group. There was no change in symptoms for 13/37 (35%) in the CL group and 3/40 (8%) in the ESS group. Symptoms were worse following surgery for 3/37 (8%) in the CL group and 0 in the ESS group.

Recurrence of disease occurred for 5/37 (14%) of the CL group and 3/40 (8%) of the ESS group. Patency of the middle/inferior meatus occurred in 24/50 (48%) CL sides and 52/60 (87%) ESS sides.

Methodological comments

- Allocation to treatment groups: historical study, patients not randomised to groups, although retrospective cases were selected randomly.
- Blinding: no.
- Comparability of treatment groups: yes for age, sex, presence of allergy and asthma. A significantly longer period had passed since surgery to the time of evaluation for patients who underwent CL. More patients in the ESS group had bilateral disease/procedure.
- All patients given same intervention?: uncertain, no details of the procedure were provided. It is likely that procedures varied during the 7-year inclusion period.
- Loss to follow-up?: no, owing to retrospective nature of study.
- Sample size: no power calculations were reported. It is possible that the study did not have sufficient power to detect a difference between groups.
- Method of data analysis: groups were compared using Fisher's exact test, chi-squared test and *t*-tests for unpaired groups.

General comments

- Generalisability: low, inclusion and exclusion criteria were not defined. Cannot determine details of procedures. The results of the CL procedure are only generalisable to patients for whom this procedure is indicated.
- Main outcome measured independently: uncertain.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Weber *et al.*, 1997[54] Germany and India *Study design*: Case series	*Treatment*: Endonasal microendoscopic pansinus operation (method previously described at Hospital Fulda, Germany) *Postoperative interventions used*: Patients received 2 × 50 μg budesonide (topical steroid) for several months postoperatively *Setting/type of anaesthesia*: Not stated	*Total number of patients*: 325 *Indication for surgery*: Bilateral chronic polypoid ethmoid sinusitis *Exclusion criteria*: None stated *Participant characteristics*: age, sex, duration of symptoms and previous surgery were not stated *Bilateral disease/surgery*: 100%	*Primary and secondary outcome measures used*: Improvement in symptoms, success, complications *Method of assessing outcomes*: Standard patient interview and postoperative endoscopic examination (questionnaire was sent to patients who failed to attend follow-up) *Length of follow-up*: 20 months to 10 years

Results

Eighty-nine per cent of patients stated improvement or complete freedom from complaints, 9% reported being unchanged and 2% reported impairment. The maxillary sinus antrostomies appeared open endoscopically in 69% of patients followed up. Recurrently polyposis in the ethmoid region was present on endoscopic follow-up in 25% of patients, and 13% in the maxillary sinus mucosa. An overall success rate of 92% was obtained from endoscopic follow-up and subjective assessments.

Of the 325 patients, severe bleeding arose in 30 cases and 12 patients required packed erythrocyte concentrate transfusion. In 650 operations, 2.3% had CSF leak, 1.4% lesion of periorbit, 0.8% numbness of teeth or lips, 3.7% blood transfusion and 0.3% had injury of internal carotid artery.

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled? yes.
- All patients given same intervention?: uncertain, study involved 15 surgeons and two centres.
- Loss to follow-up?: yes, 155 patients did not attend follow-up, of whom 22 returned their questionnaires.
- Method of data analysis: descriptive results only.

General comments

- Generalisability: low, inclusion and exclusion criteria were not defined.
- Main outcome measured independently: no, except for patients who failed to attend follow-up.
- Inter-centre variability: not assessed.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Wigand and Hosemann, 1989[22] Germany *Study design*: Case series	*Treatment*: Endoscopic ethmoidectomy (4 types, exposure of ostio-meatal complex, anterior or posterior partial ethmoidectomy and complete ethmoidectomy) *Postoperative interventions used*: Not stated *Setting/type of anaesthesia*: Not stated	*Total number of patients*: 220 *Indication for surgery*: Nasal polyposis *Exclusion criteria*: Not stated *Participant characteristics*: age, sex, duration of symptoms and previous surgery were not stated *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: Subjective relief of symptoms and morphological recovery, complications *Method of assessing outcomes*: Surgeon assessment *Length of follow-up*: Not stated

Results

According to subjective evaluation there was complete success in 53/220 patients, successful treatment in 54/220, improvement in 73, no definite improvement in 27 and failure in 13. Endoscopic evaluations revealed normal aspects in 88/168 ethmoid procedures, 123/129 sphenoid procedures and 119/165 maxillary sinus procedures. Recurrent polyposis was present on postoperative endoscopic examination in 30/168 ethmoid procedures, 2/165 maxillary sinus procedures and no sphenoid procedures.

A series of 600 ethmoidectomies were available for the examination of complications. No major complications were encountered. A total of 3% of patients experienced loss of olfactory sensation, 0.3% CSF leak, 0.5% obstruction of lacriminal duct and 0.5% postoperative meningitis.

Methodological comments

- Prospective?: uncertain.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: no, extent of surgery varied according to severity of disease.
- Loss to follow-up?: uncertain.
- Method of data analysis: descriptive data only.

General comments

- Generalisability: low, no exclusion criteria were reported. Only generalisable to patients with nasal polyps.
- Main outcome measured independently: no.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Appendix 7

Data extraction tables – case series studies with mixed patients (polyps and non-polyps) but results reported separately

Reference and design	Intervention	Subjects	Outcome measures
Danielson and Olofsson, 1996[39] Norway *Study design*: Case series	*Treatment*: Endoscopic endonasal surgery exclusively based upon Messerklinger method *Postoperative interventions used*: 60% of patients received steroid treatment postoperatively *Setting/type of anaesthesia*: 91% of patients were operated on a day-care outpatient basis	*Total number of patients*: 230 *Indications for surgery*: Patients with nasal/paranasal complaints remitted for further treatment. 39% sinusitis, 40% nasal polyposis *Exclusion criteria*: None stated *Participant characteristics*: Age ranged 2–79 years, male: female ratio 125:105, 18/92 patients with polyps had previous 12 years surgery and mean symptom period *Bilateral disease/surgery*: 42%	*Primary and secondary outcome measures used*: Complications, symptom score, mucosa properties and recurrent polyps. *Method of assessing outcomes*: Subjective assessment by surgeon at postoperative follow-up consultations. Examination including endoscopy. Follow-up questionnaire where patients rated symptoms (1 = absence of symptoms and 5 = worsened condition) *Length of follow-up*: Mean follow-up 3 years 5 months

Results

Ninety-two patients were included in group 2, the patients with nasal polyposis. These patients were further classified into three stages; (1) polyps visible in the middle meatus; (2) polyps protruding from the middle meatus; and (3) large polypoid masses occluding the nasal cavity. After mean follow-up of 3 years 5 months, 3/18 in stage 1, 7/30 in stage 2 and 20/44 in stage 3 had improved. On endoscopic follow-up, 8/18 in stage 1, 5/30 in stage 2 and 0/44 in stage 3 showed a normal mucosa. 30/92 patients with polyps improved, 25 slightly improved, 18 were unchanged and none were worse.

The following peroperative complications occurred: profuse bleeding (8/92) and perforation of the papyraceous lamina (4/92). Postoperative complications included 3/18 stage 1 patients with scarring. Persisting polyps according to endoscopy occurred in 5/18 stage 1, 12/30 stage 2 and 28/44 stage 3 patients. In all patients 10/230 experienced profuse bleeding and 6/230 perforation of papyraceous.

Methodological comments

- Prospective?: yes.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: yes.
- Loss to follow-up?: yes. At final follow-up 216/230 answered questionnaire plus attended examination, 10 answered questionnaire only and four had died.
- Method of data analysis: descriptive statistics only, no ITT performed.

General comments

- Generalisability: low, details of inclusion and exclusion criteria were not provided.
- Main outcome measured independently: yes.
- Inter-centre variability: not applicable.
- Conflicts of interest: supported by Glaxo and Syntex, Norway.

Reference and design	Intervention	Subjects	Outcome measures
Friedman *et al.*, 2000[25] USA *Study design*: Case series	*Treatment*: Frontal sinus surgery with endoscope *Postoperative interventions used*: None stated *Setting/type of anaesthesia*: Not reported	*Total number of patients*: 200 *Indication for surgery*: Persistent chronic sinusitis. Polyposis in 68/200 patients *Exclusion criteria*: Patients with prior ethmoidectomy were included and patients with prior frontal sinus surgery were excluded *Participant characteristics*: Mean age 41 years (range 14–76) and 30/200 had undergone previous surgery. Gender and duration of symptoms were not reported *Bilateral disease/surgery*: 49%	*Primary and secondary outcome measures used*: Patency, complications, improvement in symptoms, revision surgery *Method of assessing outcomes*: Follow-up endoscopic examination with transillumination. Patient reports of improvement at follow-up (significant improvement, some improvement, little or no improvement, worsening) *Length of follow-up*: Mean 12.2 months (range 6–30.5)

Results

Postoperative assessment of patency by placing a flexible endoscope below the frontal ostium showed positive illumination in 68/200 frontal sinuses. In patients with polypoid disease, 61/68 showed positive illumination. There were 151/200 patients who reported significant improvement, 31 reported some improvement, 16 reported little or no improvement and two felt worse after surgery. Eleven of 298 patients required revision surgery.

Three patients had periorbital fat exposure intraoperatively. Minor complications included symptomatic middle turbinate lateralisation (6), postoperative bleeding (5) and septal haematoma (4). No major complications were reported.

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: yes.
- All patients given same intervention?: no, two separate techniques are described for different stages of disease.
- Loss to follow-up?: no.
- Method of data analysis: descriptive data only.

General comments

- Generalisability: medium, results are only generalisable to patients undergoing frontal surgery and are not generalisable to revision frontal surgery.
- Main outcome measured independently: uncertain.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Jacobs, 1997[29] USA *Study design*: Case series	*Treatment*: Endoscopic ethmoidectomy with frontal sinusotomies, using modified Messerklinger approach *Postoperative interventions used*: Steroid nasal inhaler was used for 5 days postoperatively *Setting/type of anaesthesia*: Setting not stated, usually general anaesthesia	*Total number of patients*: 112 *Indications for surgery*: 30 patients with diffuse sinonasal polyposis, 21 with middle meatal polyposis, 21 with encroaching cells, 15 hyperplastic sinusitis, 10 frontal recess stenosis and 4 frontal mucocele *Exclusion criteria*: Excluded patients without a minimum of 6 months follow-up or if they had less than 6 postoperative endoscopic evaluations *Participant characteristics*: Age range 17–72 years. 32/112 had undergone previous surgery. Gender and duration of symptoms were not reported *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: Improved symptoms, residual disease, patency, complications *Method of assessing outcomes*: Routine examinations including endoscopic examination at 6 months. Patients self-rating of improvement in symptoms (interview) on a scale of significant, some, none or worse. *Length of follow-up*: Mean follow-up 16 months (range 6–42)

Results

In the 51 patients with polyps 37 reported significant improvement in symptoms at the time of final follow-up, nine reported some improvements, and five reported little or no improvement. No patients felt that they were worse after surgery. For the 51 patients with polyps there were 81 operative sites of which 61 were abnormal due to the presence of residual disease at follow-up. Patency to the ostium was present postoperatively at 24 of 61 surgical sites. Overall 70/101 patients reported significant improvement, 15/101 some improvement and 16/101 no improvement.

No major complications are reported in the study. One patient experienced persistent postoperative bleeding, one developed brief periorbital ecchymoses and three patients had preorbital fat exposure but no adverse effects.

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: no, extent of surgery varied depending on extent of disease.
- Loss to follow-up?: yes, 11/112 were lost to follow-up.
- Method of data analysis: differences between groups assessed using chi-squared test with $\alpha = 0.05$, no ITT performed.

General comments

- Generalisability: medium, results are only generalisable to patients undergoing combination ethmoidectomy and frontal sinusotomy. Details of inclusion criteria not provided in detail.
- Main outcome measured independently: uncertain.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Jakobsen and Svendstrup, 2000[40] Denmark *Study design*: Case series	*Treatment*: Functional endoscopic sinus surgery (according to principles described by Stammberger) *Postoperative interventions used*: No postoperative treatment stated *Setting/type of anaesthesia*: All patients received general anaesthetic	*Total number of patients*: 237 *Indications for surgery*: Chronic infectious sinusitis (n = 91), varying degrees of nasal polyps/polyposis (n = 146) *Exclusion criteria*: Not stated *Participant characteristics*: male:female ratio 141:96, average age 45.7 years (range 11–92). 24/237 patients had previous nasal surgery. Average duration of symptoms 9.3 years (range 1–50) *Bilateral disease/surgery*: 80%	*Primary and secondary outcome measures used*: Improvement in symptoms, polyp recurrence, complications, revision surgery *Method of assessing outcomes*: Patients were asked about general impression of symptoms at follow-up such as lack of symptoms, improvement, no improvement or worsening *Length of follow-up*: 1 year

Results

Marked subjective improvement was seen in patients with nasal polyps postoperatively for the following symptoms: stenosis, anosmia, secretion, maxillary pain, frontal pain and headache. Recurrence of polyps was seen in 28% and synechia in 20% of patients. Objective improvement postoperatively was noted for nasal stenosis, nasal discharge, polyps and pain. At 1-year follow-up the overall number of patients symptom free was 103/231, 102/231 felt better, 25/231 were unchanged and one patient felt worse according to self-reports. At 1-year follow-up 43% of nasal polyp patients reported having improved symptoms, 50% reported being symptomless and 8% reported being unchanged. There were 21/237 patients requiring revision surgery.

Annoying bleeding was reported in 50/237 (21%) of patients and rhinoliquorrhoe in 3/237 patients. No significant operative complications regarding orbita or the optic nerve were noted.

Methodological comments

- Prospective?: yes.
- Consecutive patients enrolled?: yes.
- All patients given same intervention?: uncertain, extent of surgery varied with severity. The minimum necessary surgical intervention was undertaken to create ventilation and drainage of affected sinuses.
- All patients accounted for?: yes, 6/237 patients were lost to follow-up.
- Method of data analysis: only descriptive statistics reported, no ITT performed.

General comments

- Generalisability: low, difficult to determine severity of disease and exact extent of surgery.
- Main outcome measured independently: uncertain.
- Inter-centre variability: not applicable.
- Conflicts of interest: not stated.

Reference and design	Intervention	Subjects	Outcome measures
Jiang and Hsu, 2001[53] Taiwan *Study design*: Case series	*Treatment*: ESS involving an operation on or via at least one sinus with an endoscope *Postoperative interventions used*: Not stated *Setting/type of anaesthesia*: 726/1227 (59%) were performed under local anaesthetic	*Total number of patients*: 1112 (GESS 171 aged 65 plus year, FESS 837 aged 17–64 and PESS 104 aged 16 or younger) *Indication for surgery*: Chronic sinusitis, 628/1227 surgeries for no polyps, 562/1227 surgeries for polyps, 37/1227 surgeries for choanal polyps *Exclusion criteria*: None stated *Participant characteristics*: Overall mean age for children of 12.6 years and adults 43.4 (range 5–84), male:female ratio 695:417, duration of symptoms and previous surgery not reported *Bilateral disease/surgery*: 78%	*Primary and secondary outcome measures used*: Complications, improved symptoms *Method of assessing outcomes*: File review and questionnaire (improved or unimproved symptoms) *Length of follow-up*: For patients with nasal polyps (n = 248) from 7 to 126 months

Results

GESS (aged 65 plus years)

For 14/97 procedures for nasal polyps no symptoms were reported postoperatively, 29 had improved, three were unchanged and two reported that they had worsened. For the two GESS procedures for antrochoanal polyps (where answers to the survey were available) both reported that their symptoms had improved.

FESS (aged 17–64)

For 16/418 procedures for nasal polyps no symptoms were reported postoperatively, 129 had improved, 25 were unchanged and seven reported that they had worsened. Of the nine FESS procedures for antrochoanal polyps (where answers to the survey were available) two reported no symptoms, six had improved and one reported that they had worsened.

PESS (aged 16 years or younger)

For 3/47 procedures for nasal polyps no symptoms were reported postoperatively, 16 had improved, two were unchanged and one reported that they had worsened. Of the seven PESS procedures for antrochoanal polyps (where answers to the survey were available) one reported no symptoms and five had improved.

Complications occurred for 121/1227 procedures. Orbital fat extrusion in 37 procedures and periorbital exposure in seven, blood transfusion in 27 and epistaxis in 26. Surgery was halted owing to pain in eight procedures, nasolacriminal duct injury in six, dural exposure in two, CSF leak in three, diplopia in three, atrophic rhinitis in one and unremoved nasal pack in one.

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: no.
- All patients given same intervention?: no, unlikely that same surgeon performed all procedures, extent of surgery varied with severity of disease.
- Loss to follow-up?: yes, 1112 questionnaires were sent to patients and 547 were returned.
- Method of data analysis: descriptive analysis only.

General comments

- Generalisability: low, exclusion criteria were not stated.
- Main outcome measured independently: yes.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Katsantonis *et al.*, 1994[23] USA *Study design*: Case series	*Treatment*: Modified Yankauer sphenoethmoidectomy technique (marsupialisation: removal of middle turbinate, complete extirpation of anterior ethmoid cells and an extended middle meatal maxillary antrostomy) *Postoperative interventions used*: Not stated *Setting/type of anaesthesia*: Usually local anaesthesia	*Total number of patients*: 972 *Indication for surgery*: Chronic hyperplastic rhinosinusitis, recurrent nasal polyposis, sinobronchial syndrome, and recurrent purulent pansinusitis *Exclusion criteria*: Not stated *Participant characteristics*: Age, sex, duration of symptoms and previous surgery were not stated. 260/972 patients were asthmatics *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: Recurrent rates, complications *Method of assessing outcomes*: Follow-up examination *Length of follow-up*: 6–30 months, mean 14 months

Results

Results are provided for the following stages: (1) single focus disease; (2) multifocal but not contiguous; (3) complete and contiguous opacification of the ethmoid with or without maxillary, frontal and sphenoid sinus involvement; partially responsive to medication and (4) contiguous disease-associated demineralisation of ethmoidal cells septi and or massive involvement of all paranasal sinuses; non-responsive to medication.

Recurrence rates for stage 2 were 30/512, stage 3 44/270 and stage 4 46/190 patients.

There was one major complication which was an orbital haematoma and there were 11 minor complications which included asthma (4), periorbital oedema (1), epistaxis (2) and crusting (4).

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: no, not all patients were followed up.
- All patients given same intervention?: no, extent of surgery depended on severity of disease.
- Loss to follow-up?: uncertain, not all patients undergoing procedure were included in study (only 972/1085 patients).
- Method of data analysis: descriptive results only.

General comments

- Generalisability: low, owing to lack of exclusion criteria. Results are only generalisable to patients undergoing sphenoethmoidectomy procedures.
- Main outcome measured independently: no.
- Inter-centre variability: not assessed.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Kennedy, 1992[30] USA *Study design*: Case series	*Treatment*: Endoscopic ethmoid surgery. In some cases a KTP/532 or holmium:YAG laser was used *Postoperative interventions used*: Polypoid patients restarting oral prednisone prior to surgery had this treatment tapered postoperatively *Setting/type of anaesthesia*: Almost all procedures were performed under local anaesthesia	*Total number of patients*: 120 *Indication for surgery*: Non-polypoid disease (49/120), middle meatal polyposis (37/120) and diffuse polyposis (34/120) *Exclusion criteria*: Patients were excluded if they did not return for follow-up examination *Participant characteristics*: Age range 15–77 years and 85/120 patients had undergone previous surgery. Gender and duration of symptoms were not stated *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: Improvement in symptoms, healing of nasal cavity, revision surgery *Method of assessing outcomes*: Follow-up nasal endoscopy, patient postoperative questionnaire asking them to scale their overall improvement and improvement for specific symptoms (either posted or given at follow-up) as no improvement (25%), mild improvement (25–50%), marked improvement (>50%) *Length of follow-up*: Mean period of endoscopic follow-up was 18 months (range 3–51)

Results

An improvement in symptoms was reported in 97.5% of patients at the time of the final follow-up examination (85% marked improvement, 12.5% mild improvement, 2.5% no improvement or worse). Forty-five per cent of operated sides were abnormal on follow-up with endoscopy. Evidence of residual or recurrent polyposis was seen in 5% of the cavities operated on at final examination. Five of 120 patients underwent residual ethmoid surgery.

No major complications were encountered. One patient developed mild bronchospasm during the procedure but this did not require termination.

Methodological comments

- Prospective?: data collection was both retrospective and prospective.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: no, extent of surgery varied according to extent of disease, in some cases a laser was used. Adjunctive medical therapy also varied according to extent of disease.
- Loss to follow-up?: yes, patients who were excluded because they did not return for follow-up did not differ significantly in their subjective symptom improvement scores from those who did return.
- Method of data analysis: the retrospective patients did not differ significantly from the prospective patients in their subjective symptom improvement scores. Results were descriptive, odds ratios and chi-squared values were provided.

General comments

- Generalisability: medium, few details of exclusion/inclusion criteria provided.
- Main outcome measured independently: yes.
- Inter-centre variability: not assessed, some patient data were collected in Egypt.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Lawson, 1991[31] USA *Study design*: Case series	*Treatment*: Conventional intranasal ethmoidectomy with endoscope, modification of Yankauer technique *Postoperative interventions used*: Steroid use not reported postoperatively *Setting/type of anaesthesia*: Local or general anaesthesia	*Total number of patients*: 90 *Indication for surgery*: Focal (21), pansinusitis (9), panpolyposis (24), asthma/sinusitis (7), asthma/polyps (29) *Exclusion criteria*: Patients who could not be reached by mail or telephone to participate in follow-up *Participant characteristics*: mean age 48.8 years (range 21–81), male:female ratio 60:30 and 36/90 patients had previous surgery. Duration of symptoms was not reported *Bilateral disease/surgery*: 79%	*Primary and secondary outcome measures used*: Surgical success, disease recurrence, improved symptoms, complications *Method of assessing outcomes*: Follow-up examination by surgeon. Patient rating of improvement of symptoms at follow-up (improved, unchanged or worse) *Length of follow-up*: mean 42 months (range 2–14 years)

Results

Success rate 73%: focal disease 90%, diffuse sinusitis 100%, pansinusitis and asthma 57%, asthmatics and panpolyposis 48%. Recurrence rates for asthma–aspirin sensitivity–nasal polyp triad were 44%. Of those with asthma, 33% reported improved symptoms after surgery, 66% unchanged and 10% worse. Nineteen of 90 experienced recurrent polyp disease.

Complications of 1077 procedures included CSF leaks (3), orbital haematomas (2), periorbital ecchymosis and emphysema (3), haemorrhages (2), epiphora (2). Overall incidence of complications: 1.1%.

Methodological comments

- Prospective?: yes, for follow-up questionnaire.
- Consecutive patients enrolled?: no.
- All patients given same intervention?: uncertain, the study selects patients who underwent surgery retrospectively so technique is likely to have varied, dependent on disease location and severity.
- Loss to follow-up?: uncertain, only 90 of the 1077 procedures performed were able to be followed up and included in the study.
- Method of data analysis: no ITT performed, and there was significant loss to follow-up.

General comments

- Generalisability: medium, owing to only a small proportion of the sample being followed.
- Main outcome measured independently: uncertain.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Levine, 1990[32] USA *Study design*: Case series	*Treatment*: FESS modified Messerklinger technique, some patients with massive polyps had them debulked with a KTP/532 laser *Postoperative interventions used*: Aqueous beclomethasone nasal spray for postoperative polypoid changes without crusts *Setting/type of anaesthesia*: 208/250 under local anaesthesia	*Total number of patients*: 250 *Indication for surgery*: Sinonasal polyposis (131), chronic sinusitis (119) *Exclusion criteria*: None stated *Participant characteristics*: Age, sex and duration of symptoms were not reported. 13/250 had had previous surgery. *Bilateral disease/surgery*: 83%	*Primary and secondary outcome measures used*: Improvement in symptoms, mean blood loss, complications, polyp recurrence, revision surgery *Method of assessing outcomes*: Symptoms by asking patients, surgeon assessments *Length of follow-up*: From 12 to 42 months (mean 17)

Results

Ten patients underwent revision surgery. Thirty-nine of 221 patients felt that their surgery was a failure and that symptoms were no better. Three felt worse after surgery. Eighteen of 221 patients had persistent symptomatic polyps and 21/221 had asymptomatic polyps post-surgery. Considering only the patients with an original diagnosis of polyps, 101/115 were successfully treated.

Mean blood loss was 65 ml (range 25–200 ml). Three patients were readmitted to hospital within 10 days of FESS for bleeding. Three patients developed unilateral eye ecchymoses and 17 developed symptomatic middle meatal stenosis.

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: no, same surgeon did perform all procedures but surgery varied according to extent of disease.
- Loss to follow-up?: yes, 221/250 patients were followed postoperatively.
- Method of data analysis: no ITT performed. Results were descriptive only.

General comments

- Generalisability: low, no exclusion criteria given.
- Main outcome measured independently: uncertain.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Lund and MacKay, 1994[38] UK *Study design*: Case series	*Treatment*: Endoscopic sinus surgery (functional for chronic and acute sinusitis) *Postoperative interventions used*: Postoperative intranasal steroids for all and oral steroid therapy for polyp patients, antibiotics *Setting/type of anaesthesia*: General anaesthesia 97%	*Total number of patients*: 650 *Indications for surgery*: Chronic rhinosinusitis (51%), gross polyposis (47%) and acute recurrent rhinosinusitis (2%) *Exclusion criteria*: Those included had similar surgery and were available for 6-month follow-up *Participant characteristics*: Age, sex, duration of symptoms and previous surgery were not reported *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: improvement in symptoms, revision surgery, complications *Method of assessing outcomes*: Patient rating of symptoms at 6 months follow-up as cured, improved, the same or worse. Surgeons assessment and follow-up endoscopy *Length of follow-up*: 6 months

Results

After 6 months, 78% of patients reported that they had improved, 9% that they were cured, 11% unchanged and 2% worse. There was no difference between patients with chronic rhinosinusitis and diffuse polyposis. 3% of patients underwent revision surgery within 6 months.

Of the 650 patients, one developed a CSF leak and one an orbital haematoma. No cases of diplopia, blindness, meningitis or death were noted.

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: no, extent of surgery varied with extent of disease.
- Loss to follow-up?: no.
- Method of data analysis: Descriptive results only.

General comments

- Generalisability: low, unclear exclusion and inclusion criteria.
- Main outcome measured independently: uncertain.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Massegur *et al.*, 1995[42] Spain *Study design*: Case series	*Treatment*: Endoscopic ethmoidal surgery (modified Messerklinger and Stammberger technique) *Postoperative interventions used*: Postoperative saline rinse, beclomethasone or budesonide spray 2× daily *Setting/type of anaesthesia*: 30 general anaesthetic, 110 sedated + local anaesthetic, 110 general and topical	*Total number of patients*: 250 *Indications for surgery*: 29 antrochoanal polyps, 62 polyposis and ASA sensitivity, 112 polyposis non-ASA, 34 chronic suppurative sinusitis, 7 mucoceles, 1 schwannoma and 5 aspergillomas *Exclusion criteria*: None stated *Participant characteristics*: Age, sex and duration of symptoms were not reported. 58/250 patients had had previous surgery *Bilateral disease/surgery*: 70%	*Primary and secondary outcome measures used*: Disease recurrence, improvement, revision surgery, complications *Method of assessing outcomes*: Postoperative patient questionnaire containing subjective assessment of nasal obstruction, smell and discharge along with objective assessment of recurrence, synechia and patency. Follow-up endoscopy *Length of follow-up*: Minimum 1 year, maximum 4 years

Results

Marked improvement was noted in 93% of patients with antrochoanal polyps, 48% with ASA polyps, 65% polyps and asthma and 90% polyps without asthma. Fourteen of 250 patients required revision surgery.

The following complications occurred: postoperative epistaxis (6 patients), temporary diplopia (2), palpebral haematomas (5), asthma attacks (2), epiphora (2), CFS leak (1), cardiac arrest (1), partial closures of middle meatal antrostomy (10).

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: no, surgical procedure varied according to indication and extent of disease.
- Loss to follow-up?: no.
- Method of data analysis: descriptive statistics only.

General comments

- Generalisability: low, exclusion criteria were not defined.
- Main outcome measured independently: yes.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Moses *et al.*, 1998[33] USA *Study design*: Case series	*Treatment*: FESS revision surgery *Postoperative interventions used*: Not stated *Setting/type of anaesthesia*: Not stated	*Total number of patients*: 90 *Indication for surgery*: Polyposis (50) *Exclusion criteria*: Patients with sinonasal or skull base cancer, inverting papilloma or trauma-related conditions were excluded *Participant characteristics*: Median age 42 years (range 20–77), male:female ratio 36:54, all patients had had previous FESS surgery, median interval since previous surgery 19 months. 35/90 patients had asthma, 33/90 had allergy, 37/90 had frontal sinus disease *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: Success, additional surgery required, complications *Method of assessing outcomes*: Standard postoperative follow-up *Length of follow-up*: Patients were followed for a mean of 22.8 months (range 8–44)

Results

Sixty of 90 patients were successfully treated with a single procedure; 30/90 patients required additional sinus surgery. Of the 50 patients with polyps, 21 were failures (required further sinus surgery).

Complications consisted of one CSF leak.

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: no, only revision FESS procedures were selected from the series to report.
- All patients given same intervention?: uncertain, three surgeons performed all procedures, although it is likely that extent of surgery varied with severity of disease.
- Loss to follow-up?: no.
- Method of data analysis: chi-squared analysis to determine the significant of clinical parameters.

General comments

- Generalisability: low, results are only generalisable to patients who have already had previous sinus surgery, unclear description of patient group.
- Main outcome measured independently: no.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Nishioka *et al.*, 1994[34] USA *Study design*: Case series	*Treatment*: FESS modification of Messerklinger technique, with liberal use of a partial middle turbinectomy *Postoperative interventions used*: Intranasal steroids for at least 6 months *Setting/type of anaesthesia*: Not stated	*Total number of patients*: 283 *Indication for surgery*: Chronic sinusitis. Polyps were present in 47.5% of sides for the non-allergic group and 50.8% of sides for allergic patients *Exclusion criteria*: Patients with cystic fibrosis and immotile-cilia syndrome were excluded. *Participant characteristics*: Mean age 44 years (range 4–83), male:female ratio 161:122. Duration of symptoms and previous surgery were not reported. 211/283 patients were non-allergic, 72/283 had allergy, 5 of the allergic patients had ASA triad *Bilateral disease/surgery*: 86%	*Primary and secondary outcome measures used*: Patency, synechiae formation, polyp recurrence *Method of assessing outcomes*: Surgeon assessment *Length of follow-up*: Mean follow-up 14.9 months (range 0.75–44.3)

Results

The rate of middle meatotomy closure was 13/211 non-allergic patients and 6/72 allergic patients. Synechiae formed in 31/211 non-allergic patients and 9/72 allergic patients. The prevalence of polyp recurrence in non-allergic patients was 17/101 and in allergic patients 14/39.

Methodological comments

- Prospective?: uncertain.
- Consecutive patients enrolled?: yes.
- All patients given same intervention?: uncertain if same surgeon performed all procedures, if standard procedure changed over time and if extent of surgery was dependent on severity of disease.
- Loss to follow-up?: no.
- Method of data analysis: no confidence intervals were given. Likelihood ratios were calculated, chi-squared for differences ($p < 0.05$), direct comparison of seasonal versus perennial allergic groups by Fisher's exact test.

General comments

- Generalisability: medium, results would not be generalisable to patients with cystic fibrosis or immotile-cilia syndrome.
- Main outcome measured independently: no.
- Inter-centre variability: not assessed.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Sobol *et al.*, 1998[49] Canada *Study design*: Case series	*Treatment*: FESS performed using a standard technique by addressing the obstruction at the osteomeatal complex. Anterior and posterior ethmoidectomies were performed in all cases. Microdebrider used in some cases *Postoperative interventions used*: Not stated *Setting/type of anaesthesia*: Not stated	*Total number of patients*: 393 *Indication for surgery*: All patients had chronic sinusitis, 185/393 (47%) with polyposis *Exclusion criteria*: Not stated *Participant characteristics*: Mean age 45 years (range 17–77), male:female ratio 195:198 and 31.9% had had previous surgery. History of asthma in 29.5%, aspirin sensitivity 10.9% and allergy in 34.6%. Duration of symptoms not reported *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: Complications, success, revision surgery *Method of assessing outcomes*: Chart review, physician follow-up assessment and telephone follow-up. Patient report was obtained at 6- and 12-month postoperative follow-ups *Length of follow-up*: Follow-up at 6 months for 344 patients and at 12 months for 267 patients

Results

Sixteen of 393 patients required revision surgery within 1 year. At 6 months follow-up, 277/344 patients reported a positive outcome and 67/344 reported a negative outcome. At 12 months follow-up, 186/267 reported a positive outcome and 81/267 a negative outcome.

Complications occurred in 4/393 patients: CSF leak (1), orbital cellulitis (2) and bacterial meningitis (1).

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: no, extent of surgery varied with disease severity.
- Loss to follow-up?: yes, 33/393 (8.4%) were lost to follow-up, 49/393 failed to attend 6-month follow-up and 126/393 failed to attend 12-month follow-up.
- Method of data analysis: chi-squared analysis was performed ($p = 0.05$). No ITT performed.

General comments

- Generalisability: low, no exclusion criteria were provided.
- Main outcome measured independently: no.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Venkatachalam and Bhat, 1999–2000[50] New Delhi *Study design*: Case series	*Treatment*: FESS, classical Messerklinger technique *Postoperative interventions used*: Not stated *Setting/type of anaesthesia*: Local anaesthesia	*Total number of patients*: 210 *Indication for surgery*: Chronic hyperplastic sinusitis, 27 with ethmoidal polyps and 39 with antrochoanal polyps *Exclusion criteria*: None stated *Participant characteristics*: majority were aged 31–40 years (range 7–66), male:female ratio 122:88, duration of symptoms was most commonly 6–24 months (range 6 months–25 years), 39/210 had previous surgery *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: Complications, improvement in symptoms *Method of assessing outcomes*: Unclear, physician assessment. Complete relief 90–100% betterment, partial relief 50–90% betterment and poor <50% betterment *Length of follow-up*: 9–33 months (mean 18.3 months)

Results

There was complete relief of symptoms in 147/210 patients, 39/210 had partial relief and 15/210 had poor/no relief. Of those patients with partial relief, 14/39 had recurrence of polyps identified during follow-up.

The only major complications were injury to the lamina papyracea in two patients. Minor complications included bleeding in 12 patients and postoperative synechia in 18 patients.

Methodological comments

- Prospective?: uncertain.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: no, extent of surgery varied with disease severity.
- Loss to follow-up?: yes, 9/210 were lost to follow-up.
- Method of data analysis: descriptive data only, no ITT performed.

General comments

- Generalisability: low, no exclusion criteria reported.
- Main outcome measured independently: uncertain.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Wolf *et al.*, 1995[43] Austria *Study design*: Case series	*Treatment*: Endoscopic endonasal sinus surgery (as described by Messerklinger and Stammberger) *Postoperative interventions used*: Antibiotics and topical corticosteroids *Setting/type of anaesthesia*: 45% local anaesthesia	*Total number of patients*: 124 *Indications for surgery*: Chronic recurring sinusitis (n = 71), chronic recurring sinusitis with diffuse polyposis and/or antrochoanal polyps (n = 53) *Exclusion criteria*: Only children were included *Participant characteristics*: mean age 12 years (range 3–16) and male:female ratio 59:65. Duration of symptoms was not reported. 14/124 children had had previous adenoidectomy *Bilateral disease/surgery*: 63%	*Primary and secondary outcome measures used*: Success relieving symptoms, recurrence and complications *Method of assessing outcomes*: Chart review and questionnaire sent to patients (attempted to determine surgical success and relief of specific symptoms) *Length of follow-up*: Not stated

Results

Of the patients who returned the questionnaire (n = 71), 53% noted complete resolution of rhinorrhoea, 40% improved, 3% no difference and 3% worse. The sensations of nasal obstruction were completely relieved in 31%, improved in 57%, no difference in 10% and worsened in 2%. Recurrent infections were eliminated in 48%, decreased in 43%, no change in 7% and increased in 2%. Headache was relieved in 41%, improved in 44% and not changed in 15%. Pulmonary symptoms were relieved in 50%, improved in 8%, not significantly changed in 42% and worsened in no patients. Persistent cough was relieved in 45%, improved in 27% and no change in 27%. Twenty-one of 124 had revision surgery of which 18/53 were for polyps.

Overall 41% were very satisfied, 46% satisfied, 13% dissatisfied. Reoperation was necessary in 16% of patients.

Problems encountered during surgery included anatomical problems (n = 21), diffuse bleeding (n = 13), pain (n = 1).

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: no, extent of surgery was determined by radiology and intra-operative findings.
- Loss to follow-up?: yes, response rate on the questionnaire was 57%.
- Method of data analysis: descriptive statistics only.

General comments

- Generalisability: low, no details of exclusion criteria, generalisable only to children.
- Main outcome measured independently: yes.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Appendix 8

Data extraction tables – case series studies with mixed patients (polyps and non-polyps) but results not reported separately

Reference and design	Intervention	Subjects	Outcome measures
Davis *et al.*, 1991[27] USA *Study design*: Case series	*Treatment*: FESS, Messerklinger technique with minor variations (partial middle turbinectomy ± septoplasty liberally performed) *Postoperative interventions used*: Topical steroids on polypoid tissue, antibiotics (oral and topical), steroid nasal spray for <3 months *Setting/type of anaesthesia*: Inpatient or outpatient. Local or general anaesthesia	*Total number of patients*: 200 *Indication for surgery*: Chronic sinusitis (200), chronic sinusitis with polyps (103/200), chronic sinusitis with polyps and allergy (44/200) *Exclusion criteria*: Patients with CF and other syndromes were excluded *Participant characteristics*: age range 4–83 years, sex, duration of symptoms and previous surgery not reported *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: Improvement in symptoms, patient satisfaction, complications, patency *Method of assessing outcomes*: Surgeon assessment, patient questionnaires asked patients if they were asymptomatic, the same, better or worse. *Length of follow-up*: Up to 36 months

Results

Patency of the surgical meatus overall was 93.55%; for those patients followed up to 3 years, patency was 87.5%. Of the patients with polyps, 9.7% (10/147) have closed. Of questionnaire responders 65/68 (96%) were improved or asymptomatic 1 year after their procedure; 61/68 (90%) would undergo the procedure again. Sixteen of 147 polyp patients failed, 20/178 of all patients failed.

No major complications occurred. Minor complications included periorbital fat identification (6 patients), epiphora (1) and synechiae formation (20).

Methodological comments

- Prospective?: yes.
- Consecutive patients enrolled?: yes.
- All patients given same intervention?: no, extent of surgery varied with disease severity.
- Loss to follow-up?: yes, 22/200 (11%) failed to return for 3-month follow-up and were eliminated from analysis. There were 116/200 (58%) patients who responded to questionnaire.
- Method of data analysis: no ITT analysis performed. The differences between groups were assessed using *z*-tests of two means and chi-squared.

General comments

- Generalisability: medium, cannot be generalised to patients with CF or other syndromes. Details of patients' characteristics in this study were sparse.
- Main outcome measured independently: yes.
- Inter-centre variability: not assessed, two separate centres contributed patients.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Delank and Stoll, 1998[48] Germany *Study design*: Case series	*Treatment*: Bilateral FESS according to methods published by Wigand *Postoperative interventions used*: None stated *Setting/type of anaesthesia*: Not stated	*Total number of patients*: 115 *Indication for surgery*: Group A, no endonasal polyps, slight hypertrophy of turbinates (26); group B, polyps restricted to area between middles turbinate and lateral nasal wall (29); group C, polyps within the middle and upper meatuses (46); group D, subtotal or total blockage of the nose by polyps (14) *Exclusion criteria*: Patients with unilateral sinusitis and or previous sinus surgery were excluded. Patients with an established allergy or history of allergic rhinosinusitis were excluded *Participant characteristics*: Average age 44 years (range 14–79), male:female ratio 63:52, duration of olfactory dysfunction average 10.5 months, patients had had no previous sinus surgery *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: Olfaction *Method of assessing outcomes*: Olfactory tests (psychophysical methods, qualitative and quantitative), patient questionnaire assessing ability to taste and smell *Length of follow-up*: Not stated

Results

After FESS, improvements in the olfactory threshold and or the olfactory discriminations occurred in 70% (67/96) of anosmic or hyposmic patients. Twenty per cent of patients achieved postoperative normosmia. Hyposmic patients had increased smell sensitivity in 38/60 (63%) of cases. Improvement was most evident in groups A and B (milder disease) with 18/25 benefiting from FESS. Olfaction decreased postoperatively in 9/115 (8%) patients.

Methodological comments

- Prospective?: yes.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: no, extent of surgery varied with extent of disease. Not sure if all procedures were performed by same surgeon.
- Loss to follow-up?: no.
- Method of data analysis: analysis was descriptive only.

General comments

- Generalisability: medium, results may not be generalisable to those with unilateral disease, allergy or previous surgery.
- Main outcome measured independently: yes.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Friedman *et al.*, 2000[28] USA *Study design*: Case series	*Treatment*: ESS plus middle turbinate medialisation. Almost entirely using a microdebrider *Postoperative interventions used*: None stated *Setting/type of anaesthesia*: Not stated	*Total number of patients*: 500 *Indication for surgery*: Persistent chronic sinusitis (364) or polyposis (136) *Exclusion criteria*: Patients who had had previous endonasal surgery were excluded *Participant characteristics*: Age, sex and duration of symptoms were not reported. No patients had had previous surgery *Bilateral disease/surgery*: 43%	*Primary and secondary outcome measures used*: Improvement in symptoms, synechiae formation, complications *Method of assessing outcomes*: Patients were asked if their condition had significantly improved, improved somewhat, had not improved or was worse. Endoscopic follow-up *Length of follow-up*: Mean 10 months (range 6–18)

Results

After surgery 390/500 patients reported significant improvement, 72 reported some improvement, 34 noted little or no improvement and four felt worse following surgery. After surgery 93% of patients had middle turbinate medialisation with a well-defined synechia between the septum and middle turbinate 4 weeks after surgery. Lateral synechiae did not develop in 88% of patients.

One major complication occurred (CSF leakage). The following minor complications occurred postoperative bleeding (8) and septal haematoma (5). Lateral synechia formation also occurred, although numbers not given.

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: uncertain.
- All patients given same intervention?: uncertain if all procedures were performed by a single surgeon. It is likely that the extent of surgery varied with disease severity.
- Loss to follow-up?: no, owing to retrospective design.
- Method of data analysis: descriptive analysis only.

General comments

- Generalisability: medium, not generalisable to patients who have undergone previous surgery, may only be generalisable to patients undergoing ESS with use of a debrider.
- Main outcome measured independently: no.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Park *et al.*, 1998[35] USA *Study design*: Case series	*Treatment*: FESS, in most cases removing the uncinate process, bulla ethmoidalis and anterior ethmoid cells *Postoperative interventions used*: Systemic steroids for 2 days post-surgery, 3 or more antibiotics for 3 weeks or more in most patients *Setting/type of anaesthesia*: Not stated	*Total number of patients*: 79 *Indication for surgery*: Medically resistant chronic sinusitis or recurrent acute sinusitis. 58/79 (73%) had obstructing nasal polyposis *Exclusion criteria*: Patients without asthma *Participant characteristics*: Average age 50 years (range 6–81). Sex and duration of symptoms were not reported. 56% of patients had had previous sinus surgery. All patients had asthma, 47% Samter's triad *Bilateral disease/surgery*: Nearly 100%	*Primary and secondary outcome measures used*: Complications, improvement in symptoms, hospitalisation and medication use *Method of assessing outcomes*: Patient questionnaire, telephone contacts, clinic evaluations and review of medical records *Length of follow-up*: Average follow-up 19 months (range 12–108)

Results

Of 79 patients, 68 stated that FESS improved their sinus symptoms. There was a statistically significant improvement in the following symptoms: nasal congestion, nasal drainage, post-nasal drip, fever, bad breath, headaches, cough, taste and smell disturbance ($p < 0.05$). Congestion in the ears and visual disturbances did not significantly improve after surgery. There were 75% of patients who stated that they still had persistent sinus symptoms after surgery. In patients who stated that their sinusitis worsened their asthma, 80% reported improvement after FESS. Hospitalisations, emergency room visits, and corticosteroid use all decreased following surgery ($p < 0.05$).

The following complications were reported: haemorrhage (2), cardiac ischaemia (1), nasocriminal duct injury (1), CSF leak (1) and diplopia (1).

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: no.
- All patients given same intervention?: no, extent of surgery depended on severity of disease.
- Loss to follow-up?: no.
- Method of data analysis: pre- and post-scores were compared using chi-squared analysis ($p < 0.05$).

General comments

- Generalisability: medium, results may not be generalisable to patients without asthma.
- Main outcome measured independently: yes.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Schaefer, 1998[36] USA *Study design*: Case series	*Treatment*: Endoscopic intranasal ethmoidectomy and middle meatus antrostomy/sphenoidotomy/ frontal sinostomy. Associated procedures were septoplasty, orbital decompression and drainage of orbital abscess *Postoperative interventions used*: Not stated *Setting/type of anaesthesia*: 2 patients underwent surgery with local anaesthesia.	*Total number of patients*: 509 *Indications for surgery*: Symptomatic sinusitis (n = 322), polyps with or without sinusitis (n = 139) orbital abscess secondary to sinusitis (n = 7), thyroid eye disease (n = 41), allergic fungal sinusitis (n = 10) *Exclusion criteria*: Procedure must be ethmoidectomy performed by author in manner described by report with complications known. Patients must have failed medical treatment *Participant characteristics*: Median age 42 years (range 12–84), male:female ratio 261:248, 49.5% of patients had had previous surgery. Duration of symptoms not reported. *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: Revision surgery, complications *Method of assessing outcomes*: Surgeon reports *Length of follow-up*: 5 years

Results

Fifteen (2.9%) patients underwent revision surgery.

Complications consisted of three epistaxis, one preseptal eyelid haemorrhage and one needle puncture of the ethmoid dura resulting in CSF drainage.

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: no.
- All patients given same intervention?: no, procedure varied according to extent of disease and need for associated procedures.
- Loss to follow-up?: no
- Method of data analysis: descriptive data only.

General comments

- Generalisability: medium.
- Main outcome measured independently: no.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Stammberger and Posawetz, 1990[21] Austria *Study design*: Case series	*Treatment*: FESS, Messerklinger technique *Postoperative interventions used*: Removing postoperative crusts under endoscopic control, topical cortisone used in special cases *Setting/type of anaesthesia*: Not stated	*Total number of patients*: 500 *Indication for surgery*: 246/500 massive nasal polyposis *Exclusion criteria*: None stated *Participant characteristics*: age, sex and duration of symptoms, were not reported. Many patients had had previous surgery *Bilateral disease/surgery*: Not stated	*Primary and secondary outcome measures used*: Improvement in symptoms, synechiae formation, complications *Method of assessing outcomes*: Patient questionnaire asking about degree of improvement and duration. Surgeon assessment *Length of follow-up*: Retrospective period of 10 years, mean follow-up not reported

Results

Of the patients where headache was the only leading symptom, 88% reported that their problem had completely disappeared or had become considerably better. Of 500 patients, 425 reported that after FESS improvement in their symptoms was very good or good, 30/500 reported improvement was fair, 21/500 reported improvement was moderate and 23/500 reported no improvement or bad.

Eight per cent of all patients experienced synechiae formation. Eight of 500 patients experienced stenoses of an enlarged maxillary sinus ostium, nine patients had lesions of the lamina papyracea, 12 had intra- or postoperative bleeding requiring packing, one patient required a blood transfusion. Ten cases of repeat surgery were required to finish the procedure. In one case a sponge inserted to prevent lesions was forgotten for several months and caused the patient considerable problems. There were nine cases of orbital penetration and five soft tissue infiltrations after sinoscopy.

Methodological comments

- Prospective?: no.
- Consecutive patients enrolled?: no.
- All patients given same intervention?: no, unlikely that same surgeon performed all procedures and extent of surgery varied with disease severity.
- Loss to follow-up?: uncertain.
- Method of data analysis: very few point estimates were provided.

General comments

- Generalisability: low, no clear exclusion criteria provided.
- Main outcome measured independently: yes.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Reference and design	Intervention	Subjects	Outcome measures
Wigand *et al.*, 1978[47] Germany *Study design*: Case series	*Treatment*: Endonasal sinus surgery with endoscopic control (including maxillary sinus or ethmoidectomy). Wigand technique *Postoperative interventions used*: Scrupulous cleaning and mucosal treatment over many weeks *Setting/type of anaesthesia*: Not stated	*Total number of patients*: 315 *Indication for surgery*: 239 chronic sinusitis including severe polyposis, 76 chronic ethmoiditis, mostly severe polyposis *Exclusion criteria*: None stated *Participant characteristics*: Age, sex, duration of symptoms and previous surgery were not reported *Bilateral disease/surgery*: 43%	*Primary and secondary outcome measures used*: Improvement in symptoms, postoperative complaints, revision surgery *Method of assessing outcomes*: Not stated *Length of follow-up*: 3–6 months

Results

Of the 239 chronic sinusitis patients who underwent endonasal operations of a maxillary sinus, 12 (5%) revision procedures were necessary. A total of 196/239 patients lost their symptoms after 3 months. Of the 76 patients with chronic ethmoiditis undergoing ethmoidectomy there was success in 43 (57%); after 6 months the improvement rate was 62/76 (82%).

Intermediate and long-range postoperative complaints were absent in comparison with what has been found with CL and radical transfrontal ethmoidectomy. There was avoidance of mutilating defects and scar formation at the facial walls of the sinuses.

Methodological comments

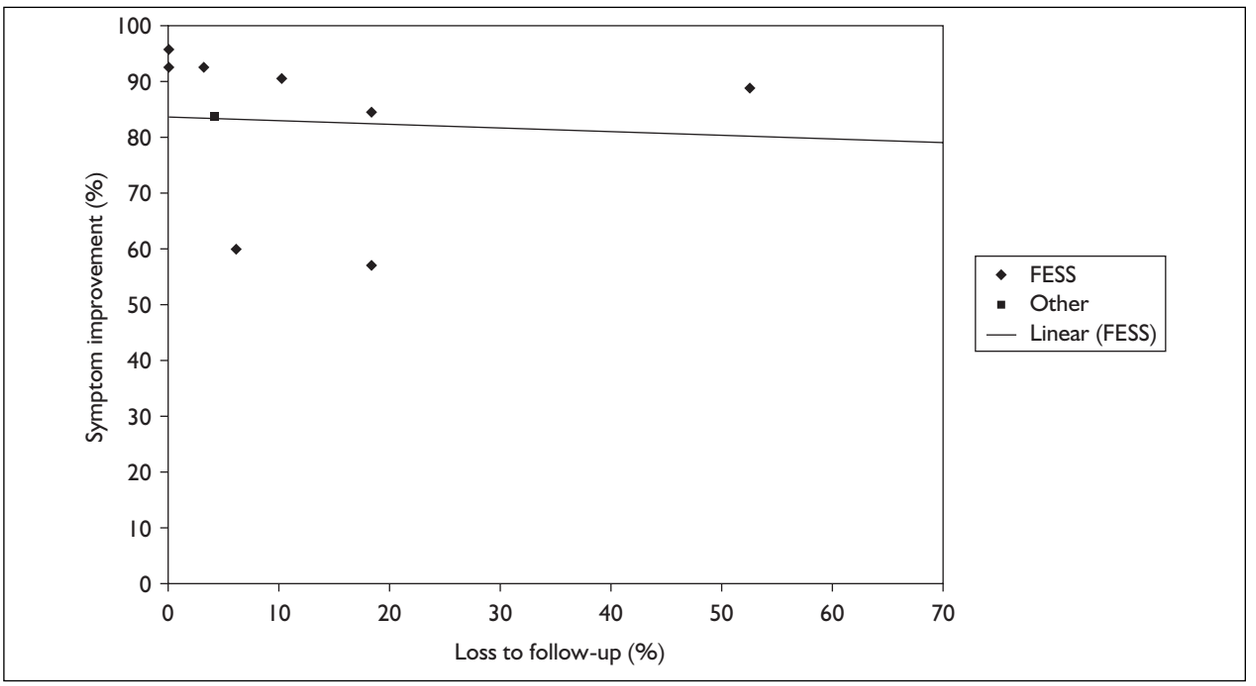
- Prospective?: no.
- Consecutive patients enrolled?: yes.
- All patients given same intervention?: uncertain.
- Loss to follow-up?: no.
- Method of data analysis: only descriptive data provided.

General comments

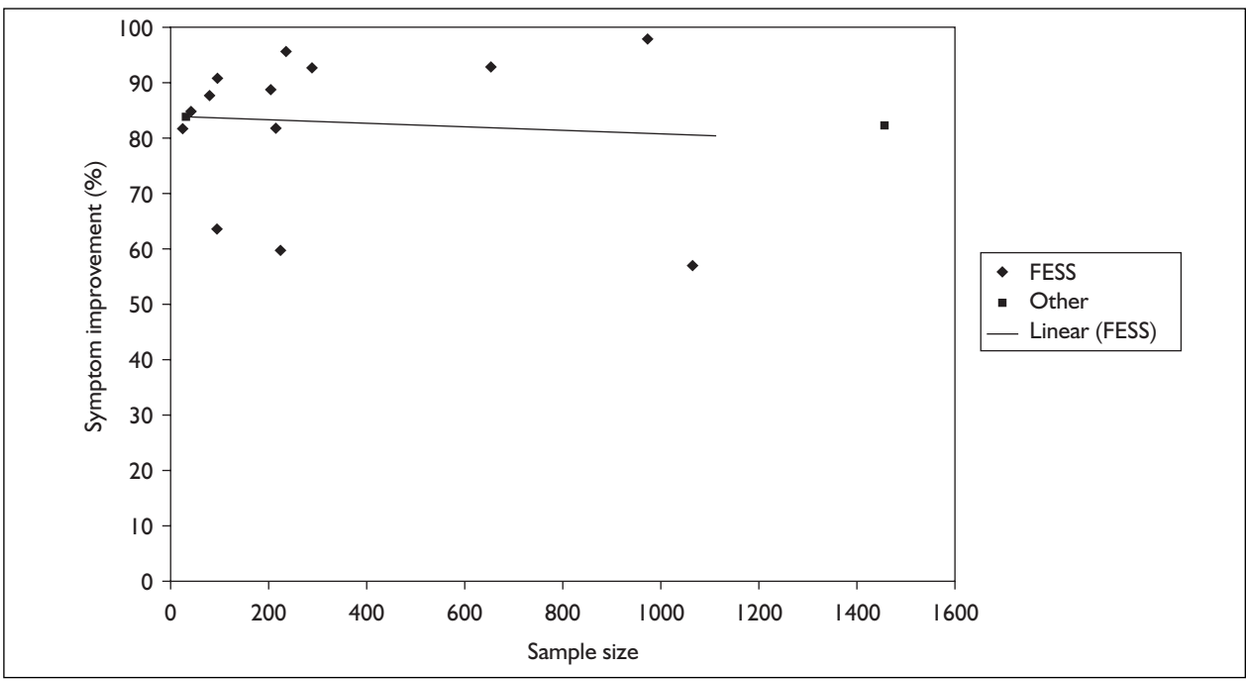
- Generalisability: low, no clear exclusion criteria provided.
- Main outcome measured independently: uncertain.
- Inter-centre variability: not applicable.
- Conflicts of interest: none stated.

Appendix 9

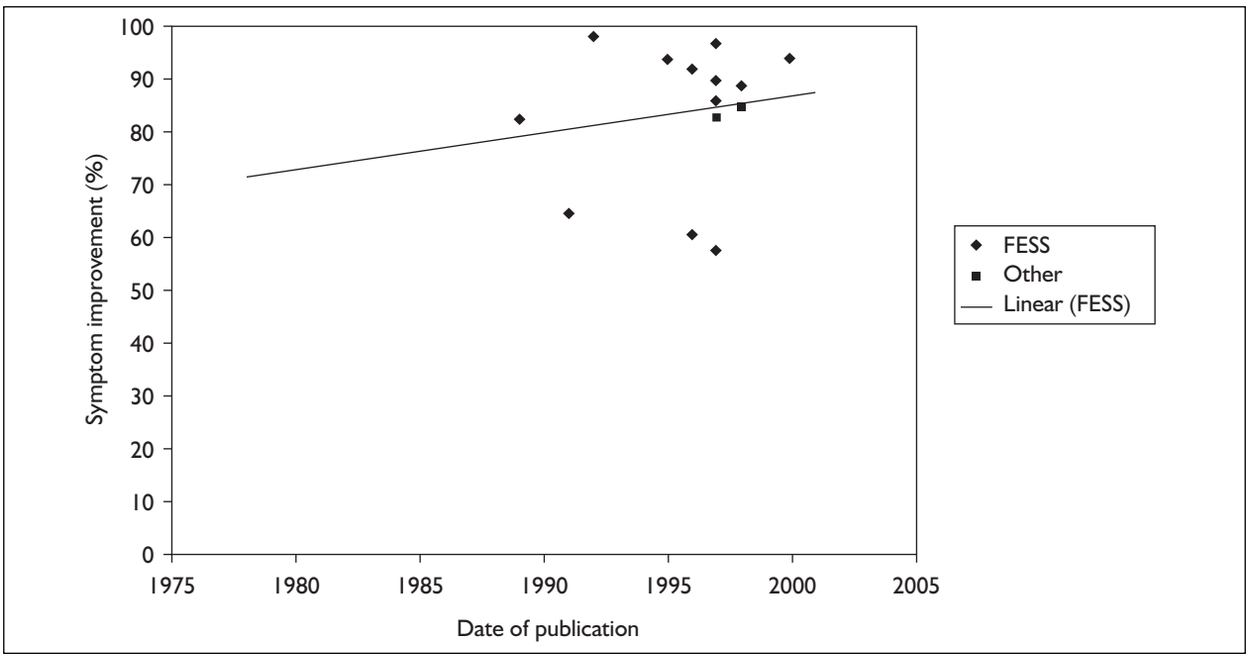
Charts illustrating possible confounding factors for the main outcome (symptom improvement) for patients with polyps



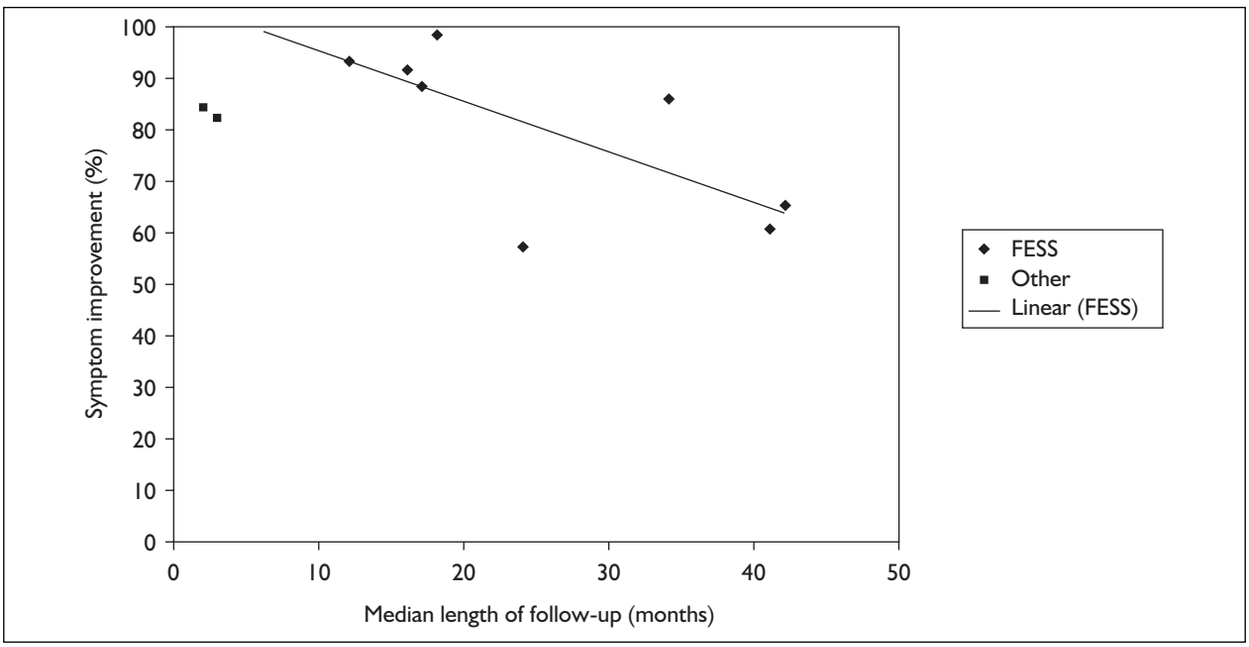
Percentage symptom improvement after FESS for polyps and percentage loss to follow-up



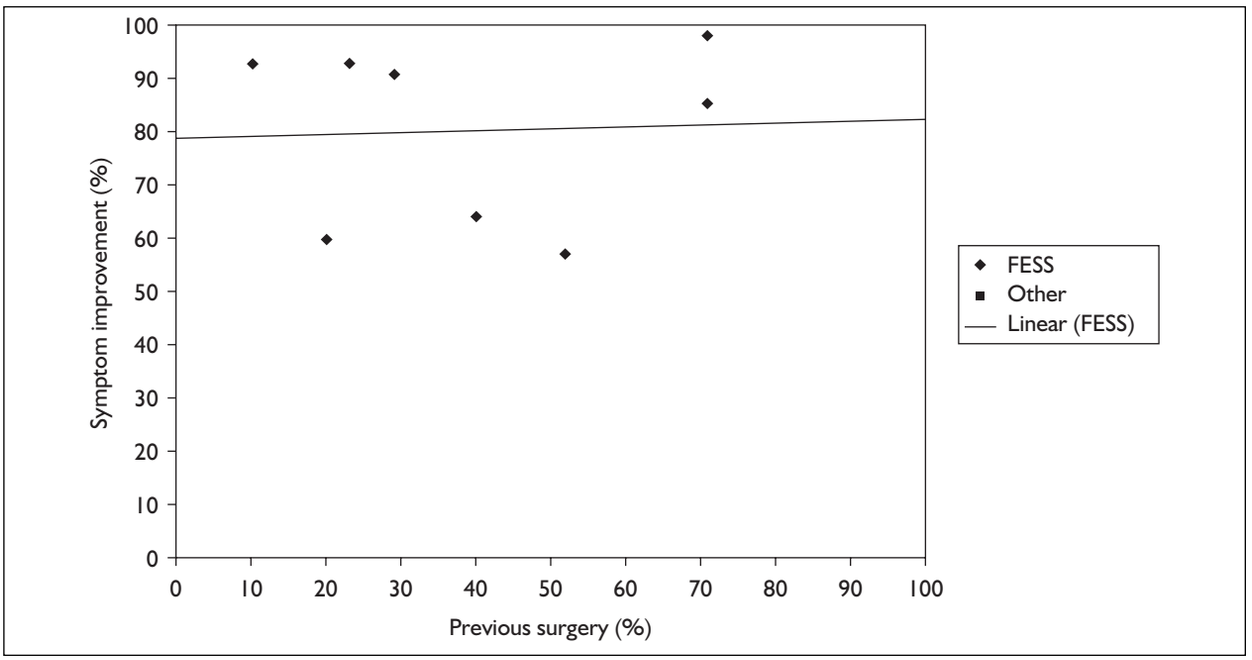
Percentage symptom improvement after FESS for polyps and sample size



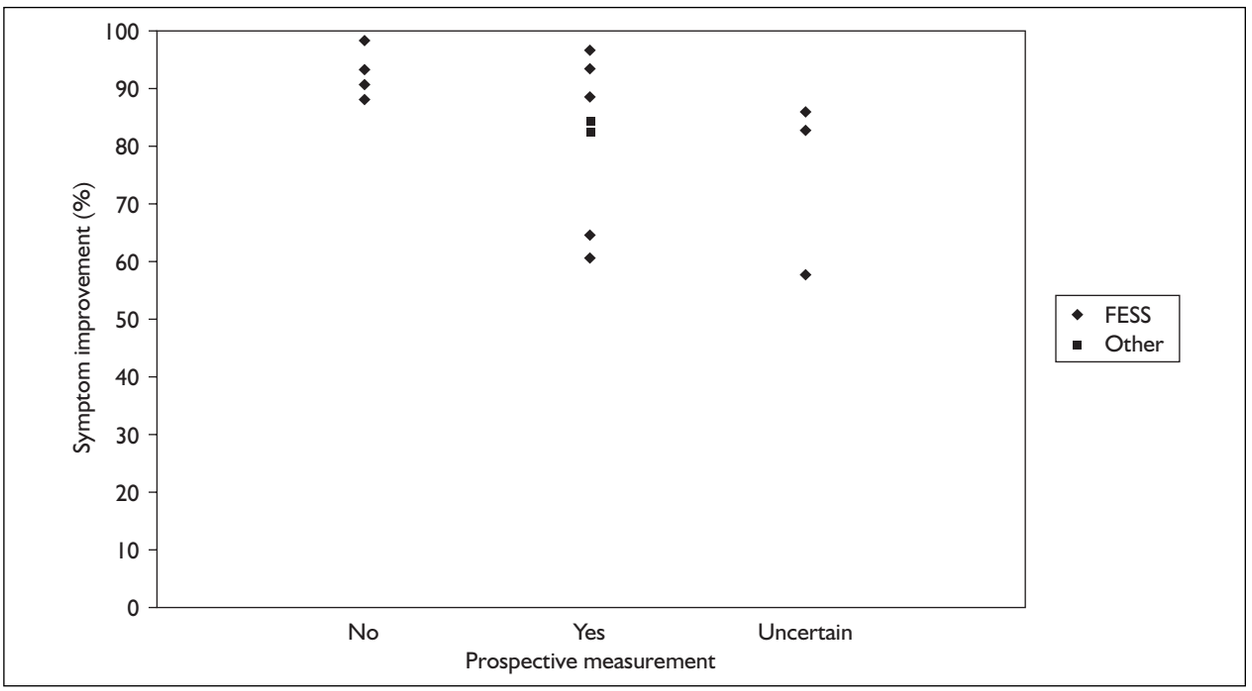
Percentage symptom improvement after FESS for polyps and date of publication



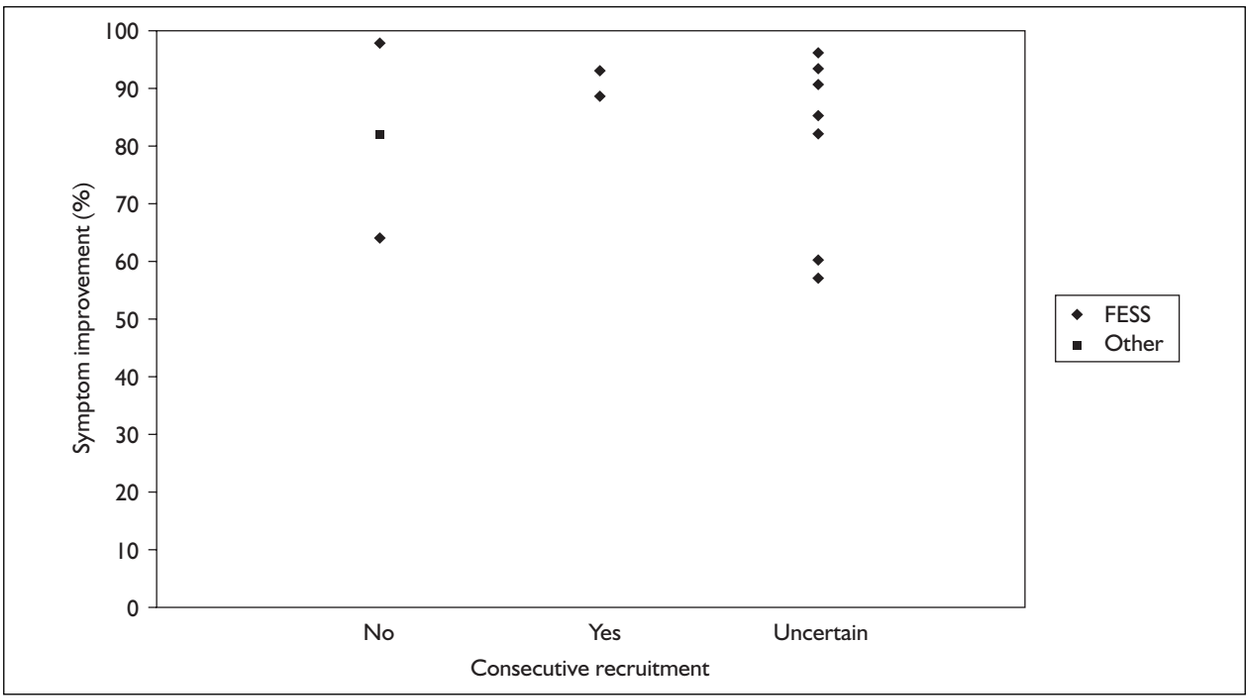
Percentage symptom improvement after FESS for polyps and median length of follow-up



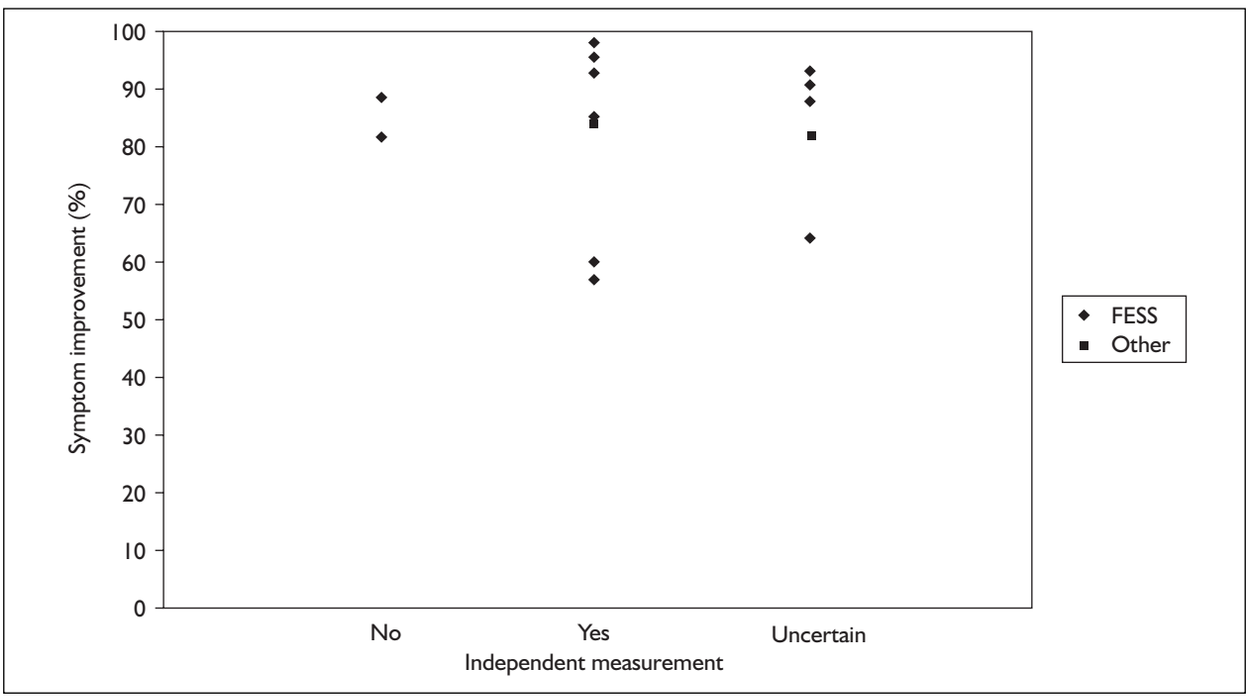
Percentage symptom improvement after FESS for polyps and percentage of patients undergoing previous surgery



Percentage symptom improvement after FESS for polyps and prospective study design



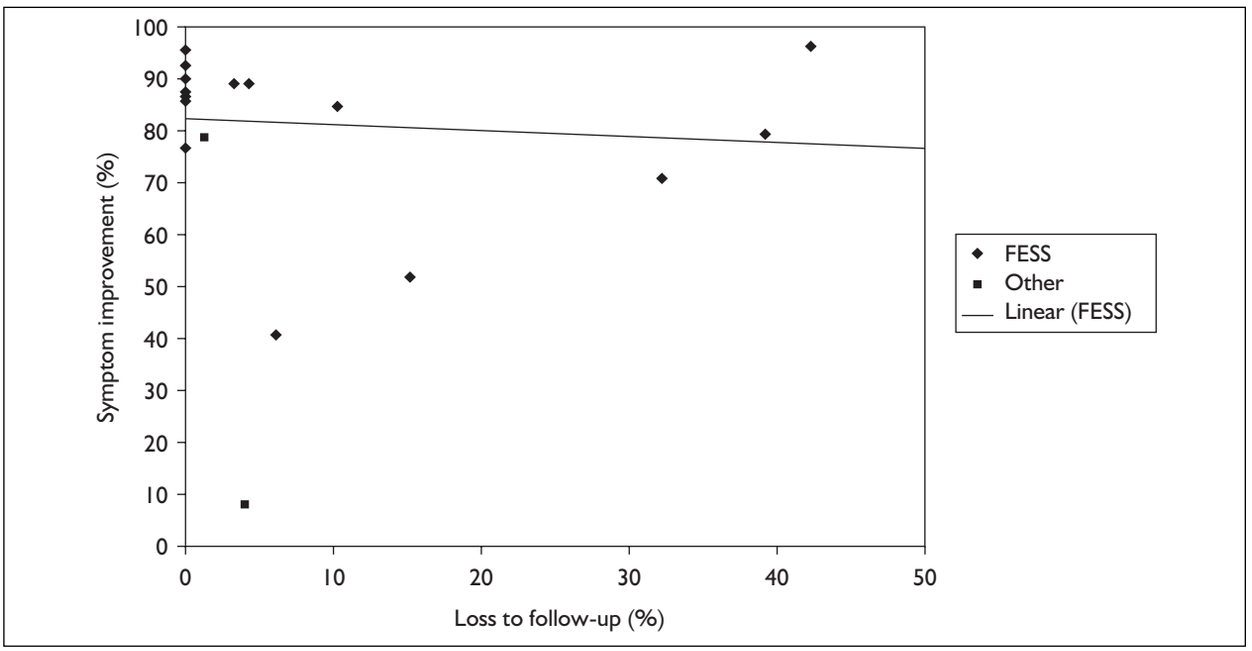
Percentage symptom improvement after FESS for polyps and consecutive selection of patients



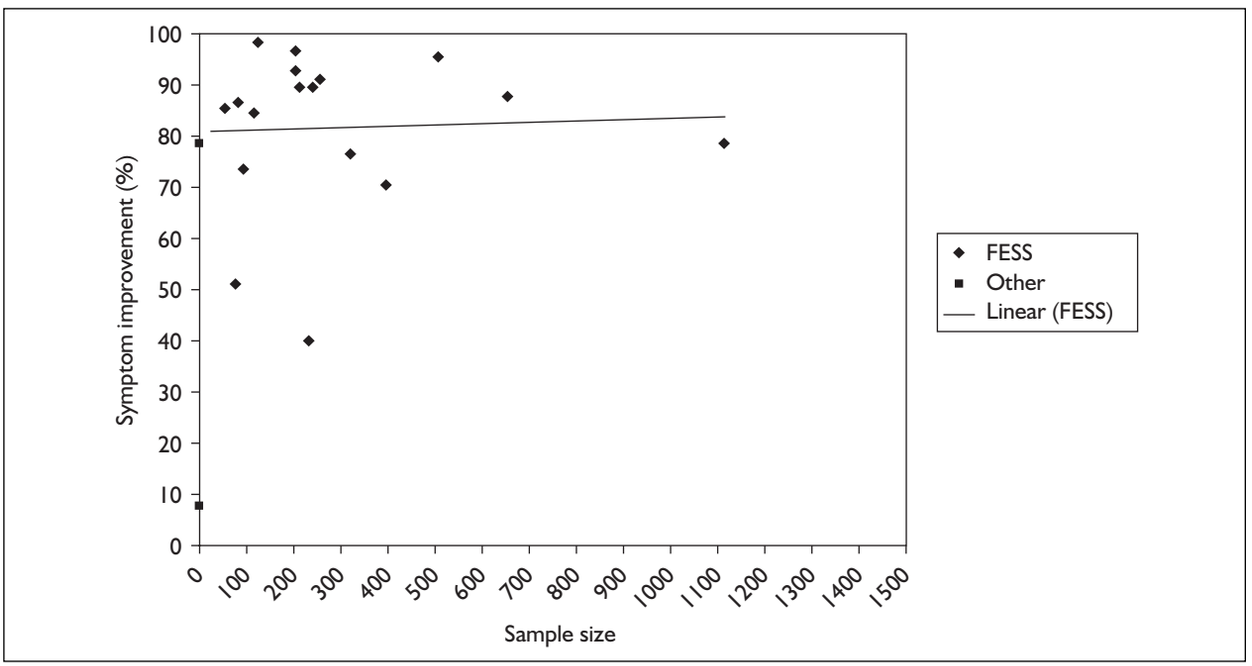
Percentage symptom improvement after FESS for polyps and independent assessment of outcomes

Appendix 10

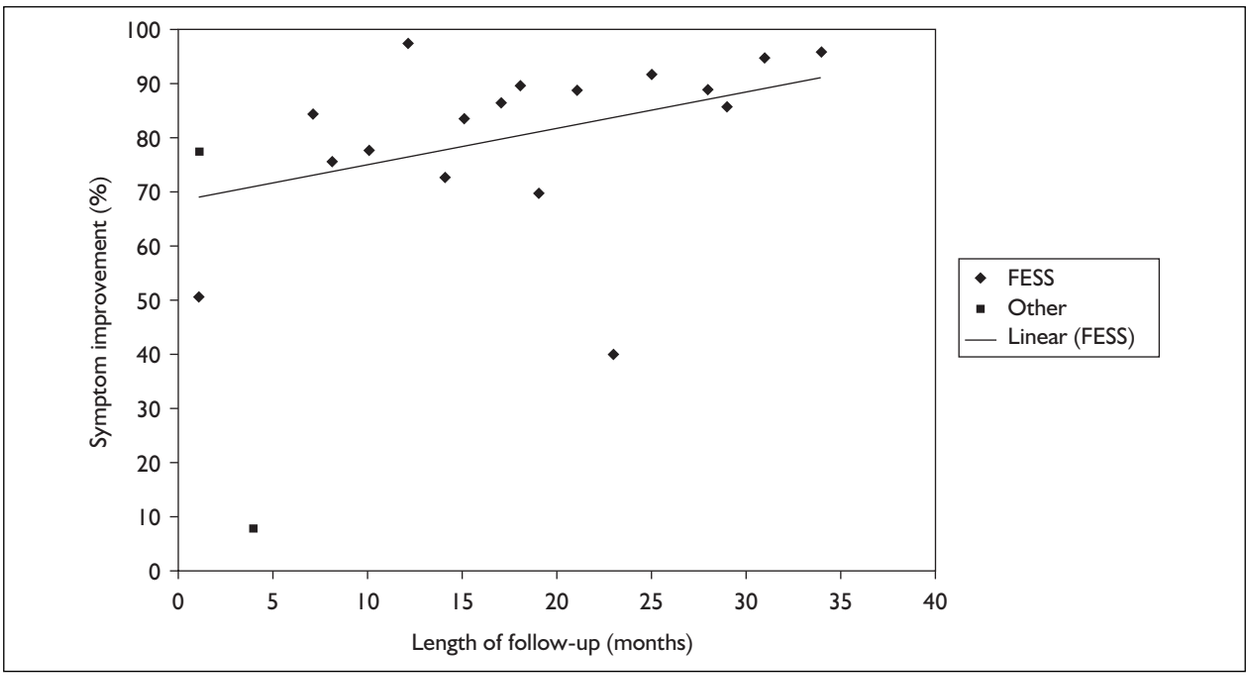
Charts illustrating possible confounding factors for the main outcome (symptom improvement) for mixed patients (with and without polyps)



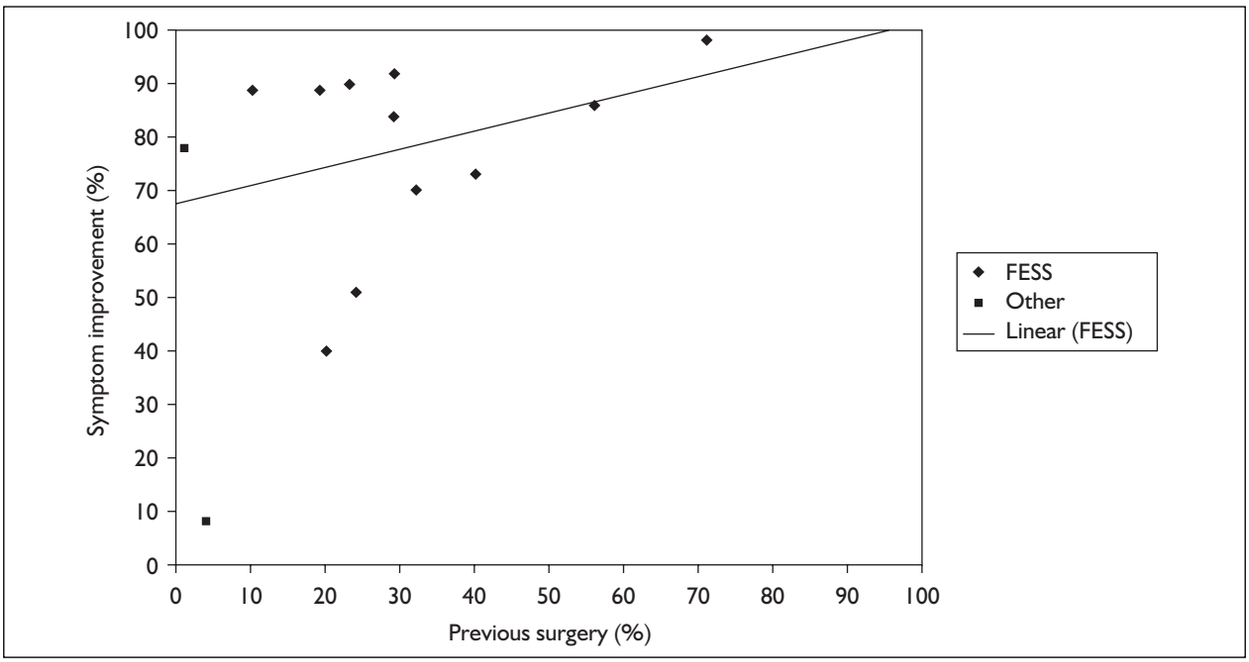
Percentage symptom improvement after FESS and percentage loss to follow-up



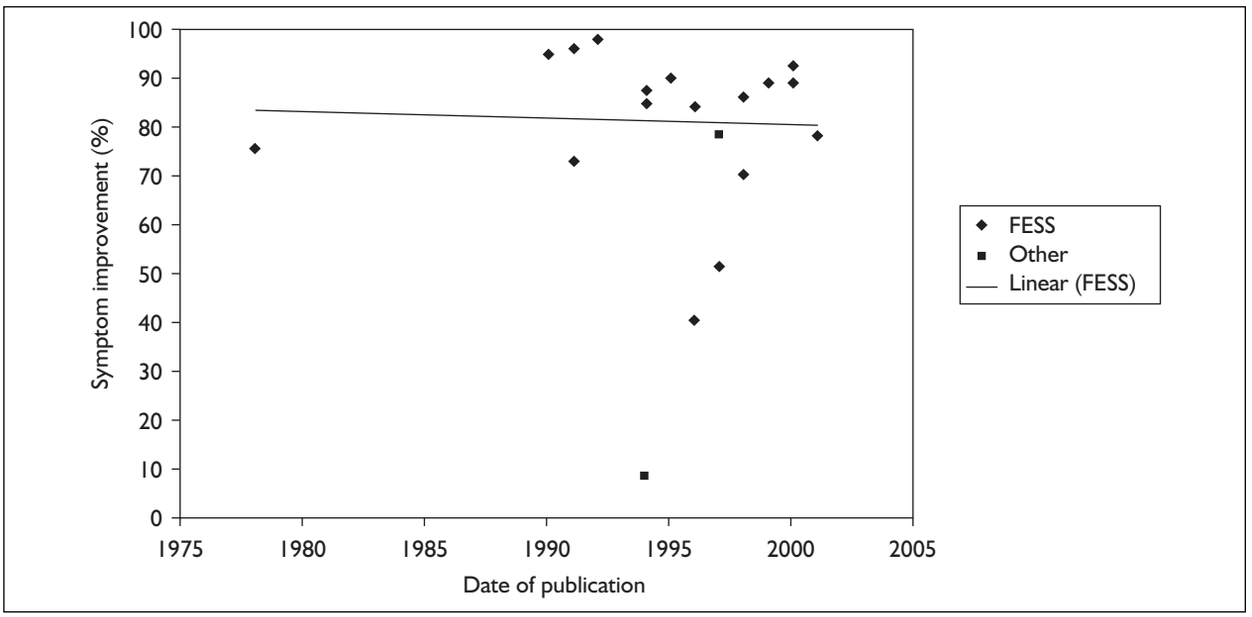
Percentage symptom improvement after FESS and sample size



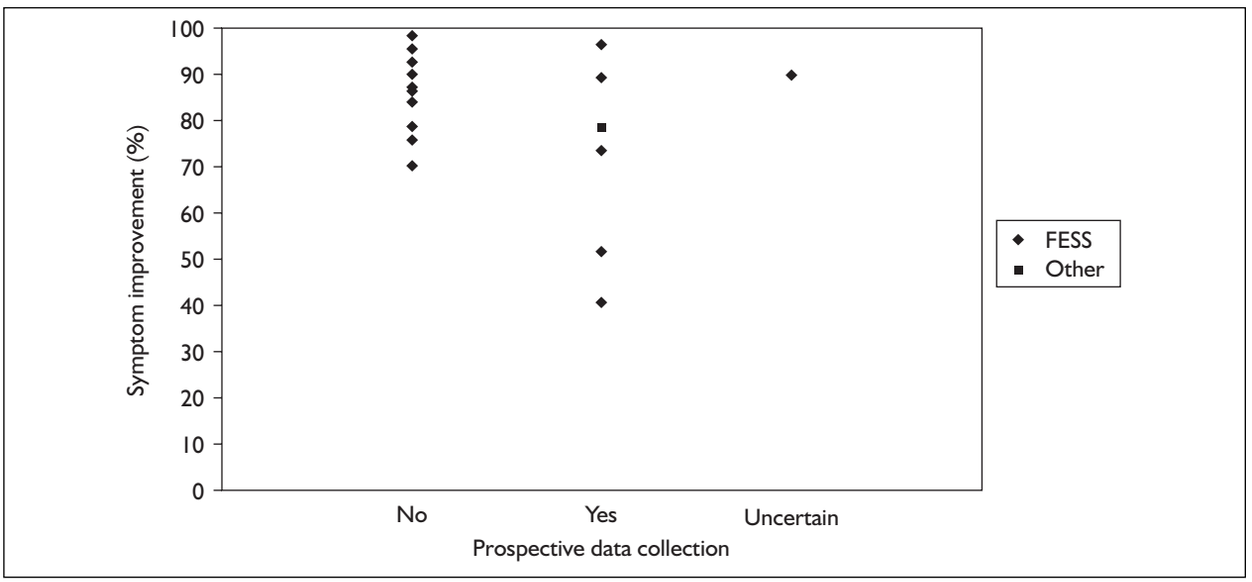
Percentage symptom improvement after FESS and median length of follow-up



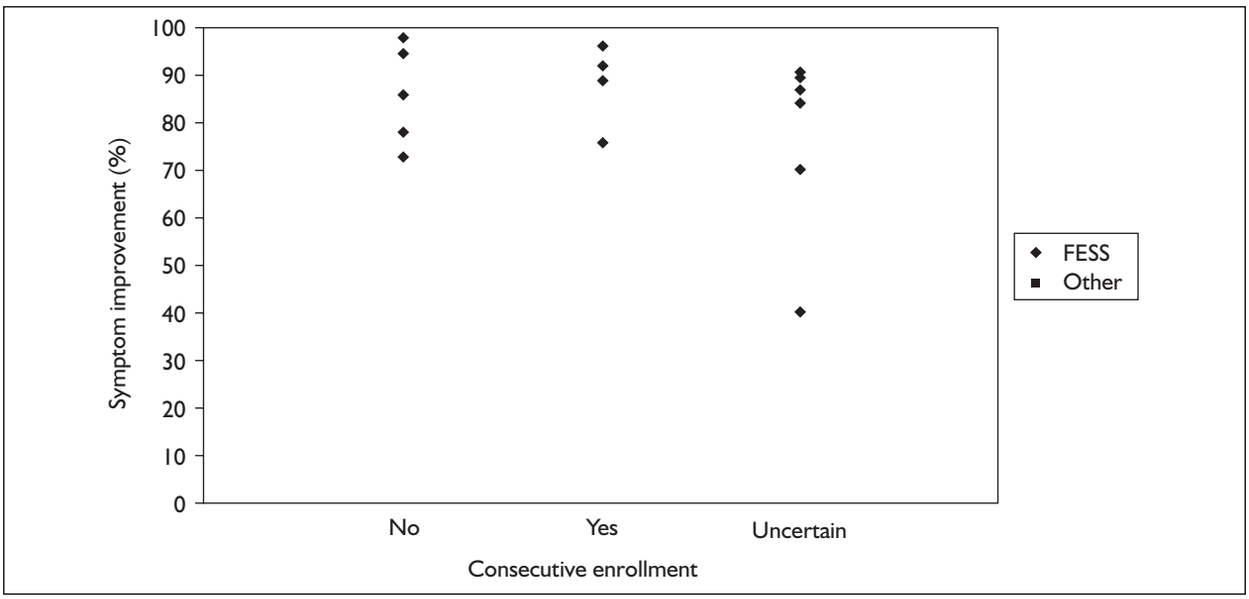
Percentage symptom improvement after FESS and percentage of patients who had undergone previous surgery



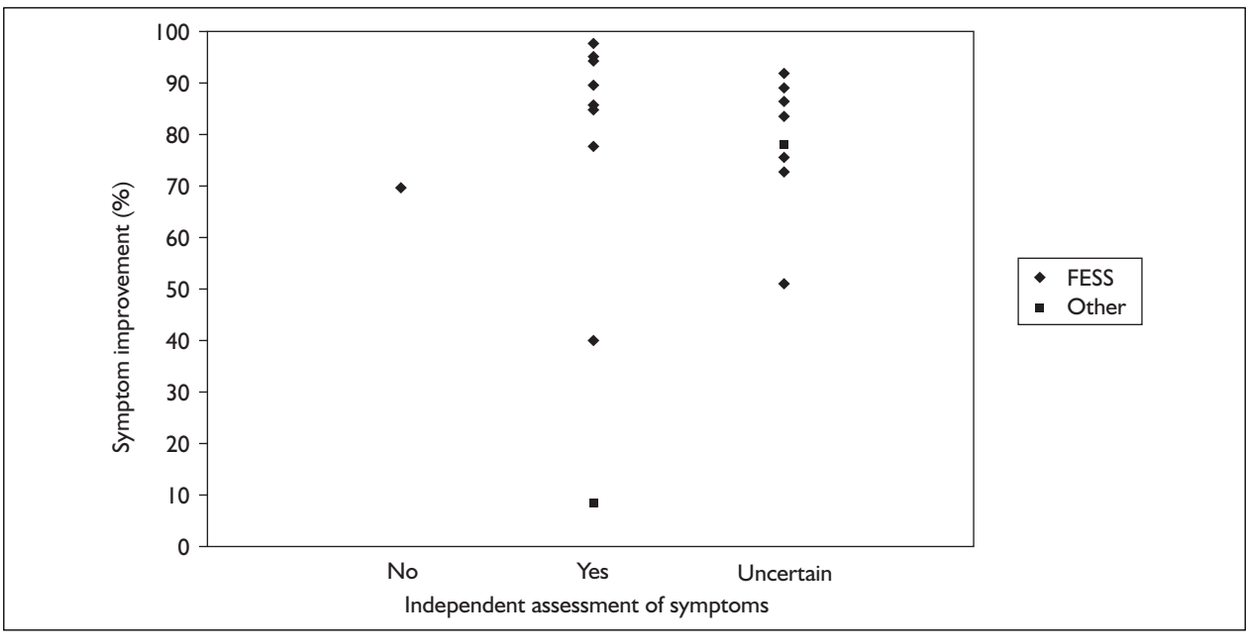
Percentage symptom improvement after FESS and date of publication



Percentage symptom improvement after FESS and prospective study design



Percentage symptom improvement after FESS and consecutive selection of patients



Percentage symptom improvement after FESS and independent assessment of outcomes

Appendix 11

Citations and abstracts of subgroups (specific patients, polyps or techniques/technology) for FESS and the excision of nasal polyps

Functional endoscopic sinus surgery subgroups	Description of subgroup
Specific patient groups ***Allergic fungal sinusitis*** Kinsella JB, Bradfield JJ, Gourley WK, Calhoun KH, Rassekh CH. Allergic fungal sinusitis. *Clin Otolaryngol* 1996;**21**:389–92. Abstract: Allergic fungal sinusitis is a non-invasive disease, first described in the early 1980s. We review our experience with 25 patients treated at the University of Texas Medical Branch, Galveston. All patients were treated surgically, using endoscopic techniques in 17 and combined endoscopic and external procedures in eight. Histological evidence of tissue invasion was absent in all 25 patients, in spite of extensive destruction of the skull base in four. Dematiaceous fungi were the most common cultural isolate. Fifteen patients were available for more than 6 months postoperative follow-up. None of the eight patients who developed recurrent disease had been treated with postoperative systemic steroids. Four of the seven patients who remained disease-free had received steroids. Clinical trials to test the efficacy of systemic steroids in the prevention of disease recurrence are clearly warranted.	Allergic fungal sinusitis
Kupferberg SB, Bent JP, Kuhn FA. Prognosis for allergic fungal sinusitis. *Otolaryngol Head Neck Surg* 1997;**117**:35–41. Abstract: Allergic fungal sinusitis is a recently described clinical entity that has gained increased attention as a cause of chronic sinusitis. The diagnosis can be established by demonstrating (1) type I hypersensitivity confirmed by history, skin tests or serology; (2) nasal polyposis; (3) characteristic CT scan; (4) eosinophilic mucus without fungal invasion into sinus tissue; and (5) positive fungal stain of sinus contents removed intraoperatively or during office endoscopy. The exact pathogenesis of allergic fungal sinusitis remains controversial, and no treatment modality has proved to be consistently effective. Several reports during the last decade have suggested that allergic fungal sinusitis recurs more frequently than chronic bacterial sinusitis, but no studies have specifically addressed the prognosis of allergic fungal sinusitis. During the past two and a half years, we have treated 26 patients with allergic fungal sinusitis. The treatment always included functional endoscopic sinus surgery, topical nasal steroids, postoperative nasal saline irrigations and endoscopic cleaning in the office. Adjuvant medical therapy included systemic steroids, oral antifungals, a combination of systemic steroids and oral antifungals, or in some cases, no additional treatment. Outcome was graded subjectively as improved, unchanged or worse. Mean follow-up was 14.5 months. Twenty-two of 26 patients were improved. In reviewing postoperative outcomes, we observed endoscopic recurrent disease that generally preceded patient symptoms. Consequently, we developed an endoscopic staging system to record postoperative clinical status. Use of this staging system allowed evaluation of various treatments and enabled classification of patient outcome. Nineteen of 24 patients examined with extensive follow-up had objective signs of recurrent disease. It appears that this is a chronic disease characterized by physical signs that appear before the return of subjective clinical symptoms.	Allergic fungal sinusitis
Roth M. Should oral steroids be the primary treatment for allergic fungal sinusitis? *Ear Nose Throat J* 1994;**73**:928–30. Abstract: A case of allergic fungal sinusitis successfully controlled with oral corticosteroids followed by endoscopic sinus surgery is presented. The clinical diagnosis of AFS is emphasized. Endoscopic sinus surgery is preferable to open sinus techniques since the underlying mucosal disease is reversible. A prospective study is needed to determine the most appropriate treatment for this unique clinical disorder. DEM: chronic-sinusitis-diagnosis; chronic-sinusitis-drug-therapy; chronic-sinusitis-surgery; nose-polyp-diagnosis. DER: adult-; article-; case-report; endoscopic-surgery; ethmoidectomy-; human-; male-; mycosis-diagnosis; -oral-drug-administration; -topical-drug-administration. DRM: prednisone-drug-therapy; steroid-drug-therapy.	Allergic fungal sinusitis

Fryen A, Mayser P, Glanz H, Fussle R, Breithaupt H, de Hoog GS. Allergic fungal sinusitis caused by *Bipolaris (Drechslera) hawaiiensis*. *Eur Arch Oto-Rhino-Laryngol* 1999;**256**:330–4. Abstract: Depending on the aggressiveness of the pathogen and a patient's immunocompetence, fungal polypoid pansinusitis or allergic fungal sinusitis (AFS) may be a life-threatening disease. Apart from the clinical findings, its diagnosis is based on the demonstration of mucinous material with abundant eosinophils in the paranasal sinuses (indicating an allergic process), cultivation of the causative pathogen and immunocompetence of the patient. In a 20-year-old immigrant Sudanese woman, AFS due to *Bipolaris (Drechslera) hawaiiensis* was diagnosed. Because of intracranial extension, the disease had led to erosion of the cranial base and orbit with amaurosis on the right side and focal epilepsy. In addition to endonasal microsurgical pansinus operations, local irrigation therapy with amphothericin B was accompanied by systemic treatment with itraconazole after *in vitro* cultivation of the pathogen and determination of its sensitivities. Interdisciplinary management included a combination of endonasal surgery with debridement of infected tissues and wide drainage of the sinuses without removal of skull bone or the dural lesion in addition to specific antimycotic treatment. Injury to adjacent anatomical structures must be avoided in any case to prevent systemic or possibly lethal dissemination of infection.	Allergic fungal sinusitis
Kupferberg SB, Bent JP. Allergic fungal sinusitis in the pediatric population. *Arch Otolaryngol Head Neck Surg* 1996;**122**:1381–4. Abstract: Objective: To determine the optimal treatment in paediatric patients with allergic fungal sinusitis (AFS). Design: A retrospective review of 10 patients diagnosed as having AFS. Setting: Academic tertiary medical centre. Patients: Paediatric patients who fulfilled 5 criteria necessary for diagnosis of AFS: (1) type I hypersensitivity; (2) nasal polyposis; (3) characteristic computed tomographic scan; (4) histological evidence of eosinophilic mucus without evidence of fungal invasion into sinus tissue; and (5) a positive fungal stain or culture of sinus contents. Treatment: All patients were treated with functional endoscopic sinus surgery with removal of fungal debris. Adjuvant therapy included nasal irrigations, postoperative endoscopic cleanings and systemic corticosteroids in 9 of 10 patients. Mean outcome measure: Clinical disease monitored endoscopically by means of an objective staging system. Results: Five patients were without disease (stage 0), 1 had allergic mucin and mucosal oedema (stage I), 1 had allergic mucin and polypoid oedema (stage II), and 3 had polyps and/or fungal debris (stage III). Conclusions: The treatment and prognosis of paediatric AFS are similar to those of adult AFS. However, systemic corticosteroids should be weaned aggressively in children to minimize complications, particularly long-term growth retardation.	Allergic fungal sinusitis in children
Allergy	
Endoscopic sinus surgery: sinonasal polyposis and allergy. *Ear Nose Throat J* 1993;**72**:544, 547–4.	Allergy
Nishioka GJ, Cook PR, Davis WE, McKinsey JP. Immunotherapy in patients undergoing functional endoscopic sinus surgery. *Otolaryngol Head Neck Surg* 1994;**110**:406–12. Abstract: A total of 283 consecutive patients with chronic sinusitis underwent functional endoscopic sinus surgery. There were 72 allergic patients and 211 nonallergic patients. Data were collected on the effect of immunotherapy on middle meatotomy patency, synechiae formation and recurrent polyps in allergic patients. Data supported the following conclusions: (1) Immunotherapy given either before or after surgery does not statistically influence middle meatotomy patency, synechiae formation, or recurrence of polyps after functional endoscopic sinus surgery. However, the data do suggest, for all three outcome parameters, that allergic patients who undergo immunotherapy do better than those who do not undergo immunotherapy and, with the exception of recurrent polyps, do as well as nonallergic patients. (2) The prevalence of preoperative polyps is the same for allergic and nonallergic patients in this study, but polyp recurrence is higher in allergic patients. (3) Approximately 40% of allergic patients who began preoperative immunotherapy stopped immunotherapy after surgery because their allergic symptoms resolved or were minimal. A comment regarding this observation is provided.	Allergy
ASA/aspirin intolerance/Samter's triad	
Hosemann W. Surgical treatment of nasal polyposis in patients with aspirin intolerance. *Thorax* 2000;**55**:S87–S90.	Aspirin intolerance
Amar YG, Frenkiel S, Sobol SE. Outcome analysis of endoscopic sinus surgery for chronic sinusitis in patients having Samter's triad. *J Otolaryngol* 2000;**29**:7–12.	Samter's triad

Abstract: A study was conducted to assess outcome analysis in acetylsalicylic acid (ASA) triad patients after endoscopic sinus surgery (ESS). The control group consisted of patients with chronic sinusitis, with or without asthma, who had also undergone ESS. The study group contained 18 patients with the classic triad who were compared with 22 controls. The study was conducted in retrospective fashion highlighting clinical presentation, radiologic evaluation, surgical findings, and recurrence rate of nasal polyps. Although both groups had a relatively similar age of onset of symptoms, the symptomatic picture was different in the two groups. Radiologic evaluation of the nose and paranasal sinuses revealed more extensive involvement of the sinuses in ASA triad patients. Furthermore, ASA triad patients underwent a greater number of repeat operations. This review suggests that ASA triad patients respond less well to surgical intervention and that other treatment modalities should perhaps be explored.

Dias MA, Biedlingmaier JF. Ketorlac-induced status asthmaticus after endoscopic sinus surgery in a patient with Samter's triad. *Otolaryngol Head Neck Surg* 1997;**117**:S176–S178. — Samter's triad

Asthma

Dinis PB, Gomes A. Sinusitis and asthma: how do they interrelate in sinus surgery? *Am J Rhinol.* 1997;**11**:421–8. — Asthma

Abstract: Sinusitis has been suspected to be etiopathogenically linked to bronchial asthma. Asthma, on the other hand, has been reported to affect negatively the outcome of sinus surgery. The purpose of this study is to elucidate how sinusitis and asthma clinically interrelate, in a group of asthmatic subjects undergoing surgical interventions on the sinuses. A total of 43 asthmatic patients, selected for functional endoscopic sinus surgery, preoperatively had their sinus disease staged and their lung function tested, and were evaluated for allergy and aspirin sensitivity. One year after surgery the surgical results were analysed, lung function was re-assessed and patients' clinical status addressed through a questionnaire; and 93 nonasthmatic patients, whose functional endoscopic sinus surgery was contemporaneous, were used as a control group for the surgical results. Asthma was a critical factor negatively affecting the outcome of sinus surgery. On the other hand, sinus disease extension did not correlate with asthma severity at any stage. Sinus surgery, despite being capable of improving asthma, ultimately failed to produce significant change in lung function scores. Furthermore, consistent good surgical results on the nose did not come across as a critical issue for postoperative asthma improvement. We concluded that, if the surgical intervention on the sinuses was found to be able clinically to benefit asthma evolution, other evidence does not seem to support a causative relationship between sinusitis and asthma. Instead, since asthma was shown to affect sinus disease severity significantly, their association apparently reflects a systemic inflammatory process of the respiratory mucosa.

Dunlop G, Scadding GK, Lund VJ. The effect of endoscopic sinus surgery on asthma: management of patients with chronic rhinosinusitis, nasal polyposis, and asthma. *Am J Rhinol.* 1999;**13**:261–5. — Asthma

Abstract: We attempted to determine the efficacy of endoscopic sinus surgery in adult patients with asthma and chronic rhinosinusitis or nasal polyposis. Fifty asthmatic patients from 17 to 74 years of age with a history of either chronic rhinosinusitis or nasal polyposis were examined. Sinonasal disease was confirmed endoscopically and with computerized tomography, and all had failed aggressive medical management of their sinonasal disease before undergoing endoscopic sinus surgery performed by the same surgeon in all cases. The following were compared for 12 months: preoperative and postoperative overall asthma control, peak flow measurements, asthma medication requirements, including the use of oral steroids, and hospitalizations for asthma. Twenty patients felt that their asthma control had improved postoperatively. Twenty per cent used less steroid inhaler, and 28% less bronchodilator inhaler. Of those 23 patients measuring peak flows, seven achieved higher levels and seven noted fewer dips and swings. Significant reductions in oral steroid requirements ($p < 0.001$) and hospitalization for asthma ($p < 0.025$) were also recorded postoperatively. Irrespective of whether the patient had chronic rhinosinusitis or nasal polyposis, both groups improved postoperatively. The commonest symptoms experienced by the group as a whole and by the nasal polyposis patients were hyposmia and nasal obstruction. Postnasal discharge and headache were more important in the chronic rhinosinusitis group. Mean visual analog scores improved for all symptoms; in particular for nasal obstruction and sense of smell. Aggressive management of sinonasal pathology can improve asthma status. No major differences were recorded for outcomes when comparing patients with chronic rhinosinusitis or nasal polyposis; in particular there was no evidence for a worsening of asthma after nasal polypectomy.

Park AH, Lau J, Stankiewicz J, Chow J. The role of functional endoscopic sinus surgery in asthmatic patients. *J Otolaryngol* 1998;**27**:275–80. — Asthma

Abstract: Objective: This study was conducted to determine the efficacy of FESS (functional endoscopic sinus surgery) on sinus and asthma symptoms. Method: Seventy-nine patients with asthma and medically unresponsive sinusitis were evaluated. Maximal medical therapy was attempted to relieve both sinus and asthma symptoms. The surgical procedures involved standard FESS techniques. Fifty-six percent of patients had undergone a sinus procedure prior to the FESS. Nasal polyposis was noted in 73% of the group. The majority of patients had pansinusitis. Results: Eighty-six percent of patients stated that FESS improved their sinusitis. Nine of 11 sinus symptoms recorded preoperatively diminished significantly ($p < 0.05$) following surgery. Eighty percent of patients noted improvement of their asthma following FESS. The factors associated with treatment failure and the unique characteristics of this disease process were evaluated. Conclusions: FESS is a viable option in the treatment of asthma when medical therapy fails.

Lawson W. The intranasal ethmoidectomy – an experience with 1077 procedures. *Laryngoscope* 1991;**101**:367–71. — Asthma

Abstract: A series of 1077 intranasal ethmoidectomies (825 with sphenoid sinusotomies) was performed in 600 patients over a 15-year period at The Mount Sinai Medical Center. The technique is a modification of the classical operation originally proposed by Yankauer. The rate of significant complications was 1.1%. A subset of 90 patients underwent 166 procedures and were followed an average of 3.5 years. The patients were analysed according to whether the disease was focal or diffuse, infectious or polypoid, and whether asthma was present. The surgical success rate was 88% in nonasthmatics, but dropped to 50% in asthmatic patients despite total sphenoethmoidectomy. This underscores the importance of this condition as a biological modifier of surgical prognosis. Accordingly, a system of classification of sinus diseases is proposed based upon disease extent and type and whether asthma is present.

Lund VJ. The effect of sinonasal surgery on asthma. *Allergy* 1999;**54**:141–5. — Asthma

Children

Bolt RJ, de Vries N, Middelweerd RJ. Endoscopic sinus surgery for nasal polyps in children: results. *Rhinology* 1995;**33**:148–51. — Children

Abstract: Functional endoscopic sinus surgery (FESS) was performed on 21 children with nasal polyps, who had a total of 34 operations, on 65 sides. Retrospectively, we reviewed the preoperative symptoms, preoperative findings and results of FESS. The diagnoses were made with anterior rhinoscopy and CT scan. Allergy could be confirmed in 24%. Half of the children (52%) had been previously operated on because of nasal polyps. They had more recurrences and worse results than children who underwent primary FESS. The subjective results were good in 77% with a mean follow-up of more than two years. However, a poor correlation between subjective and objective results was noted. Minor complications were seen in 9.2% of 65 sides operated on. The specific advantages of FESS in children are discussed.

Jiang RS, Hsu CY. Functional endoscopic sinus surgery in children and adults. *Ann Otol Rhinol Laryngol* 2000;**109**:1113–16. — Children

Abstract: Functional endoscopic sinus surgery (FESS) has become a popular procedure for the treatment of adults with chronic sinusitis. Recently, it has also been applied in the pediatric population. It has been used to treat chronic sinusitis in our department since April 1988. As of March 1998, 1112 patients were available for analysis by file and questionnaire review. Of the 1112 patients, 104 patients (9.4%) who were 16 years of age or younger at the time they first underwent FESS in our department were included in the paediatric endoscopic sinus surgery (PESS) group. The other 1008 patients (90.6%) were included in the ordinary FESS group. In total, 121 PESS and 1106 (adult) FESS operations were performed on these patients. Operative complications occurred in 5 PESS operations (4.1%) and 116 FESS operations (10.5%). The postoperative improvement rate was 84% in PESS and 77.1% in FESS. We conclude that PESS can be applied to treat chronic sinusitis effectively in the pediatric population and with less morbidity than FESS.

Risavi R, Klapan I, Handzic-Cuk J, Barcan T. Our experience with FESS in children. *Int J Pediatr Otorhinolaryngol* 1998;**43**:271–5. — Children

Abstract: Between 1993 and 1996 we operated on 50 children with one of the following surgical indications: 17 children with a complication of acute rhinosinusitis and the

propagation of the process towards the orbit (periorbitis), six children with an ethmoid and sphenoid foreign body (shrapnels shells), 11 children with an antrochoanal polyp, four children with nasal polyposis in cystic fibrosis and 12 children with chronic rhinosinusitis after 2–4 acute reinfections. The surgery was done under endotracheal anesthesia with hypotension. CT axial and coronal tomograms were done during the preoperative treatment. During the 2 weeks preoperative treatment, the patients with polyposis and antrochoanal polyps were treated with 4–8 mg of cortisone per os or i.m., and also with fluticasone propionate 100 mg twice a day and antibiotics in chronic and acute rhinosinusitis. The children's age was between 7 and 15 years. In the patients with nasal polyposis and antrochoanal polyps ($n = 15$) postoperatively, we had four cases of synechiae, recurrent polyposis in two and antrochoanal polyps in two cases.

Triglia JM, Nicollas R. Nasal and sinus polyposis in children. *Laryngoscope* 1997;**107**:963–6. — Children
Abstract: Nasal and sinus polyposis in the pediatric population is uncommon and its etiology is unclear. In this 11-year retrospective study, the authors describe the aetiologic features and evaluate the effectiveness of endoscopic sinus surgery in 46 children. Patients were divided into three groups according to whether nasal and sinus polyposis was isolated ($n = 14$), or associated with either asthma ($n = 5$) or cystic fibrosis ($n = 27$). An allergy was present in 10% of patients with isolated polyposis, 80% of patients with polyposis associated with asthma and 22% of patients with polyposis associated with cystic fibrosis. The indications for surgery were disabling symptoms, especially chronic nasal obstruction, rhinorrhea, mouth breathing and failure to respond to medical treatment. No surgical complications were encountered. Most patients reported improvement in quality of life with reduction of nasal obstruction in 83% of cases and rhinorrhea in 61%. Minor asymptomatic recurrence (i.e. a few micropolyps localized on the roof of the ethmoid cavity) was observed in 24% of the cases in this series, and major recurrence with the same functional symptoms as before surgery in 12%. However, recurrences were higher in patients with cystic fibrosis, because minor recurrence with no clinical manifestation was observed in 32% of these cases and major recurrence in 16%. Endoscopic sinus surgery must be decided in collaboration with the paediatric and pulmonary physicians, and must be performed skillfully. With a mean follow-up of 3.7 years, results in this series are encouraging.

Wolf G, Greistorfer K, Jebeles JA. The endoscopic endonasal surgical technique in the treatment of chronic recurring sinusitis in children. *Rhinology* 1995;**33**:97–103. — Children
Abstract: Chronic recurring sinusitis (CRS) is a difficult diagnosis to make in the paediatric patient. However, increased awareness by physicians and improved technology are contributing to an increasing frequency of this diagnosis. Children with their immature development of the paranasal sinuses and immunological systems present special problems in the treatment of CRS. Concern must be given to potential alteration of the development of the paranasal sinus system and tooth buds in the maxilla by a surgical procedure in children. Various surgical procedures have been recommended in the past in the treatment of CRS failing medical management. A review of 124 paediatric patients undergoing endoscopic endonasal sinus surgery using the technique of Messerklinger and Stammberger in the treatment of CRS over an 11-year period is presented. A detailed questionnaire regarding patients' satisfaction and symptomatic relief has been sent to all patients. The results indicate a successful outcome from this technique and a high level of patient satisfaction. No complications such as CSF leak or orbital injury have been encountered, and no evidence of altered facial growth and development has been noted. We find the endoscopic endonasal technique to be a safe and effective method in the treatment of children with CRS failing medical management.

Al Ammar AY, Tewfik TL, Mazer BD, Manoukian JJ. Nasal polyps in children. *Can J Allergy Clin Immunol* 2000;**5**:123–8. — Children
Abstract: Objective: In this study, patients with nasal polyps (NP) were divided into three groups: patients with cystic fibrosis (CF), patients with clinically isolated NP, and patients with antro-choanal (AC) polyps. Our objective was to compare these three groups and evaluate our management and outcomes in terms of current pediatric literature. Design: This was a retrospective study of 35 children diagnosed with NP between October 1988 and September 1998 in the otolaryngology department of a tertiary-care center. Methods: Patients were studied with respect to their sex, age, associated systemic pathology, symptoms, association with allergy and bronchial asthma, response to medical and surgical treatment, and recurrence rate. Results: The most common pathology associated with NP was found to be CF. NP in children with CF were generally more aggressive and more

resistant to medical and surgical treatment than were isolated NP or AC polyps. Allergy and bronchial asthma were associated with isolated NP more than with CF or AC polyps. Conclusion: The etiology and pathogenesis of NP are not fully understood. Studying NP with respect to their associated systemic pathology, rather than studying them as a single entity, could facilitate understanding of their natural history and may improve treatment results. Surgery remains the best treatment modality for NP, with endoscopic sinus surgery the surgical procedure resulting in the lowest recurrence rate. DEM: nose-polyp-surgery. DER: disease-association; cystic-fibrosis; asthma-; allergy-; endoscopic-surgery; human-; male-; female-; clinical-article; child-; adult-; article-.

Dutt SN, Haider AA, Stewart M, Chen J, Morrissey SMC. Outcome analysis of functional endoscopic sinonasal surgery for paediatric rhinosinusitis using the Lund–Mackay–Kennedy scoring system. *Indian J Otolaryngol Head Neck Surg* 1999;**51**:16–20. — Children

Abstract: There are very few indications for surgical management of chronic rhinosinusitis in children. This has been partly due to the fact that the definition of what qualifies as recalcitrant sinusitis in children is still obscure. There is also significant evidence in literature that surgery, especially radical surgery, on the nose and sinuses in children would result in some interference with the growth of the facio-maxillary skeleton. The advent of functional endoscopic sino-nasal surgery (FESS) in recent years has changed the philosophy of surgery for paediatric rhinosinusitis and has proven to be an effective choice of management in difficult cases. We present here our experience and preliminary results with the use of FESS in nine children with sinonasal disorders including cystic fibrosis. The usefulness of the recently described Lund–Mackay–Kennedy scoring system for chronic rhinosinusitis in terms of symptom score, radiological score, endoscopic score and surgical score has been demonstrated. DEM: rhinosinusitis-surgery; scoring-system; endoscopic-surgery. DER: clinical-article; human-; child-; adolescent-; male-; female-; cystic-fibrosis; nose-polyp; asthma-; treatment-outcome; article-.

Venkatachalam VP. Functional endoscopic sinus surgery in children. *Indian J Otolaryngol Head Neck Surg* 1999;**51**:28–31. — Children

Abstract: Functional endoscopic sinus surgery which has been introduced in Europe by Messerklinger and Stammberger and later on in the United States by Kennedy, has now become a standard modality of treatment for sinus diseases in our country. However, most of the work reported from our country pertains to adult population. In this paper, we present our experience in 30 children who underwent functional endoscopic sinus surgery over the past four years. The age of the patients varied from 7 to 14 years. All the patients tolerated the procedure well and there was no major complication. Follow-up period varied from 9 to 39 months with a mean follow-up of 18.3 months. Out of 30 patients, 27 patients were available for long term assessment of results. 18 patients (66.67%) reported complete improvement of symptoms, while 6 patients (22.22%) had partial improvement. 3 patients (11.11%) showed no improvement. The results of this small series reveal that functional endoscopic sinus surgery has a definite role in the treatment of sinus disease in children. DEM: endoscopic-surgery; sinusitis-surgery. DER: human-; clinical-article; child-; male-; female-; maxilla-sinusitis; paranasal-sinusitis; endoscopic-polypectomy; ethmoidectomy-; nose-polyp; article-.

Lund VJ. Bacterial sinusitis – etiology and surgical-management. *Pediatr Infect Dis J* 1994; **13**:S58–S63. Ref ID: 554. — Children

Manning SC, Wasserman RI, Silver R, Phillips DI. Results of endoscopic sinus surgery In pediatric patients with chronic sinusitis and asthma. *Arch Otolaryngol Head Neck Surg* 1994;**120**:1142–5. — Children

Abstract: Objective: To determine the efficacy of endoscopic sinus surgery in paediatric patients with chronic sinusitis and asthma. Setting: Patients were selected from the tertiary care practice of a pediatric pulmonologist (R.S.) and immunologist (R.L.W.); all underwent sinus surgery at Children's Medical Center at Dallas (Tex). Patients: Fourteen pediatric patients aged 3.5 to 13 years with severe asthma requiring at least intermittent systemic steroid therapy. All patients had a history of sinusitis aggravating asthma and all had computed tomographic evidence of chronic sinus disease. Intervention: All patients underwent endoscopic sinus surgery consisting of bilateral total ethmoidectomies and middle meatus antrostomies at a minimum. Main outcome measures: The period 12 months prior to surgery was compared with 12 months postoperatively with regard to total hospitalization days for asthma treatment, number of school days missed, pulmonary function test results and

systemic glucocorticoid medication requirements. Symptom scores for asthma and sinusitis were assessed via parental questionnaire both preoperatively and postoperatively. Results: No significant difference was found for pulmonary function test results. Eleven of 14 patients demonstrated a significant reduction in hospitalization and school days missed. Twelve of 14 patients experienced a reduction in glucocorticoid requirements. Eleven of 14 and 13 of 14 patients experienced a significant improvement in asthma and sinusitis symptom scores. Conclusion: Endoscopic sinus surgery was effective in reducing sinusitis and improving the overall management of asthma in a majority of study patients.

Slapak I. Indications for endonasal surgery in children. *3rd European Congress of the European Federation of Oto-Rhino-Laryngological Societies Eufos, 2nd Vol* 1996;107–10. Children
Abstract: In 1991–1995 173 children were treated by endonasal endoscopic surgery at the Paediatric ENT Clinic in Brno, 108 boys and 65 girls, age 2 to 19 years were operated. The majority of children were 10–14 years old. The most common indications for endonasal surgery were: 49 cases of a cyst in the maxillary sinus, 35 cases of recurrent sinusitis, 48 cases of nasal polyps.Endonasal surgery was also carried out for less common causes: choanal atresia (7×), orbitocellulitis with orbital abscess (4×), dacryocystitis (1×), cyst of sphenoidal cavity (2×). It was operated: sinoscopy of maxillary sinus 116×, nasal polyps extraction 50×, antrostomy 56×, drenage of orbita absces 4×. The work discusses diagnostic and therapeutical procedures carried out in these diagnoses and therapeutic results.

Hebert RL, Bent JP. Meta-analysis of outcomes of pediatric functional endoscopic sinus surgery. *Laryngoscope* 1998;**108**:796–9. Children
This record is a structured abstract written by CRD reviewers. The original has met a set of quality criteria. Since September 1996 abstracts have been sent to authors for comment. Additional factual information is incorporated into the record. Noted as (A: …).
Authors' objectives
To assess the effectiveness and safety of paediatric functional endoscopic sinus surgery.
Type of intervention
Treatment.
Specific interventions included in the review
Functional endoscopic sinus surgery (FESS) usually consisted of middle meatal antrostomy and anterior ethmoidectomy with some patients requiring complete ethmoidectomy. Other procedures included frontal recess and sphenoid sinusotomy. A second procedure was frequently done, two to three weeks after surgery for removal of splints or biological debris.
Participants included in the review
Children aged from 11 months to 18 years with continued symptoms of chronic sinusitis (nasal obstruction, nasal discharge, cough, headache) despite appropriate medical therapy, and confirmed by abnormal paranasal sinus computed tomography scans were included. Children with underlying medical problems such as cystic fibrosis, immunodeficiencies and asthma were included in 4 out of 8 published articles.
Outcomes assessed in the review
Positive outcomes assessed included the following: 'improved' defined as met expectations, improved, satisfied, improved quality of life; 'much improved' defined as exceeded expectations, greatly improved, very satisfied, disease free, cure; and 'other' including would recommend FESS to other patients or would allow repeat surgery if needed. Ascertainment of outcome was measured by follow-up care giver questionnaire or telephone survey or chart review.
Study designs of evaluations included in the review
Published and unpublished series of children undergoing FESS that scored more than 50 points on defined validity criteria were included. Average length of follow-up was 3.7 years. Eight retrospective and one prospective series were included.
What sources were searched to identify primary studies?
English language studies were sought in the MEDLINE database (1986 to 1996) by cross-referencing the key words: 'pediatric'; 'sinusitis'; 'functional endoscopic sinus surgery'; 'endoscopic sinus surgery'; and 'FESS'. Bibliographies of all included and excluded studies were scanned. Unpublished data were obtained from a retrospective review of patients under 18 years of age undergoing FESS from 1991 to 1996 at the authors' institution.
Criteria on which the validity (or quality) of studies was assessed
Identified studies were scored using the following criteria: length of follow-up; retrospective vs prospective; sample size; and separate reporting of outcome for chronically ill patients. A total of 30 points was given to each of the following categories: follow-up; sample size; and addressing underlying disease. The total score possible was 100.

How were decisions on the relevance of primary studies made?
Listings were reviewed by two authors independently and abstracts considered relevant selected. Methods sections of 23 full-length articles were blindly reviewed by one author for inclusion.
Identified studies scored on validity criteria. Only studies scoring >50 points on validity criteria were included.
How were judgements of validity (or quality) made?
The authors do not state how the papers were assessed for validity, or how many of the authors performed the validity assessment.
How were the data extracted from primary studies?
The authors do not state how the data were extracted for the review, or how many of the authors performed the data extraction.
Number of studies included in the review
9 studies, including 8 published (832 children) and 1 unpublished series (50 children), were included (882 children).
How were the studies combined?
An overall average positive response rate was calculated.
How were differences between studies investigated?
The chi-squared test and Fisher's exact test were used to compare the average positive outcome of the published and the unpublished articles. Sub-group analysis was conducted for children with cystic fibrosis and for studies that had excluded this group of children.
Results of the review
The unpublished series excluded children with significant underlying medical diseases and included children with asthma. One prospective series was found.
Positive outcome for FESS: overall combined average for positive outcome = 88.7%. Rates in published series ranged from 77% to 100% with an average of 88.4%; rate in the unpublished series was 92% (95% CI: 81%, 98%). No statistically significant difference was shown between published and unpublished series using chi-squared test ($p = 0.38$, power = 0.51) or Fisher's exact test ($p = 0.646$, power = 0.12). Positive outcome in children with cystic fibrosis or immunodeficiency (2 published series): rates reported as 0% and 57%. Reported that these patients required multiple procedures. Studies that excluded children with cystic fibrosis or immunodeficiency (2 published series with 62 children and 1 unpublished series with 50 children): published series rate = 89% and 86%; unpublished series rates = 92%.
Major complications (4 series, 690 children): 4 children (0.6%), including 2 with meningitis. Most studies did not report frequency of complications such as synechia or easily controlled epistaxis. 3 published and the unpublished data reported no major complications. Two studies did not report complications. No reports of blindness, cerebrospinal fluid leaks or intracranial bleeds were found.
Was any cost information reported?
No.
Authors' conclusions
Paediatric functional endoscopic sinus surgery is a safe and effective treatment for chronic sinusitis that is refractory to medical treatment.
CRD commentary
The aims and inclusion criteria were stated. Unpublished data were included though no systematic attempts were made to identify unpublished data. Methods used to assess validity were described.
The discussion included mention of some limitations of the primary studies including retrospective studies, the lack of consistent use of an objective measure of outcome, small sample size and the lack of differentiation in the series of outcome based on significant underlying disease.
By limiting the literature search to English language studies identified in MEDLINE, other relevant studies may have been omitted. No details were given of methods used to extract data. Consideration could have been given to including all relevant studies and then assessing the influence of study quality on the outcomes.
Fuller details of the included studies would have been helpful such as methods of evaluation of outcome, drop-out rates and methods used to select patients. It was not clear how drop-outs were treated in the analysis. Heterogeneity was not assessed though some investigation of factors that may influence outcome was undertaken. In the unpublished series only 45% of children undergoing FESS were included in the analysis and it is not clear how representative the subjects in other series were of children undergoing this procedure.

Some assessment of how representative the sample is would be helpful in assessing the relevance of the results to all children undergoing this procedure.
What are the implications of the review?
Clinical: paediatric FESS is an effective and safe procedure.
Research: the authors consider that more long-term standardised prospective studies are required.
Subject index terms
Subject indexing assigned by NLM: Endoscopy/mt (methods); Sinusitis/su (surgery); Adolescence; Child; Child, -Preschool; Follow-Up-Studies; Infant; Retrospective-Studies
Country code
United States
Address for correspondence
Dr R L Hebert II, 2403 Seminole Road, Augusta, GA 30904, USA.
E-mail:RLHII@WORD

Produced by the NHS Centre for Reviews and Dissemination, University of York.

Record number and entry date:
981077 31082000.

Stankiewicz JA. Pediatric endoscopic nasal and sinus surgery. *Otolaryngol Head Neck Surg* 1995;**113**:204–10. — Children

Abstract: A total of 83 children and teenagers underwent endoscopic nasal and sinus surgery. Six patients had surgery for choanal atresia (4) and adenoid hypertrophy (2) and will only be briefly mentioned. Seventy-seven children and teenagers underwent endoscopic sinus surgery for acute and chronic sinusitis, choanal polyposis, and nasal polyposis with a minimum 2-year follow-up. One hundred and thirty-three ethmoidectomies, 37 sphenoidotomies and 119 maxillary antrostomies were performed. Subjective evaluation of the sinus surgery patients indicated that 38% of patients were cured and 55% improved during an average of 3.5 years of follow-up. The number cured and number improved are lower and higher, respectively, than in other reports of results because of the longer follow-up and patient selection. In addition, objective data were obtained on 34 patients with a second- or third-look procedure 2 weeks to 2 months after surgery. These examinations found significant granulation tissue, and almost 50% of patients had at least one maxillary ostia closed. Long-term objective results, however, are not available to determine whether the ostia remained closed. Problems with healing in children's endoscopic sinus surgery are unpredictable compared with those in adult surgery because postoperative debridement and examination are often difficult to perform, thus allowing tissue to heal without control. In this series, other factors such as the increased risks of cystic fibrosis, allergy, and immunodeficiency were also more prevalent and compromised healing [Abstract truncated at 250 words].

Gordts F, Clement PA. Unusual choanal polyps. *Acta Otorhinolaryngol Belg* 1997;**51**:177–80. — Children

Abstract: Four children with choanal polyps are presented. Their age and/or the site of origin of the polyps are unusual. At the time of diagnosis, the two boys were respectively 3 years 9 months and 4 years 6 months. The two girls were aged 9 and 10. In one of the patients the polyp originated from the sphenoidal sinus, in another from the inferior turbinate. The age of the child complicates diagnosis, endoscopic sinus surgery and postoperative care.

Cystic fibrosis

Rosbe KW, Jones DT, Rahbar R, Lahiri T, Auerbach AD. Endoscopic sinus surgery in cystic fibrosis: do patients benefit from surgery? *Int J Pediatr Otorhinolaryngol* 2001;**61**:113–19. — Cystic fibrosis

Abstract: Objective: To examine the effects of endoscopic sinus surgery on the pulmonary status of cystic fibrosis (CF) patients through the objective parameters of steroid use, pulmonary function tests (PFTs), and inpatient hospital days (IHDs). Methods: Retrospective chart review of all patients with CF who underwent endoscopic sinus surgery from 1993 to 1999 at a tertiary care children's hospital. Preoperative pulmonary function, inhaler and steroid use, and IHDs were compared to postoperative parameters within a 1-year period. Results: Sixty-six patients, including eight lung transplant patients, underwent a total of 112 endoscopic sinus surgery procedures; 25 patients underwent more than one procedure. Patients were taking oral steroids preoperatively in 28% of procedures and inhaled steroids in 40%. Postoperatively, there was no statistically significant change in oral or inhaled steroid use, or in postoperative pulmonary function. If the index hospitalisation, which was often for reasons not related to sinus disease, was considered part of the preoperative time period,

endoscopic sinus surgery (ESS) was noted to result in a marked reduction (9.5 days (adjusted), $p = 0.001$) in hospital days during the subsequent 6 months. If the date of the procedure alone was used to define pre- and postoperative time periods, the reduction in postoperative days was more modest and not statistically significant [3.5 days (adjusted), $p = 0.21$]. Conclusions: Although we found no statistically significant difference in PFTs, or steroid requirements following ESS, ESS may have resulted in a reduced need for hospitalization in the 6 months following the procedure. Future prospective studies in a larger number of patients and using more detailed outcome measures are needed to better evaluate the effects of endoscopic sinus surgery in pediatric patients with CF.

Albritton FD, Kingdom TT. Endoscopic sinus surgery in patients with cystic fibrosis: an analysis of complications. *Am J Rhinol* 2000;**14**:379–85. CF
Abstract: The application of endoscopic sinus surgery (ESS) for the management of paranasal sinus disease in patients with cystic fibrosis (CF) has been well described. Due to underlying medical issues such as acquired coagulopathies and advanced pulmonary disease, perioperative morbidity is assumed to be higher in this group. The incidence and type of complications associated with CF patients undergoing ESS has not been previously described. We reviewed 52 consecutive endoscopic procedures in 41 patients with CF performed by a single surgeon over a 34-month period. This review focused on perioperative and postoperative complications. Additional clinical data gathered included estimated blood loss, length of procedure, coagulation laboratory studies, the presence of nasal polyposis, the use of nasal packing, pulmonary function status and average hospitalization time. A total of six complications were identified – four immediate and two delayed. The perioperative or immediate complications included two cases of epistaxis, one case of periorbital ecchymosis, and one case of pulmonary haemorrhage. Delayed complications include one case of epistaxis and one case of intranasal scarring. In two of these six patients, length of hospitalization was prolonged for management of the associated complications. No study has specifically addressed complications of ESS in the CF patient. Our review demonstrates a complication rate of 11.5%, which compares favourably with the non-CF ESS complication rates of 0–17% reported in the literature. Critical to successful management of these patients is coordinated care delivered by the paediatrician or internist, the pulmonary specialist, the anaesthesia team and the otolaryngologist. In addition to a review of current literature, we discuss the overall management approach adopted at our institution and highlight elements thought to minimize morbidity.

Brihaye P, Jorissen M, Clement PA. Chronic rhinosinusitis in cystic fibrosis (mucoviscidosis). *Acta Otorhinolaryngol Belg* 1997;**51**:323–37. CF
Abstract: The authors present two clinical studies performed in the ENT departments of two Belgian Universities. A total of 248 patients with mucoviscidosis (cystic fibrosis, CF) were assessed by means of nasal endoscopy. One hundred and eighteen underwent computed tomography of the paranasal sinuses (CT) and 55 were endoscopically operated. This allowed the observation of different clinical patterns of rhinosinusitis: mucopyosinusitis (pseudomucocele) of the maxillary antrum with bulging of the lateral nasal wall (LNW), nasal polyposis with erosion of the LNW and chronic purulent rhinosinusitis with an isolated prominent uncinate process. The treatment of those patients could be tailored to the individual clinical pattern. Medical therapy consisted of systemic antibiotics and topical drugs delivered by sprays or by lavages with a nose can. Surgery was mainly aimed at removing the massive polyposis when it interfered with the daily life activities. The use of the endoscope enabled more extensive procedures to be performed safely resulting in a lower recurrence rate. In patients with chronic rhinosinusitis without polyposis, yet presenting ostiomeatal obstruction, a limited and more functional endoscopic surgery was indicated in order to restore some drainage and to improve the penetration of topical drugs into the affected sinus. A short addendum presents two studies: one about genetics and the other about prevalence of middle ear disease in CF. The first concluded that no clear correlation was found between DF508 (the most common CF mutation) and nasal polyposis. The second revealed that in contrast with the extremely high prevalence of sinus problems, there was no clear evidence of an increased prevalence of middle ear disease in CF.

Cuyler JP, Monaghan AJ. Cystic fibrosis and sinusitis. *J Otolaryngol* 1989;**18**:173–5. CF
Abstract: Children from the University of Alberta Cystic Fibrosis Clinic were evaluated for nasal polyposis and sinusitis. The results of office examination, coronal CT scanning and functional endoscopic sinus surgery are compared. Sinonasal disease was found to be

ubiquitous in children with cystic fibrosis evaluated with coronal CT scanning. Coronal CT scanning was found to be an accurate predictor of sinonasal disease, and useful for defining the complex anatomy of this region. Outpatient endoscopic sinus surgery, after pre-op assessment by a paediatric pulmonologist, was found to be a safe procedure, with lesser morbidity than conventional sinus surgery.

Duplechain JK, White JA, Miller RH. Pediatric sinusitis. The role of endoscopic sinus surgery in cystic fibrosis and other forms of sinonasal disease. *Arch Otolaryngol Head Neck Surg* 1991; **117**:422–6. CF
Abstract: Functional endoscopic sinus surgery has altered the surgical treatment of sinus disease in adults. We report our experience with functional endoscopic sinus surgery in the paediatric population. Functional endoscopic sinus surgery was safe and effective and compared favourably with traditional surgery with regard to operative time, blood loss and parental opinion.

Halvorson DJ, Dupree JR, Porubsky ES. Management of chronic sinusitis in the adult cystic fibrosis patient. *Ann Otol Rhinol Laryngol* 1998;**107**:946–52. CF
Ref ID: 68
Abstract: Cystic fibrosis (CF) is an autosomal recessive disorder affecting exocrine gland function. Although CF was formerly a deadly disease of infants and children, recent improvements in antibiotics, nutritional therapy and supportive care have extended the median survival to adulthood. Patients with CF often present with sinusitis and nasal polyposis in addition to recurrent pulmonary infections. Although the effectiveness of endoscopic sinus surgery in children with CF has been documented, the treatment guidelines and efficacy in the adult CF patient are unknown. We present a series of 16 adult patients with CF and chronic sinusitis. The majority of patients presented with nasal polyposis and concomitant pulmonary complications. Endoscopic findings are reviewed, with an emphasis on improving pulmonary function following endoscopic sinus surgery. Preliminary findings suggest that endoscopic sinus surgery improves symptoms of sinusitis and exercise tolerance and may delay the progressive respiratory failure that often affects the adult CF patient.

Jones JW, Parsons DS, Cuyler JP. The results of functional endoscopic sinus (FES) surgery on the symptoms of patients with cystic fibrosis. *Int J Pediatr Otorhinolaryngol* 1993;**28**:25–32. CF
Abstract: The relationship between cystic fibrosis (CF) and sinus disease has been appreciated since at least 1959. Unfortunately the standard methods used to treat sinus disease have been very unrewarding in the CF patients. We evaluated the long-term results achieved on 17 patients with CF that underwent FES surgery between July 1988 and January 1991. This group consisted of 16 paediatric and 1 adult patients with previously diagnosed CF, documented chronic sinus disease and nasal polyposis that had failed long-term maximal medical management. The patients, or their parents, were contacted and asked to rate the severity and frequency of their symptoms associated with chronic sinus disease, pre- and postoperatively. The specific symptoms evaluated were nasal obstruction, nasal discharge, postnasal drip, halitosis and cough. In addition, we attempted to measure the number of hospitalizations and the presence and frequency of headaches. We were able to show that, while there was no change in the relative health of patients as measured by the number of hospitalizations, there was a significant improvement in the quality of life. There was a marked decline in the frequency of nasal obstruction, nasal discharge and postnasal drip and a high level of patient satisfaction with the procedure. No changes were seen in the frequency or nature of the cough, halitosis or headache.

Kerrebijn JD, Poublon RM, Overbeek SE. Nasal and paranasal disease in adult cystic fibrosis patients. *Eur Respir J* 1992;**5**:1239–42. CF
Abstract: Children with cystic fibrosis frequently have nasal polyps and sinusitis. This study addresses (para-) nasal disease in 39 adult cystic fibrosis patients. Fifteen patients (39%) had recently had serious nasal symptoms and 26% sinusitis. Seventeen (44%) had nasal polyposis. Almost all sinus radiographs taken showed opacification, which was unrelated to symptoms. Polypectomies and antral irrigations were usually ineffective, whilst more extensive surgery generally gave better results. It is concluded that a substantial number of adult cystic fibrosis patients frequently have upper airway symptoms. Sinus radiographs have little or no diagnostic value. Treatment of (para-) nasal disease in cystic fibrosis patients can be difficult; a guideline for treatment is suggested, calling for simple interventions coupled with intranasal steroids and nasal irrigation in early disease and for endoscopic to radical sinus surgery in recurrent advanced disease.

Madonna D, Isaacson G, Rosenfeld RM, Panitch H. Effect of sinus surgery on pulmonary function in patients with cystic fibrosis. *Laryngoscope* 1997;**107**:328–31. CF
Abstract: The impact of sinus surgery on the pulmonary status of cystic fibrosis patients is unknown. This retrospective study reviewed the charts of the cystic fibrosis patients presenting to our institution's cystic fibrosis centre with nasal obstruction, recurrent sinusitis and nasal polyposis. This group subsequently underwent endoscopic ethmoidectomy and antrostomy. Fourteen of the 15 patients, ages 5–24 years, received preoperative and postoperative pulmonary function testing obtained by spirometry. The data were compiled and analysed statistically. Our results suggested no significant improvement in the pulmonary function of cystic fibrosis patients after sinus surgery.

Moss RB, King VV. Management of sinusitis in cystic fibrosis by endoscopic surgery and serial antimicrobial lavage. Reduction in recurrence requiring surgery. *Arch Otolaryngol Head Neck Surg* 1995;**121**:566–72. CF
Abstract: Objective: An effective treatment programme for refractory chronic sinusitis in patients with cystic fibrosis has not been achieved. We developed a long-term management approach by combining endoscopic surgery with serial antimicrobial lavage (ESSAL). Design: In a before and after trial, results of ESSAL in 32 patients were compared with those of conventional sinus surgery without serial antimicrobial lavage in 19 patients. At least 1 year follow-up was available in all but one patient. Setting and patients: Patients attending the Stanford (Calif) Cystic Fibrosis Center were consecutively referred for otolaryngologic evaluation for symptoms and signs of refractory sinusitis. Those subjects who were evaluated before 1990 were treated conventionally and afterward by ESSAL. Intervention: Conventionally treated patients underwent one or more of the following procedures: polypectomy, ethmoidectomy, antrostomy or Caldwell–Luc operation. The ESSAL approach incorporated preoperative rhinosinuscopy and computed tomography, endoscopic surgery, a postoperative course of antral antimicrobial lavage and monthly maintenance antimicrobial lavage via brief antral catheterization. Main outcome measure: Intensity and frequency of sinus surgery after initial presentation. Results: The two groups were similar demographically and in clinical presentation, including the presence of nasal polyposis in 34% and 42%, respectively. The ESSAL group had fewer operations per patient, Caldwell–Luc procedures and a decrease in repeated surgery at 1-year (10% vs 47%) and 2-year (22% vs 72%) follow-ups. Conclusion: The ESSAL is a successful approach to treatment of sinusitis in cystic fibrosis that reduces recurrence requiring further surgery for at least 2 years.

RoweJones JM, Mackay IS. Endoscopic sinus surgery in the treatment of cystic fibrosis with nasal polyposis. *Laryngoscope* 1996;**106**:1540–4. CF
Abstract: We have performed endoscopic sinus surgery on 46 patients with chronic, polypoid rhinosinusitis since 1989. Follow-up ranged from 1 month to 6 years (mean, 28.2 months). Overall, our patients had a 50% chance either of their symptoms returning to preoperative severity or of undergoing a second endoscopic sinus procedure, by 18 to 24 months of postoperative follow-up. Patients with predominantly infective symptoms of mucopurulent rhinorrhea and pain had a significantly better outcome than those with predominantly nasal blockage. The chance of the former group of patients suffering symptom deterioration back to the preoperative state or undergoing a second endoscopic sinus operation was 37% of that of the latter group. The extent of disease on computed tomography scan had no relation to outcome.

TI:The role of functional endoscopic sinus surgery (FESS) after heart lung transplant in cystic fibrosis patients CF
PI:N023108481O
SD:01/01/1994
ED:31/12/1999
MC:[This project is part of a multi-centre study]
AU:Mr Peter Clark
AD:ENT/OMF, Southampton General Hospital, Tremona Road, Southampton, SO16 6YD, United Kingdom
MR:To evaluate FESS
ST:Complete
F1:Funding organisation name: NO FUNDING
F4:Funding organisation name: No Funding
F5:Funding reference number: N/A

PK:CYSTIC-FIBROSIS Q-surgery; HEART-LUNG-TRANSPLANTATION Q-methods; ENDOSCOPY
SK:HUMAN
PR:Southampton University Hospitals NHS Trust
RE:South East Regional Office.

Other patient groups

Jiang RS, Hsu CY. Endoscopic sinus surgery for the treatment of chronic sinusitis in geriatric patients. *Ear Nose Throat J* 2001;**80**:230–2. — Geriatric patients

Abstract: Although endoscopic sinus surgery is a well-documented procedure for the treatment of chronic sinusitis in children and adults, no study has been conducted to specifically investigate its application in a geriatric population. We undertook to fill this void by analysing the records of 1112 patients who had undergone endoscopic sinus surgery for chronic sinusitis in our department between April 1988 and March 1998. We categorized these patients by age. There were 171 patients (15.4%) in the geriatric group (age: ⩾65 yr), 837 patients (75.3%) in the adult group (age: 17 to 64), and 104 patients (9.4%) in the paediatric group (age: ⩽16 yr). We found that the geriatric group experienced a disproportionately larger share of operative complications, but most of them were minor. Outcomes were similar in all three groups. We conclude that endoscopic sinus surgery is a safe and effective treatment for older patients with chronic sinusitis. DEM: chronic-sinusitis-surgery; chronic-sinusitis-therapy; geriatric-patient; endoscopic-surgery; nose-polyp-diagnosis; nose-polyp-surgery. DER: chronic-disease; aging-; documentation-; surgical-technique; safety-; treatment-indication; antibiotic-therapy; questionnaire-; patient-care; treatment-outcome; human-; male-; female-; major-clinical-study; adolescent-; aged-; child-; adult-; article-.

Rossi RM, Wanke C, Federman M. Microsporidian sinusitis in patients with the acquired immunodeficiency syndrome. *Laryngoscope* 1996;**106**:966–71. — HIV

Abstract: Sinusitis in patients with human immunodeficiency virus (HIV) infection usually arises from the same organisms that are infective in the nonimmunosuppressed population. The authors of this article report that optimal antimicrobial treatment and functional endoscopic sinus surgery failed to eradicate sinonasal disease in three of five patients with acquired immunodeficiency syndrome (AIDS) and refractory sinusitis. The sinonasal disease was manifested by congested, edematous and polypoid mucosa, often with a superimposed bacterial infection from ostial obstruction. After tissue was sent for electron microscopy (EM), the patients were eventually diagnosed with microsporidiosis of the sinonasal cavities. Microsporidia are obligate intracellular protozoans that have been seen in AIDS patients with diarrhoea. These protozoans have only recently been identified in sinonasal tissue. Microsporidia are often missed on routine histopathology. The authors present case reports on their five AIDS patients with refractory sinusitis. The management of refractory sinusitis in the HIV-infected population, including mandatory EM of sinonasal tissue, is also discussed.

Ku PKM, Tong MCF, Leung CY, Pak MW, van Hasselt CA. Nasal manifestation of extranodal Rosai–Dorfman disease – diagnosis and management. *J Laryngol Otol* 1999;**113**:275–80. — Extranodal Rosai–Dorfman disease

Abstract: Two cases of Rosai–Dorfman disease with polypoid nasal infiltration mimicking nasal tuberculosis and malignant lymphoma are reported. This rare benign disease was first described by Rosai and Dorfman in 1969 and is characterized by histiocytic proliferation. It is seldom considered in the differential diagnosis of granulomatous diseases due to its rarity and histological similarity to other diseases. Extranodal manifestations of this disease are uncommon. Although no specific treatment can guarantee a sustained remission of this disease, surgery for loco-regional lesions can result in long-term symptomatic control and restoration of function. Both patients underwent endoscopic resection of the nasal polypoid lesions and have subsequently been free of recurrence. Loco-regional infiltration of the nasal cavity by Rosai–Dorfman disease is effectively managed by endoscopic resection.

Emery BE, Oberle AD, Abreo F, Day TA, Stucker FJ. *Schizophyllum commune* sinusitis – a case-report and radiologic findings. *Am J Rhinol* 1995;**9**:149–54. — Schizophyllum-commune sinusitis

Abstract: Chronic sinusitis is now considered the most common chronic disease seen in this country. The infections are commonly polymicrobial and include aerobes and anaerobes. Fungal sinusitis accounts for up to 10% of cases of chronic sinusitis, and the disease ranges from allergic fungal sinusitis through fungus balls to invasive fungal sinus disease. We report the case of a 19-year-old black female with nasal obstruction, clear rhinorrhea and nasal polyps. She underwent endoscopic sinus surgery after medical management failed to eradicate her symptoms. Cultures from her paranasal sinuses grew *S. commune*, a

mushroom, a member of the Basidiomycetes. There have been four prior reports of *S. commune* sinusitis described in the literature. Presented is a review of the literature, a description of the histologic, mycologic and radiologic findings and suggested treatment. The magnetic resonance imaging (MRI) findings are presented here for the first time.

Specific types of polyps

Antrochoanal polyps

Cook PR, Davis WE, McDonald R, McKinsey JP. Antrochoanal polyposis: a review of 33 cases. *Ear Nose Throat J* 1993;**72**:401–10. — Antrochoanal

Abstract: We report on a series of 33 consecutive cases of antrochoanal polyp (ACP) treated by endoscopic sinus surgery over a five-year period. All but one patient was treated by endoscopic sinus surgery alone. This method of treatment was quite effective for ACPs. These 33 patients represent 22.3% of all nasal polyp patients on whom we operated during the same period. This incidence of ACP is greater than that generally reported in the literature. Some authors have attempted to distinguish ACPs from common nasal polyps primarily on the basis of morphology, histology, and the clinical behavior of the ACPs. In our series, a multivariate analysis, including histopathologic correlation, did not support the notion that ACPs are clearly distinct from common nasal polyps. Some interesting differences between the polyp groups did, however, become evident in our data analysis. Generally, ACPs are not thought to be associated with allergic disease; however, in our series we found the association of allergic disease with ACPs to be statistically significant (chi-squared = 4.575, $p < 0.05$).

Aktas D, Yetiser S, Gerek M, Kurnaz A, Can C, Kahramanyol M. Antrochoanal polyps: analysis of 16 cases. *Rhinology* 1998;**36**:81–5. — Antochoanal polyps

Abstract: Antrochoanal polyps are rare lesions. Several surgical techniques have been reported to provide complete cure of the disease. However, inadequate treatment may result in a high rate of recurrences. The aetiological as well as predisposing factors are not well understood. We present a literature review and discuss the clinical, pathological and histological features of 16 patients with antrochoanal polyps, who have been surgically treated by either an endoscopical or conventional approach. It has been found that allergy has no role in the aetiology of antrochoanal polyps. However, the majority of the patients have sinonasal disease. The most common preoperative radiological finding is the mucocoele-like appearance, which has also been confirmed in surgery. It is remarkable that antrochoanal polyps have recurred in 4 out of 8 patients, who underwent simple intranasal polypectomy and inferior turbinectomy. As compared to conventional technique, the endoscopic approach proves to be superior.

el Guindy A, Mansour MH. The role of transcanine surgery in antrochoanal polyps. *J Laryngol Otol* 1994;**108**:1055–7. — Antochoanal polyps

Abstract: During a period of two years, 24 cases of antrochoanal polyps were diagnosed by clinical examination, nasal endoscopy and computerized tomography. Surgery started with endoscopic transnasal removal of the polyp. Every attempt was made to remove the antral portion of the polyp through the wide ostium. Then transcanine sinuscopy was performed. Remnants of the polyp were detected and removed in five cases. One or more other cysts were found and extirpated in 11 cases. Endoscopic follow-up for 18 months to three years revealed no recurrence. It is recommended that endoscopic middle meatal surgery should be combined with transcanine sinuscopy to ensure complete removal of antrochoanal polyps

Basak S, Karaman CZ, Akdilli A, Metin KK. Surgical approaches to antrochoanal polyps in children. *Int J Pediatr Otorhinolaryngol* 1998;**46**:197–205. — Antrochoanal in children

Abstract: Antrochoanal polyps (ACP) represent 4–6% of all nasal polyps in the general population, but this proportion increases to 33% in the paediatric group. The aim of this study is to discuss clinical and radiological findings, and some different surgical approaches with their results in the paediatric patients. This study consists of eight children with ACP diagnosed by means of clinical examination, nasal endoscopy and computed tomography. One patient was treated only with simple polypectomy. In five patients, transcanine sinuscopy (TS) was added to functional endoscopic sinus surgery. Four of the patients underwent anterior ethmoidectomy and uncinectomy. Middle meatal antrostomy was applied to two of them. No recurrence was encountered within 5–30 months. The decision for the appropriate type of surgery for ACP is influenced by factors such as patient's age, other accompanying sinus pathologies, recurrence after previous surgery, and the possibility of total excision. In patients carrying the risk of recurrence, it is especially important to remove the polyp completely and

manage other sinus pathologies, as well as avoiding an unnecessarily expanded operation. In selected patients, we believe that TS may be adequate in totally removing ACP.	
Hong SK, Min YG, Kim CN, Byun SW. Endoscopic removal of the antral portion of antrochoanal polyp by powered instrumentation. *Laryngoscope* 2001;**111**:1774–8. Abstract: Objectives: To introduce a new surgical technique for endoscopic removal of the antral portion of antrochoanal polyp (ACP) by powered instrumentation and to determine its efficacy by measures of relevant patient outcome. Study design: Prospective study in 28 patients undergoing endoscopic sinus surgery for ACP by our surgical technique. Methods: Improvements of clinical symptoms and endoscopic and computed tomographic findings were evaluated postoperatively with a follow-up period ranging from 12 to 52 months. All symptom scores on a 100-mm visual analogue scale before operation were compared with those at the last visit after operation. Postoperative endoscopic and computed tomographic findings were graded using a three-point scale ranging from 0 to 2. In surgical technique, the antral portion of ACP was identified through the enlarged ostium under intranasal endoscopy and removed by a blade of powered instrumentation that was inserted through the canine fossa. Results: Symptom scores were all significantly reduced postoperatively. All but one patient showed improvement in clinical symptoms and endoscopic and computed tomographic findings during the follow-up period. There were no major complications specific to this technique. Conclusion: Our technique provides an attractive alternative to other methods for removing the antral portion of an ACP and is associated with excellent outcomes and minimal morbidities.	Antrochoanal polyp by powered instrumentation
Kamel R. Endoscopic transnasal surgery in antrochoanal polyp. *Arch Otolaryngol Head Neck Surg* 1990;**116**:841–3. Abstract: The current treatment of antrochoanal polyp is simple avulsion of the nasal part with or without removal of the antral part. The antral part is removed through a Caldwell–Luc antrostomy, inferior meatal antrostomy, or middle meatal antrostomy. In this study, endoscopic surgery was performed in 22 cases of antrochoanal polyps where the antral part was removed through the middle meatus. Two new instruments were designed to help complete removal of the antral part of the polyp through the maxillary ostium. Some points of controversy concerning the antrochoanal polyp are discussed according to the diagnostic and therapeutic endoscopic findings. Endoscopic follow-up of these cases for periods ranging between 6 and 30 months, with an average of 20 months, showed no recurrence. It was concluded that endoscopic surgery of the antrochoanal polyp through the middle meatus could be performed as an outpatient procedure, and is safe and reliable.	Antrochoanal polyp
Raji A, Essaadi M, Detsouli M, Chekkoury IA, Benchakroun. The antrochoanal polyp. *Acta Otorhinolaryngol Belg* 2000;**54**:473–8. Abstract: The antrochoanal polyp is a particular pathology of nasal fossae and sinuses. Since the first description made by Killian, several pathogenic mechanisms and surgical techniques have been reported. The polyp exeresis is classically made using the Caldwell–Luc approach. The aim of our study is to lay stress on the interest of endonasal surgery compared to other surgical procedures. Between 1996 and 1998, we operated on 12 cases by endonasal approach. Diagnosis is made upon clinical, CT-scan and pathological data. In all cases, an extended middle meatotomy is performed. In 3 cases, it is associated with an inferior meatotomy. The polyp pedicle is systematically coagulated at level of its maxillary implantation area. No recurrence, nor operative complication are noted. The average follow-up is 12 months.	Antrochoanal polyp
Sato K, Nakashima T. Endoscopic sinus surgery for chronic sinusitis with antrochoanal polyp. *Laryngoscope* 2000;**110**:1581–3. Ref ID: 149	Antrochoanal polyp
Gerek M, Yetiser S, Dundar A, Ozkaptan Y. Transnasal and transcanine endoscopy in management of antrochoanal polyp. *Sydney '97 – XVI World Congress of Otorhinolaryngology Head and Neck Surgery, Tomes 1 and 2* 1996;1499–503. Abstract: Different surgical methods have been in practice in the management of the antrochoanal polyp. In the last three years, 15 cases of huge anthrochonal polyps extending to nasopharynx were diagnosed by clinical examination, nasal endoscopy, computerized tomograpy. The diagnosis of anthrochonal polyp was confirmed by histopathologic examination of the surgical material. Endoscopic sinus surgery was used in the removal of anthrochonal polyps through middle meatal antrostomy and the greater portions were	Antrochoanal polyp

removed by forceps orally. By opening a wide middle meatal antrostomy and by performing transcanine sinoscopy, all the detected remnants of the polyps were removed carefully. In 11 of the cases, one or more cystic lesions were accompanied to anthrochonal polyps in maxillary sinus and they were also removed. In the follow-up period of at least 8 months, no recurrence was observed. It is advised that combination of sinoscopy and transnasal endoscopy will be the excellent surgical option in the management of anthrochonal polyps.	
Loury MC, Hinkley DK, Wong W. Endoscopic transnasal antrochoanal polypectomy: an alternative to the transantral approach. *South Med J* 1993;**86**:18–22. Abstract: The use of functional endoscopic sinus surgery has been limited typically to management of chronic sinusitis, nasal polyposis and recurrent acute sinusitis. Antrochoanal polyps (ACPs) traditionally have been resected using a Caldwell–Luc sinusotomy. We used the endoscopic approach, however, in the treatment of five cases of ACP. There was recurrence in one case, but the polyp was successfully removed endoscopically. In the other four cases there has been no evidence of recurrence at a maximum follow-up of 24 months. We believe that transnasal endoscopic antrochoanal polypectomy is an excellent surgical option; there is significantly less postoperative morbidity than with the transantral approach, and rates of complete cure are similar.	Antrochoanal polyps
Deka RC. Antrochoanal polyp: its pathogenesis origin and management by functional endonasal endoscopic surgery. *Indian J Otolaryngol Head Neck Surgery* 1999;**51**:33–5.	Antrochoanal polyps
Orvidas LJ, Beatty CW, Weaver AL. Antrochoanal polyps in children. *Am J Rhinol* 2001; **15**:321–5. Abstract: Although relatively rare, antrochoanal polyps represent one of the most common types of polyp diagnosed in children without cystic fibrosis. In an attempt to better define this entity and discuss treatment options, the histories and operative reports of all 25 children (aged 17 years and younger) diagnosed with an antrochoanal polyp between 1970 and 1997 at our institution were reviewed. All 25 children complained of nasal obstruction on presentation; other presenting symptoms included rhinorrhea (48%), snoring (36%), and mouth breathing (32%). All 25 patients were noted to have a mass in the nose on examination, and 16 (64%) also had a mass noted in the nasopharynx. All but 1 patient underwent surgical removal of the polyp: intranasal avulsion only, 2 patients; Caldwell–Luc procedures, 10 patients; intranasal procedures, 8 patients; and endoscopic procedures, 4 patients. Mean time to first recurrence was 44.5 months. Seven patients (29%) who underwent excision at our institution experienced recurrence, 3 after endoscopic procedures and 4 after intranasal procedures (with or without Caldwell–Luc; 1 of these patients had a second recurrence), Complications were unusual and included bleeding after pack removal (8.3%) and facial paresthesias (10%). Follow-up ranged from 2 days to almost 27 years and was aided by telephone interviews. We conclude that surgical treatment of these lesions is safe and effective. Endoscopic removal may result in a higher recurrence rate.	Antrochoanal polyps
Myatt HM, Cabrera M. Bilateral antrochonanal polyps in a child: a case report. *J Laryngol Otol* 1996;**110**:272–4. Abstract: In this paper we present the first ever reported case of simultaneously occurring bilateral antrochoanal polyps in a fit 12-year-old child. The antrochoanal polyps (ACP) were removed using functional endoscopic sinus surgery (FESS) which achieved complete cure. Histological analysis of the polyps showed them to be of benign inflammatory origin.	Antrochoanal polyps in a child
Woolley AL, Clary RA, Lusk RP. Antrochoanal polyps in children. *Am J Otolaryngol Head Neck Med Surg* 1996;**17**:368–73.	Antrochoanal polyps in children
Vleming M, de Vries N. Endoscopic sinus surgery for antrochoanal polyps. *Rhinology* 1991; **29**:77–8.	Antrochonal polyps
Sphenochoanal polyp	
Soh KB, Tan KK. Sphenochoanal polyps in Singapore: diagnosis and current management. *Singapore Med J* 2000;**41**:184–7. Abstract: Sphenochoanal polyp is a rare form of choanal polyp. If unrecognised, they can be mistaken for an antrochoanal polyp. This will result in unnecessary exploration of the maxillary sinus, and a failure to remove the sphenoidal component of the sphenochoanal polyp. Adequate preoperative evaluation with computed tomography or magnetic resonance is mandatory to ascertain the correct diagnosis, and to facilitate the planning of the	Sphenochoanal polyps

appropriate surgical procedure. We present two patients with sphenochoanal polyp and a review of the literature.	
Crampette L, Mondain M, Rombaux P. Sphenochoanal polyp in children. Diagnosis and treatment. *Rhinology* 1995;**33**:43–5. Abstract: Two cases of sphenochoanal polyp (SCP) in children are reported. SCPs originate in the sphenoid sinus cavity, and extend into the choanal via the ostium. Symptoms associated with the syndrome include nasal blockage and headaches. Endoscopical examination reveals the presence of a choanal polyp, and the sphenoid origin of the polyp can be determined by CT scan. In cases where the middle meatus is obstructed, an opacity of the maxillary sinus is often observed. SCPs cannot be distinguished from antrochoanal polyp (ACP) by histological means. The treatment of the SCPs involves surgical removal and enlargement of the sphenoid sinus ostium. Ignorance surrounding the existence and the treatment of this syndrome may result in insufficient treatment and the consequent recurrence of the disorder.	Sphenochoanal polyp in children
Eloy P, Evrard I, Bertrand B, Delos M. Choanal polyp of sphenoidal origin. Report of two cases. *Acta Otorhinolaryngol Belg* 1996;**50**:183–9. Abstract: Clinical presentation and imaging of two cases of choanal polyp extruding from the sphenoid sinus are presented. The clinical, radiological and pathological features of the choanal polyp are reviewed. The major role of radical endoscopic sinus surgery consisting of a complete removal of the polyp and of its insertion into the paranasal sinus cavity is emphasized.	Sphenochonal polyp
Dadas B, Yilmaz O, Vural C, Calis AB, Turgut S. Choanal polyp of sphenoidal origin. *Eur Arch Otorhinolaryngol* 2000;**257**:379–81. Abstract: Sphenochoanal polyp is a rare entity which originates in the sphenoid sinus cavity and extends into the choana via the ostium. It presents in a similar manner to the more common antrochoanal polyp. Radiological examination is necessary to differentiate between these two types. We present a case of sphenochoanal polyp and review the clinical, radiological and pathological features. The role of endoscopic sinus surgery is emphasised.	Sphenochoanal polp
Tosun F, Yetiser S, Akcam T, Ozkaptan Y. Sphenochoanal polyp: endoscopic surgery. *Int J Pediatr Otorhinolaryngol* 2001;**58**:87–90. Abstract: Sphenochoanal polyp is a rare entity originating from sphenoid sinus. It may be confused with antrochoanal polyp on anterior rhinoscopy because of its similar appearance. Computerized tomography and nasal endoscopy have contributed to an increase of accuracy in the diagnosis of these masses. Simple polypectomy that leaves some part of the polyp inside the sphenoid sinus carries a high risk of recurrence. Destructive external approaches to gain access to the sphenoid sinus are also not advisable in children for a benign disease. We present two cases of sphenochoanal polyps in two children that were operated by endonasal endoscopic approach. They were free of symptoms after surgery. No complications and recurrences were observed at 28 and 18 months of follow-up periods respectively.	Sphenochoanal polyp
Ileri F, Koybasioglu A, Uslu S. Clinical presentation of a sphenochoanal polyp. *Eur Arch Oto-Rhino-Laryngol* 1998;**255**:138–9. Abstract: Although choanal polyps frequently arise from the maxillary sinus, a choanal polyp originating from the sphenoid sinus is a rare entity. In this report, an unusual case of a large choanal polyp taking origin from the sphenoid sinus is presented. The reasons for its development and methods of management are discussed.	Sphenochoanal polyp
Sethi DS, Lau DP, Chee LW, Chong V. Isolated sphenoethmoid recess polyps. *J Laryngol Otol* 1998;**112**:660–3. Abstract: Isolated sphenoethmoid recess (SER) polyps are rare. They usually arise from the sphenoid sinus. We report six patients with SER polyps as the only abnormal clinical finding at initial presentation. All cases were investigated with outpatient biopsy and computed tomography (CT) or magnetic resonance (MR) imaging. Preoperative histology revealed three cases of inflammatory disease, two cases with inverted papilloma, and one case of an ectopic pituitary adenoma arising from the sphenoid sinus. One of the inflammatory polyps arose directly from the mucosa around the sphenoid ostium. The other five cases involved the sphenoid sinus. Except for the ectopic pituitary adenoma all the polyps were managed by transnasal endoscopic surgery. We emphasize that isolated SER polyps may signify existing sphenoid pathology and a preoperative biopsy is valuable for planning surgery.	Sphenoethmoid recess polyps

Specific techniques/technologies

Computer aided surgery

Caversaccio M, Bachler R, Ladrach K, Schroth G, Nolte LP, Hausler R. Frameless computer-aided surgery system for revision endoscopic sinus surgery. *Otolaryngol Head Neck Surg* 2000;**122**:808–13. — Computer aided

Abstract: To increase the intraoperative safety factor and to acquire anatomic assistance during revision endoscopic sinus surgery (RESS), we used an optical computer-aided surgery (CAS) system that we developed collaboratively in Bern, Switzerland. During 1 year, 25 RESSs were performed with CAS: recurrent polyposis ($n = 20$), recurrent frontal recess stenosis ($n = 3$) and recurrent frontal recess stenosis with mucocele ($n = 2$). These patients were compared with a control group of 10 patients undergoing RESS without CAS. The same surgeon (M.C.) performed all operations, and there were no minor or major complications in either group. The clinical inaccuracy of our system is between 0.5 and 2 mm with paired-point and surface matching. The navigation system is an important aid to surgeons in identifying anatomic landmarks that are typically difficult to visualize in this type of surgery, thus reducing the stress placed on the surgeon.

Gibbons MD, Gunn CG, Niwas S, Sillers MJ. Cost analysis of computer-aided endoscopic sinus surgery. *Am J Rhinol* 2001;**15**:71–5. — Computer aided

This study has been evaluated by a health economist for CRD. In due course a structured abstract will be written for this record, and, in the meantime, this provisional record has been loaded for information purposes.If you would like us to prioritise the writing of this abstract and you would like to receive an early copy, please contact the NHS Centre for Reviews and Dissemination (tel: (+44)-1904-434560 or e-mail: jc32@york.ac.uk) quoting the Accession Number of this record.
Economic analysis
Conclusions, commentary and implications
Subject index terms
Subject indexing assigned by NLM:
Alabama; Chronic-Disease; Cost-Benefit-Analysis; Endoscopy/ec (economics); Endoscopy/mt (methods); Human; Otorhinolaryngologic-Surgical-Procedures/ec (economics); Otorhinolaryngologic-Surgical-Procedures/mt (methods); Retrospective-Studies; Rhinitis/ec (economics); Rhinitis/su (surgery); Sinusitis/ec (economics); Sinusitis/su (surgery); Therapy,-Computer-Assisted/ec (economics)
Country code
USA
Address for correspondence
Dr M J Sillers, Department of Surgery, Division of Otolaryngology/Head and Neck Surgery, The University of Alabama at Birmingham, 1501 5th Ave, South Birmingham, AL 35233, USA.
Produced by the NHS Centre for Reviews and Dissemination, University of York.

Record number and entry date:
20011018 30052001.

Anon JB, Lipman SP, Oppenheim D, Halt RA. Computer-assisted endoscopic sinus surgery. *Laryngoscope* 1994;**104**:901–5. — Computer assisted

Gunkel AR, Freysinger W, Thumfart WF, Pototschnig C. Complete sphenoethmoidectomy and computer-assisted surgery. *Acta Otorhinolaryngol Belg* 49:257. — Computer assisted

Olson G, Citardi MJ. Image-guided functional endoscopic sinus surgery. *Otolaryngol Head Neck Surg* 2000;**123**:188–94. — Computer assisted

Abstract: Introduction: Computer-aided surgery (CAS) technology in functional endoscopic sinus surgery (FESS) has engendered considerable discussion. Objective: The goals of this study were to describe CAS preoperative planning (software-based CT image analysis) and to develop intraoperative CAS strategies for endoscopic sinus surgery. Study design: Between October 1, 1997, and December 31, 1998, the StealthStation (Sofamor Danek, Memphis, TN) was used in 61 FESS cases, and a retrospective review of the findings was performed. The indication for surgery in all instances was chronic rhinosinusitis refractory to medical management. The StealthStation was used to review all CT scans before surgery. Anatomic fiducial registration supplemented by contour mapping was used. Results: Localization accuracy was estimated to be within 2 mm or better. The StealthStation was used for both CT image review and intraoperative localization. CAS was useful in the frontal recess,

sphenoethmoid region, posterior ethmoid system, and skull base area. CAS was deemed helpful in situations where the surgical anatomy was altered by previous surgery and extensive inflammatory disease (polyposis, fungal sinusitis, and pansinusitis). Conclusion: The paradigm of image-guided FESS surgery, which integrates CAS into FESS, will serve to increase surgical effectiveness and decrease surgical morbidity.

Sedlmaier B, Schleich A, Hoell T, Ohnesorge I, Jovanovic S. NEN-ENT navigation system – first clinical application. *4th European Congress of Oto-Rhino-Laryngology Head and Neck Surgery, Vols 1 and 2* 2000;1247–51. — Computer navigation

Abstract: Intraoperative computer navigation will soon play an important role in ENT skull base procedures. The NEN navigational system was used in 20 patients who underwent microendoscopic surgery for polypoid rhinosinusitis. Preoperative imaging data consisted of an axially oriented spiral CT scan resulting in a slice thickness of 1 mm. Data acquired during clinical application was used to optimize navigation accuracy by improving the selection of marker positions, avoiding ferromagnetic materials in surgical instruments and developing a sensor fixed to the upper jaw for tracking patient head movements. Thus it was possible to improve navigation accuracy from 3.5 mm to 1.5 mm in the plane of the sphenoid bone. Precise computer guided navigation will be an indispensible tool in difficult cases of skull base surgery in the future. For routine procedures such as microendoscopic endonasal sinus surgery, the systems have to be cost-effective and easy to operate.

Frontal sinus surgery

Iro H, Zenk J. A new device for frontal sinus endoscopy: first clinical report. *Otolaryngol Head Neck Surg* 2001;**125**:613–16. — Frontal sinus

Abstract: Objective: Endoscopically or microscopically controlled paranasal sinus surgery currently represents the state of the art. For anatomic reasons the ostium of the frontal sinus and the frontal sinus itself are difficult to observe. Flexible endoscopes are often difficult to implement and do not provide enough light intensity to visualize all parts of the frontal sinus. Materials and methods: A specially curved rigid endoscope with a working channel of 1.5 mm that allows passage into the frontal sinus has been developed to manage this problem. The system was used on 15 patients during paranasal sinus surgery to evaluate possible indications and its clinical usefulness. Results: The endoscope could be introduced into the frontal sinus after an ethmoidectomy had been performed in all of the patients. The anatomy of the sinus could be visualized with sufficient light intensity in 14 patients. The shadowing of the frontal sinus seen in CT was not due to polyps of the mucosa of the frontal sinus in all cases, but rather due to secretion with otherwise normal mucosa. In the cases with polyps, it was necessary to irrigate with saline solution to prevent the buoyant polyps from collapsing over the endoscope. The following specific indications for this endoscopic version were established during this first test: intraoperative and postoperative control of the frontal sinus, clinical evaluation of tumour growth into the frontal sinus, biopsies within the frontal sinus, and evaluation of fractures. Conclusion: The new device provides further insight within the field.

Moriyama H, Fukami M, Yanagi K, Ohtori N, Kaneta K. Endoscopic endonasal treatment of ostium of the frontal sinus and the results of endoscopic surgery. *Am J Rhinol* 1994;**8**:67–70. — Frontal sinus

Abstract: We discuss a procedure for opening the nasofrontal duct and the postoperative findings in endoscopic endonasal surgery. The route of the anterior ethmoidal artery was also studied. The subjects of this study were 57 patients (105 sides) who had frontal sinus disease. The patients all underwent surgery for chronic sinusitis between 1990 and 1992. Patients undergoing revision surgery were excluded. All patients were operated on by the same surgeon. In each patient, following anterior and posterior ethmoidectomy, the frontal sinus ostial region was opened using a 70 endoscope, while carefully monitoring the anterior ethmoidal artery. The agger nasi was left intact. The cells around the ostium were opened using a curved suction tip and upward bent forceps, and the lamellae were removed to achieve the greatest possible communication with the frontal sinus. In 77 sides (73.4%), the communication between the frontal and ethmoidal sinuses was well maintained. The ostium was patent with edematous mucosa in 18 sides (17.1%). The opened ostium could not be confirmed due to presence of polyp, etc., in 10 sides (9.5%). During surgery, the route of the anterior ethmoidal artery was confirmed in 70.8%, and of these cases, it was located anterior to the third ground lamella in about 50%. DEM: chronic-sinusitis-surgery; frontal-sinus. DER: anesthesia-; article-; endoscopic-surgery; follow-up; human-; major-clinical-study; postoperative-infection-prevention; postoperative-infection-drug-therapy; technique-. DRR: erythromycin-; macrolide-.

Schaefer SD, Close LG. Endoscopic management of frontal sinus disease. *Laryngoscope* 1990;**100**:155–60. Abstract: Depending on the pathologic process, the treatment of frontal sinus disease has consisted of obliteration or ablation of the sinus, or restoration of drainage into the nose. Intranasal endoscopic enlargement of the frontal recess and ostium, and removal of disease from the medial aspect of the frontal sinus offers a minimally invasive alternative to previous operations in selected patients. To better understand the indications, limitations, and potential problems with this operation, our experience with endoscopic frontal sinustomy in 36 patients over a 30-month period is reported. During the follow-up period, 21 patients had complete resolution of all symptoms, 11 patients were improved but had at least one episode of sinusitis or headache postoperatively, and 3 patients were worse, 2 of whom required frontal sinus obliteration for control of disease. Although endoscopic frontal sinusotomy appears to be a useful alternative to traditional frontal sinus procedures in selected patients, the reader is cautioned that such surgery is technically difficult and has not yet stood the test of time required of any frontal sinus operation.	Frontal sinus disease
Friedman M, Landsberg R, Schults RA, Tanyeri H, Caldarelli DD. Frontal sinus surgery: endoscopic technique and preliminary results. *Am J Rhinol* 2000;**14**:393–403. Abstract: Endoscopic frontal sinus surgery, once the last frontier in the evolution of endoscopic sinus surgery, is considered difficult, risky to the patient and likely to result in a high failure rate. We clarify the surgical anatomy for frontal sinus surgery that, based on a review of our data, provides safe and predictable access to the frontal sinus. We studied 200 consecutive patients with respect to indications, endoscopic and radiographic findings, results and complications. The study will describe the technique in detail, including the following points: (1) computed tomography identification of the superior attachment of the uncinate process; (2) complete removal of the uncinate process, including its superior attachments, by using the microdebrider; (3) removal of the agger nasi cell, if present; and (4) verification of an open frontal sinus by a transillumination or image-guided system. Postoperative assessment of patients' symptoms and the confirmation of a patent frontal sinus by office endoscopy and transillumination indicated a 90% patency for short-term follow-up (average 12.2 months). There were no major complications. Postoperative complications included frontal recess stenosis, polypoid mucosa occluding the frontal recess and middle turbinate lateralization. All of these situations may lead to recurrence of infection and symptoms. In-depth understanding of anatomic variations of the uncinate process and precise surgical removal of its superior attachments provide surgical access to the frontal sinus that is based on the natural ostia and is, therefore, more likely to remain patent.	Frontal sinus surgery
Intra-operative imaging Freysinger W. Three-dimensional navigation in otorhinolaryngological surgery with the viewing wand. *Ann Otol Rhinol Laryngol* 1998;**107**:953–8. Abstract: We report our experiences with the ISG Viewing Wand intraoperative 3-dimensional navigation device in endonasal endoscopic procedures of the paranasal sinuses, anterior skull base and petrous bone. In the last 12 months we have routinely used the wand in 90 patients for treatment of polyposis nasi, for biopsies and removal of tumors in the nasal cavity and at the frontal skull base, for endocrine ophthalmopathy, and in 1 case for cholesteatoma. We present our computed tomography, magnetic resonance imaging and clinical protocols that allow a precise routine use of the Viewing Wand. In all cases, the system was extremely helpful for intraoperative localisation and helped to optimise surgery.	3D navigation
Cartellieri, and V, F-. Endoscopic sinus surgery using intraoperative computed tomography imaging for updating a three-dimensional navigation system. *Laryngoscope* 2000;**110**:292–6. Abstract: Objectives: The use of three-dimensional navigation systems provides information on the structures surrounding the field of operation and thereby reduces the risk of iatrogenic damage. The computed tomography (CT) data conventionally used are provided by preoperative scanning procedures, which means that tissue changes coming about during surgery are not seen on the screen. An intraoperative CT scanning procedure being able to update the CT data could provide a solution. Study design: Endoscopic sinus operations using an intraoperative CT updating the three-dimensional navigation system were performed on six persons to find out whether the above is true. Methods: Different parameters, advantages and disadvantages in the cases of these six patients were compared with a group of 22 patients who underwent conventional endoscopic sinus surgery with different three-dimensional navigation systems without updating the CT data set. Results: The intraoperative CT for updating the three-dimensional navigation system provides useful information for the	Intraoperative CT

surgeon. Conclusion: Balancing its advantages against its disadvantages, the updating of the CT data set with intraoperative CT cannot be recommended for conventional standard endoscopic sinus surgery.	
Hsu L, Fried MP, Jolesz FA. MR-guided endoscopic sinus surgery. *AJNR Am J Neuroradiol* 1998;**19**:1235–40. Abstract: We describe an interactive, intraoperative imaging-guided method for performing endoscopic sinus surgery (ESS) within a vertically open MR system. The procedure was performed with intraoperative imaging using a 0.5-T magnet with a 56-cm vertical gap. Interactive control of imaging planes was accomplished by optical tracking with two infrared light-emitting diodes mounted on an aspirator probe. The probe's position defined the location of the orthogonal imaging planes. Twelve patients with varying degrees of sinus disease underwent ESS with MR imaging guidance. Patients had acute and chronic sinusitis, nasal polyposis causing airway obstruction or tumor requiring tissue biopsy. All procedures were performed with the patients under general anaesthesia. The integration of endoscopy with optical tracking and intraoperative interactive imaging allowed localisation of anatomic landmarks during ESS. No complications were encountered.	MRI system
Zlomaniec J, Czerwonka R, Bryc S. Nasal–sinusal polyps in the picture of combined radiological–endoscopic technique. *Ann Univ Mariae Curie Sklodowska [Med]* 1992;**47**:137–40.	Radiological endoscopic technique
Lasers	
Schuman DM, Pineyro R. Functional Aqualaser sinuscopy: a safe technique for the treatment of severe nasal polyposis. *J Clin Laser Med Surg* 1994;**12**:333–7. Abstract: All degrees of sinonasal polyposis now can be surgically treated with minimal bleeding, no packing and no vasoconstrictors. The Aqualaser technique uses warmed isotonic irrigation to produce vasoconstriction of the mucosa and to clear the field of debris and secretions. This results in an improvement in visualization of the anatomical landmarks and of the pathologic process(es) present. The contact YAG laser is used as a heating element. This laserized water results in cooking of the polyps (controlling the bleeding) prior to gently coddling away the abnormal tissues with Aquadissection (warm water dissection). The instrumentation used and the technique is explained. Over 2000 procedures were reviewed resulting in no major ocular or intracranial complications.	Aqualaser
Schuman DM, Pineyro R. Functional Aqualaser sinuscopy for nasal polyposis. *Clin Laser Mon* 1994;**12**:23–6.	Aqualaser
Westhofen M, Ilgner J, Handt S. The neodymium:YAG laser in postoperative follow-up after endonasal pansinus operation. *Laser Florence '99: A Window on the Laser Medicine World* 1999;**1**:218–21. Abstract: Microscopic and endoscopic surgery are the current widely accepted state of the art for the treatment of chronic polypoid sinusitis. Postoperative recurrence of the disease is reported in 12–25% of the patients. Revision surgery mostly requires similar surgical techniques. Therefore, modifications of the primary microsurgical technique were worked out to allow wide endoscopic accessibility postoperatively. Nd:YAG laser surgical tools for the endoscopic application of laser fibres were developed for minimal invasive revision surgery. Applicators for proper fiber positioning within the paranasal sinuses were constructed. Meanwhile $n = 92$ patients are treated over a period of two years. 90% of the patients with recurrence are free of symptoms and pathological findings for more than six months. Among two treated patients two developed hyposensitivity of the pterygopalatine nerve for two and six months respectively. No further complications were seen. The new endoscopic laser surgery of the paranasal sinuses reveals a reduction of sinus disease recurrence in 90% of the patients.	Laser
Gleich LL, Rebeiz EE, Pankratov MM, Shapshay SM. The holmium:YAG laser-assisted otolaryngologic procedures. *Arch Otolaryngol Head Neck Surg* 1995;**121**:1162–6. Abstract: Objective: To determine the effectiveness of the holmium:YAG (Ho:YAG) laser in otolaryngologic procedures that necessitate the ablation of osseous and soft tissue. Design: Case series. Setting: Lahey Clinic, Burlington, Mass. Patients: Consecutive series of 37 patients; 29 with chronic sinusitis, five with chronic dacryocystitis, one with recurrent choanal stenosis, one with tracheopathia osteoplastica, and one with a sphenoid sinus mucocele. Intervention: The Ho:YAG laser was used to assist in 37 procedures, including endoscopic sinus surgery, dacryocystorhinostomy, treatment of choanal stenosis, ablation of	Laser assisted

obstructive tracheopathia osteoplastica, and removal of a sphenoid sinus mucocele. Main outcome measures: Postsurgical success and complications, satisfaction of the patients, and the ability of the laser to remove tissue. Results: Complications occurred in eight patients: intranasal or ethmoid scarring (four), persistent polyps (one), bleeding (one), stent dislodgment (one) and tracheitis (one). Three patients required revision surgery. None of the complications were related to use of the laser, although the laser may produce increased scarring. The laser was effective for osseous and soft-tissue ablation, but its usefulness was limited for hemostasis. Conclusions: The Ho:YAG laser can be used in otolaryngologic procedures when surgical access is difficult or when controlled, precise ablation of osseous tissue is necessary.

Levine HL. Lasers and endoscopic rhinologic surgery. *Otolaryngol Clin North Am* 1989; **22**:739–48. — Laser assisted
Abstract: Lasers are playing a more important role in rhinologic surgery. A new laser, the KTP/532, provides flexible fibers that can be combined with nasal endoscopes to reach the recesses and spaces of the nasal cavity. It can deal effectively with turbinate dysfunction, bleeding disorders, polyps, and scarring. The author's experience with the use of this laser is described.

Ohyama M. Laser polypectomy. *Rhinol Suppl* 1989;**8**:35–43. — Laser assisted
Abstract: The contact Nd:YAG laser technique in endonasal surgery is presented as a new therapeutic tool. The clinical experience in cases with recurrent polyposis is presented. The therapeutic results are evaluated. Although patients with nasal polyposis remain to be treated on an individual basis, due to the multifactorial etiopathogenesis of this disorder, the initial results with this new surgical procedure are promising.

Shapshay SM, Rebeiz EE, Pankratov MM. Holmium:yttrium aluminum garnet laser-assisted endoscopic sinus surgery: clinical experience. *Laryngoscope* 1992;**102**:1177–80. — Laser assisted

Zickefoose S. Nasal surgery. Using lasers with endoscopy surgery. *AORN J* 1989;**50**:979–88. — Lasers

Ikeda K, Takasaka T. Endoscopic laser sinus surgery using KTP/532 laser. *Lasers Med Sci* 1996;**11**:133–8. — Lasers
Abstract: KTP/532 lasers have been used in a variety of medical applications since 1986. The authors have explored this relatively new wavelength in Japan in the field of rhinology, and report new aspects of KTP/532 laser application in endoscopic sinus surgery on the basis of confirmatory and subjective methods. Eighty patients with chronic sinusitis and mucoceles received KTP/532 laser endoscopic sinus surgery. The KTP/532 laser demonstrated excellent results showing reduction of postoperative polyps and granulation tissues around the enlarged maxillary sinus ostium. In addition, patients with chronic sinusitis demonstrated enhanced healing of the polypoid degeneration of the maxillary sinus. However, no significant improvement in the postoperative care was observed in the enlarged opening of mucoceles. It is concluded that the KTP/532 laser is a promising tool for endoscopic sinus surgery. DEM: chronic-sinusitis-surgery; endoscopic-surgery; laser-surgery; mucocele-surgery; treatment-outcome. DER: adolescent-; adult-; aged-; article-; female-; granulation-tissue; human-; japan-; major-clinical-study; male-; maxillary-sinus; nose-polyp-prevention; nose-polyp-complication; otorhinolaryngology-; postoperative-complication; priority-journal; school-child.

Microdebriders

Hamels K, Morre TD, Clement PA. The hummer, shaver or microdebrider. *Acta Otorhinolaryngol Belg* 1997;**51**:89–91. — Microdebrider
Abstract: The major goal in functional endoscopic sinus surgery (FESS) is the precise and delicate removal of diseased tissue in order to prevent trauma to healthy mucosa, bleeding and scar formation. One of the advantages in this field is the use of the microdebrider. The authors describe the use of this instrument, as well as their own experience for nasal polypectomy, prior to the FESS procedure.

Ikui A. Dilatation of accessory ostium of maxillary sinus on endoscopic sinus surgery for pediatric sinusitis. *Jibi Inkoka Tokeibu Geka* 1999;**71**:543–6. — Microdebrider
Abstract: Five patients under eight years old with pediatric sinusitis after failing of conservative therapy were treated by Hummer Microdebrider System (Stryker Corp, USA) during endoscopic sinus surgery. Following nasal polypectomy, dilatation of the accessory ostium of maxillary sinus was performed by this system that was not harmful to the nasal and

paranasal bony structures, such as nasal turbinates, nasal septum or uncinate process. Subjective symptoms and CT findings were markedly improved in all cases. This method is appropriate for paediatric sinusitis patients to maintain normal morphology of developing sinuses because of no bony partition removal.

Microscopic surgery

Teatini GP, Stomeo F, Bozzo C. Transnasal sinusectomy with combined microscopic and endoscopic technique. *J Laryngol Otol* 1991;**105**:635–7. — Microscope

Abstract: Severe, diffuse polyposis can be adequately treated through a transnasal approach which combines microscopic and endoscopic surgery. The operating microscope is used to perform ethmoidectomy, usually from the front to the back, and to open the sphenoid sinus and the antral window. The telescopes allow the sphenoid and maxillary sinuses to be cleaned under direct view control as well as enabling good drainage to be performed from the frontal sinuses. The results from 22 consecutive patients were good, with a very low rate of minor postoperative complications.

Ohnishi T. Endoscopic endonasal microsurgery of the ethmoid sinus. *Jibi Inkoka Tokeibu Geka* 1990;**62**:343–9. — Microsurgery

Abstract: The authors describe a method of radical ethmoidectomy be means of endoscopic microsurgery. In conventional surgical treatment of chronic sinusitis with diffuse nasal polyposis one of the major causes of failure has been uncertain surgical resection of local diseases, where hidden diseases have often been left unremoved at the critical areas such as the naso-frontal duct and fontanel areas. The authors described a step-by-step surgical technique of microscopic ethmoidectomy under endoscopic control. Meticulous removal of sinus diseases and restoration of functional anatomy of the sinuses under endoscopic magnification enabled an ethmoidectomy of microscopic level. The results of this surgical technique in 30 patients revealed an improvement rate of 80 to 90% of the cases in both subjective and objective findings.

Weber R, Draf W, Keerl R, Schick B, Saha A . Endonasal microendoscopic pansinusoperation in chronic sinusitis. II. Results and complications. *Am J Otolaryngol* 1997;**18**:247–53. — Microendoscopic

Abstract: Purpose: We evaluated the long-term results and complications of endonasal pansinusoperation in chronic polypoid sinusitis. Patients and methods: In a retrospective study, 170 patients were followed-up for 20 months to 10 years after bilateral endonasal microendoscopic pansinus surgery or ethmoidectomy. The follow-up consisted of a standardized questionnaire and clinical examination with the flexible endoscope. Results: We found that 85.6% of the ethmoid cell systems, 69.4% of maxillary sinuses and 37.5% of frontal sinuses could be visualized endoscopically. The ethmoid mucosa was normal in 56% and thickened in 19%. Recurrent polyps were found in 25%. The evaluation – as per the graduation of results defined by us as a combination of examination findings and subjective assessment of the operative result – resulted in an operative success of 92%. Two studies dealing with the frequency of complications showed injury to the dura in 2.3% to 2.55% and periorbital injury without permanent sequelae in 1.4% to 3.4%. Because of two cases of bleeding from the internal carotid artery, the problems of vascular complications in particular will be thoroughly discussed. Conclusion: More than 90% of patients with chronic polypoid sinusitis gain long-term satisfying results after endonasal ethmoidectomy with microscope and endoscope. For minimizing the risk of injury of the optic nerve or the internal carotid artery preoperative, computed tomography is necessary. A special training programme is recommended.

Venkatachalam VP. Role of microrhinoscopic sinus surgery in chronic sinusitis: initial results. *Indian J Otolaryngol Head Neck Surg* 2000;**52**:219–22. — Microrhinoscopic surgery

Abstract: Chronic sinusitis with/without polyposis account for the majority of nasal pathology. The advent of functional sinus surgery has led to a better understanding of the complex anatomy of the paranasal sinuses and the surrounding vital structures. The application of surgical principle and technique of functional endoscopic sinus surgery to another approach for regional pathology using operating microscope has enabled us to significantly refine this technique of treatment of sinus pathology namely microrhinoscopic sinus surgery (MRSS). In this paper the technique as well as the initial results of the microrhinoscopic sinus surgery (MRSS) is discussed with its advantages. DEM: chronic-sinusitis-surgery; chronic-sinusitis-diagnosis; chronic-sinusitis-drug-therapy. DER: human-; clinical-article; human-tissue; clinical-trial; adult-; female-; male-; bleeding-complication; bleeding-therapy; paranasal-sinus; microrhinoscopic-sinus-surgery; surgical-technique; ethmoid-sinus; maxillary-sinus;

ethmoidectomy-; endoscopic-surgery; treatment-outcome; computer-assisted-tomography; polyposis-surgery; polyposis-drug-therapy; postoperative-care; article-. DRR: antiinflammatory-agent-drug-therapy.

Other techniques/concurrent surgery

Fortune DS, Duncavage JA. Incidence of frontal sinusitis following partial middle turbinectomy. *Ann Otol Rhinol Laryngol* 1998;**107**:447–53. — Partial middle turbinectomy

Abstract: The role of partial middle turbinate resection as an adjunct to endoscopic sinus surgery is controversial. Recent literature suggests that middle turbinate resection may have a detrimental effect on the frontal sinus. A retrospective analysis of 155 consecutive patients undergoing partial middle turbinate resection utilizing the technique of the senior author (J.A.D.) for either sinusitis or nasal obstruction was conducted. The data reveal a low rate of frontal sinusitis following partial middle turbinectomy (10%). None of the patients undergoing partial middle turbinectomy for nasal obstruction developed frontal sinusitis postoperatively. No major complications were encountered. Frontal sinusitis following middle turbinectomy was often associated with preoperative comorbidity such as asthma, nasal polyps, severe disease score on computed tomography or diseased middle turbinates. The authors conclude that partial middle turbinectomy for treatment of sinusitis and nasal obstruction has a low incidence of postoperative frontal sinusitis. Development of frontal sinusitis may be predictable on the basis of several comorbid factors.

Friedman M, Landsberg R, Tanyeri H. Middle turbinate medialization and preservation in endoscopic sinus surgery. *Otolaryngol Head Neck Surg* 2000;**123**:76–80. — Middle turbinate medialization

Abstract: Objective/Hypothesis: Lateral synechia formation between the middle turbinate (MT) and the lateral nasal wall is the most common complication of endoscopic sinus surgery. In an attempt to prevent this complication, a simple technique to preserve and medialize the MT was studied. Methods: Five hundred patients underwent endoscopic sinus surgery with MT medialization and preservation. The caudal end of the MT and the opposing septal mucosa were abraded with a microdebrider for controlled synechia formation in an attempt to avoid lateralization of the MT. Follow-up ranged from 6 to 18 months, with a mean follow-up of 10 months. Results: Ninety-three percent of the patients had successful MT medialization with a well-defined synechia between the septum and the MT. Conclusions: MT medialization with a microdebrider is simple, is reliable, and should be considered an alternative to turbinate resection or to other turbinate medialization techniques.

Mendelsohn M. Simultaneous rhinoseptoplasty and fess. *Aust J Otolaryngol* 2001;**4**:118–19. — Rhinoseptoplasty

Abstract: Combining rhinoseptoplasty with sinus surgery has been performed increasingly over the last decade. This review summarises a case series of 74 patients who underwent simultaneous rhinoseptoplasty and sinus surgery. Provided cases are selected appropriately, the complication rate when performed together was no greater than performing the procedures individually. Patients were excluded if there was severe polyposis, difficult revision sinus disease, severe infection, immunocompromise or the need for complex rhinoseptoplasty reconstruction. The development of orbital ecchymoses requires careful monitoring to exclude an intraorbital complication. DEM: nose-septum-reconstruction; paranasal-sinus. DER: human-; major-clinical-study; clinical-trial; female-; male-; adult-; surgical-technique; prospective-study; surgical-approach; postoperative-complication; disease-severity; polyposis-; paranasal-sinus-disease-surgery; paranasal-sinus-disease-disease-management; infection-; immune-deficiency; ecchymosis-complication; patient-monitoring; disease-classification; patient-satisfaction; treatment-outcome; safety-; article-.

Vanclooster C. Endoscopic septel spur resection in combination with endoscopic sinus surgery. *Acta Otorhinolaryngol Belg* 1998;**52**:335–9. — Septal spur resection

Abstract: To assess the possibilities and limitations of endoscopic septal spur resection in combination with endoscopic sinus surgery, 40 consecutive patients were prospectively evaluated. All patients suffered from chronic sinusitis and presented with a posterior septal spur. The spur resection was mainly done because of impaction on the middle meatus and was in general performed after the sinus procedure, if technically possible. Although not completely painless, the septal spur resection could be easily performed under local anaesthesia. The procedure took on average less than 5 minutes. The immediate postoperative period was always uneventful and no septal perforations were recorded at six weeks. There were no late complications. In conclusion, endoscopic resection of a septal spur can be performed safely in combination with endoscopic sinus surgery and contributes with minimal additional morbidity to the surgical success.

Gross WE. Soft-tissue shavers in functional endoscopic sinus surgery (standard technique). *Otolaryngol Clin North Am* 1997;**30**:435–41.	Soft tissue shavers
Burgess LPA, Syms MJ, Holtel MR, Birkmire-Peters DP, Johnson RE, Ramsey MJ. Telemedicine: teleproctored endoscopic sinus surgery. *Laryngoscope* 2002;**112**:216–19. Abstract: Objective/hypothesis: Teleproctored surgery projects a surgeon's expertise to remote locations. The objective of the present study was to evaluate the safety and feasibility of this technique as compared with the current standard of care. Study design: Prospective. Methods: A study was conducted in a residency training programme comparing conventionally proctored endoscopic sinus surgery cases with teleproctored cases, with the faculty surgeon supervising through audiovisual teleconferencing (VTC) in a control room 15 seconds from the operating room. Results: Forty-two control patients (83 sides) and 45 teleproctored patients (83 sides) were evaluated. There were no internal differences between groups regarding extent of polypoid disease, revision status, procedures per case, degree of difficulty, general or local anaesthesia or microdebrider use. There were no cases of visual disturbance, orbital ecchymosis or haematoma or cerebrospinal fluid leak. Orbital fat herniation and blood loss were equal between groups. Three teleproctored cases required faculty intervention: two for surgical difficulty, one for VTC problems. Teleproctored cases took 3.87 minutes longer per side (28.54 vs. 24.67 minutes, $p < 0.024$), a 16% increase. This was thought to be a result of nuances of VTC proctoring. Residents had a positive learning experience, with nearly full control of the operating suite combined with remote supervision through telepresence. Faculty thought such supervision was safe but had concerns regarding personal skills maintenance. Conclusions: Teleproctored endoscopic sinus surgery can be safely performed on selected cases with an acceptable increase in time. Teleproctored surgery with remote sites may continue to be safely investigated. Incorporating remote supervision through telepresence into the curriculum of surgical residency training requires further study.	Teleproctored
el Guindy A. Endoscopic transseptal vidian neurectomy. *Arch Otolaryngol Head Neck Surg* 1994;**120**:1347–51. Abstract: Objective: Evaluation of the endoscopic transseptal approach of vidian neurectomy. Design: A case series, with a follow-up of 12 to 24 months. Setting: A referral centre. Patients: A consecutive sample of 11 adult patients with resistant vasomotor rhinitis: eight with severe rhinorrhea and three with recurrent nasal polyposis. All patients had a negative history of allergy and negative skin tests. All patients completed the study. Intervention: The rigid nasal endoscope was used through a transseptal approach to reach the sphenopalatine foramen and to cut the vidian nerve. Main outcome measures: Intraoperative identification and cutting of the vidian nerve under direct endoscopic vision. Postoperative evaluation of rhinorrhea, sneezing and recurrent disease. Results: The vidian nerve was identified and sectioned bilaterally in all cases. Immediate and complete cessation of rhinorrhea uniformly occurred. Paroxysms of sneezing were vastly reduced. No recurrence was detected, except in one case. Three patients complained of dry eyes, but they had symptomatic relief with artificial teardrops. Conclusion: The technique of endoscopic transseptal vidian neurectomy is a minor surgical procedure with high efficacy and minimal postoperative morbidity. More cases and longer follow-up are necessary to provide long-term results.	Transeptal vidian neurectomy
el Shazly MA. Endoscopic surgery of the vidian nerve. Preliminary report. *Ann Otol Rhinol Laryngol* 1991;**100**:536–9. Abstract: The anatomy, surgical technique and difficulties of endoscopic vidian neurectomy are described. The procedure was carried out on 12 patients: 8 had resistant secretomotor rhinopathy and 4 had recurrent nasal polyposis. This technique is a minor surgical procedure with symptomatic relief and minimal postoperative morbidity.	Vidian neurectomy
Revision surgery	
Wreesmann VB, Fokkens WJ, Knegt PP. Refractory chronic sinusitis: evaluation of symptom improvement after Denker's procedure. *Otolaryngol Head Neck Surg* 2001;**125**:495–500. Abstract: Objectives: Although there is ample literature describing various aspects of functional endoscopic sinus surgery (FESS) in relationship to its success rates, very little has been reported regarding possibilities in case of recurrent failure. We investigated subjective results of Denker's procedure used as a last resort for refractory chronic rhinosinusitis/polyposis. Study design and setting: A retrospective questionnaire-based study of 82 patients who underwent Denker's procedure between 1986 and 1997 at the Erasmus University Medical Center, The Netherlands, was conducted. Results: Eighty-four percent of	Recurrent surgery

patients reported reduction of overall symptomatology. A significant reduction of nasal obstruction, headache, feeling of fullness, post-nasal drip, rhinorrhoea, facial pain, dental pain, and coughing was reported. In addition, symptoms of lower airway inflammation did improve significantly in asthmatic patients. Conclusions: These data suggest that radical surgery using Denker's approach should be considered in selected cases after recurrent failure of functional sinus surgery. Significance: A prospective study is warranted to validate this approach for refractory chronic rhinosinusitis.

Sphenoid surgery

Friedman WH, Katsantonis GP. Intranasal and transantral ethmoidectomy: a 20-year experience. *Laryngoscope* 1990;**100**:343–8. — Sphenoethmoidectomy

Abstract: Ethmoidectomy is an operation that has engendered controversy concerning the best route of surgical access. The purpose of this study was to present the results of the authors' experience in more than 1300 intranasal sphenoethmoidectomies and transantral sphenoethmoidectomies performed over a 20-year period. The authors contend that the most effective ethmoidectomy is the most complete ethmoidectomy and have previously presented a case for ethmoid marsupialization. Polyp recurrence rates of less than 20% and a major complication rate of less than 1% were reported in this study.

Gilain L, Aidan D, Coste A, Peynegre R. Functional endoscopic sinus surgery for isolated sphenoid sinus disease. *Head Neck* 1994;**16**:433–7. — Sphenoidotomy

Abstract: Background: This article reviews 12 cases of isolated sphenoid sinus disease: chronic inflammatory sinusitis (7), mucoceles (2), aspergillus lesions (2), and isolated polyp (1). Methods: Criteria for diagnosis were based on clinical symptoms, nasal endoscopic evaluation and computed tomography (CT). Magnetic resonance imaging was used only in cases of bone erosion and when patients presented with vision problems. All patients were treated by functional endoscopic sphenoidotomy. Any postoperative complications were noted. Conclusion: The reported good results, on the basis of regression of functional symptoms and with nasal endoscopic and CT evaluation, suggest that intranasal sphenoidotomy under endoscopic control is a safe and effective method of treatment of nonmalignant isolated sphenoid disease. The mean follow-up is 26 months.

Hadar T. Isolated sphenoid sinus changes – history, CT and endoscopic finding. *J Laryngol Otol* 1996;**110**:850–3. — Sphenoidotomy

Abstract: This study reviews the records of 21 patients with isolated sphenoid sinus disease who were treated by rigid endoscopic sphenoidotomy at the Nose and Sinus Unit, Department of Otolaryngology of Beilinson Medical Center, Israel. Diagnosis was made on the basis of history, rigid nasal endoscopy and computed tomography (CT) scan. The most frequent symptom was headache; no instances of 'pathognomonic' headache were found. Sphenoidotomy was performed through the area of the natural ostium. The pathological finding was infection in 11 patients, cyst in four patients, polyps in three patients, mucocoele in two and inverted papilloma in one patient. Surgical results were very good. Endoscopic sphenoidotomy proved to be safe, with minimal blood loss, reduced operating time, decreased morbidity and short postoperative hospitalization.

Katsantonis GP, Friedman WH, Bruns M. Intranasal sphenoethmoidectomy: an evolution of technique. *Otolaryngol Head Neck Surg* 1994;**111**:781–6. — Sphenoethmoidectomy

Abstract: Intranasal sphenoethmoidectomy was originally used primarily for the provision of adequate drainage of acute and subacute bacterial sinusitis. However, the spectrum of inflammatory sinus disease has changed dramatically since the popularization of broad-spectrum antibiotics, and chronic hyperplastic rhinosinusitis has replaced acute sinusitis as the primary indication for ethmoidectomy. In such cases total or almost total disease removal is crucial to providing long-term drainage and ventilation. We describe several modifications of the Yankauer sphenoethmoidectomy technique that enable the sinus surgeon to provide clearance of disease and excellent drainage for all sinuses by complete marsupialization of the sphenoid, ethmoid and maxillary sinuses. These modifications include (1) complete rather than partial removal of the middle turbinate, (2) extended middle meatal antrostomy with palatine bone resection to the pterygoid process with delineation of the inferior and medial orbital wall and (3) introduction of operative endoscopes as adjunctive tools in areas inaccessible to conventional visualization. The current technique and results in nearly 2000 procedures are described.

Klossek JM, Peloquin L, Friedman WH, Ferrier JC, Fontanel JP. Diffuse nasal polyposis: postoperative long-term results after endoscopic sinus surgery and frontal irrigation. *Otolaryngol Head Neck Surg* 1997;**117**:355–61. Abstract: Diffuse nasal polyposis remains a challenge despite recent improvements in endonasal surgery. The purpose of this study is to evaluate the results after a radical complete sphenoethmoidectomy with peroperative and postoperative frontal irrigation in cases of diffuse nasal polyposis. In this prospective study, we include 50 consecutive patients with diffuse nasal polyposis suffering from nasal obstruction, anosmia and other symptoms of chronic sinusitis. All patients were refractory to medical therapy. In each patient an endoscopic complete sphenoethmoidectomy including total excision of all diseased ethmoid mucosa was performed. Preoperative and postoperative frontal irrigation was performed systematically. The patients were followed closely with serial endoscopic examination, and CT scanning was performed between 2 and 3 years after surgery. There were no complications. Thirty-nine of the 50 patients regained satisfactory olfaction. Partial nasal obstruction persisted in four of the 50 patients. Endoscopically, polyp recurrence was noted in 3% of posterior ethmoids, 23% of anterior ethmoids and 50% of frontal recesses. We conclude that in cases of refractory and extensive nasal polyposis, a total sphenoethmoidectomy with perioperative frontal irrigation followed by long-term postoperative topical steroid therapy provides excellent improvement or cure with safety and reliability.	Sphenoethmoidectomy

Health Technology Assessment Programme

Prioritisation Strategy Group

Members

Chair,
Professor Kent Woods,
Director, NHS HTA Programme & Professor of Therapeutics, University of Leicester

Professor Bruce Campbell, Consultant Vascular & General Surgeon, Royal Devon & Exeter Hospital

Professor Shah Ebrahim, Professor in Epidemiology of Ageing, University of Bristol

Dr John Reynolds, Clinical Director, Acute General Medicine SDU, Radcliffe Hospital, Oxford

Dr Ron Zimmern, Director, Public Health Genetics Unit, Strangeways Research Laboratories, Cambridge

HTA Commissioning Board

Members

Programme Director,
Professor Kent Woods, Director, NHS HTA Programme, Department of Medicine and Therapeutics, Leicester Royal Infirmary, Robert Kilpatrick Clinical Sciences Building, Leicester

Chair,
Professor Shah Ebrahim, Professor in Epidemiology of Ageing, Department of Social Medicine, University of Bristol, Canynge Hall, Whiteladies Road, Bristol

Deputy Chair,
Professor Jenny Hewison, Professor of Health Care Psychology, Academic Unit of Psychiatry and Behavioural Sciences, University of Leeds School of Medicine, Leeds

Professor Douglas Altman, Professor of Statistics in Medicine, Centre for Statistics in Medicine, Oxford University, Institute of Health Sciences, Cancer Research UK Medical Statistics Group, Headington, Oxford

Professor John Bond, Professor of Health Services Research, Centre for Health Services Research, University of Newcastle, School of Health Sciences, Newcastle upon Tyne

Professor John Brazier, Director of Health Economics, Sheffield Health Economics Group, School of Health & Related Research, University of Sheffield, ScHARR Regent Court, Sheffield

Dr Andrew Briggs, Public Health Career Scientist, Health Economics Research Centre, University of Oxford, Institute of Health Sciences, Oxford

Dr Christine Clark, Medical Writer & Consultant Pharmacist, Cloudside, Rossendale, Lancs
and
Principal Research Fellow, Clinical Therapeutics in the School of Pharmacy, Bradford University, Bradford

Professor Nicky Cullum, Director of Centre for Evidence Based Nursing, Department of Health Sciences, University of York, Research Section, Seebohm Rowntree Building, Heslington, York

Dr Andrew Farmer, Senior Lecturer in General Practice, Department of Primary Health Care, University of Oxford, Institute of Health Sciences, Headington, Oxford

Professor Fiona J Gilbert, Professor of Radiology, Department of Radiology, University of Aberdeen, Lilian Sutton Building, Foresterhill, Aberdeen

Professor Adrian Grant, Director, Health Services Research Unit, University of Aberdeen, Drew Kay Wing, Polwarth Building, Foresterhill, Aberdeen

Professor Alastair Gray, Director, Health Economics Research Centre, University of Oxford, Institute of Health Sciences, Headington, Oxford

Professor Mark Haggard, Director, MRC ESS Team, CBU Elsworth House, Addenbrooke's Hospital, Cambridge

Professor F D Richard Hobbs, Professor of Primary Care & General Practice, Department of Primary Care & General Practice, University of Birmingham, Primary Care and Clinical Sciences Building, Edgbaston, Birmingham

Professor Peter Jones, Head of Department, University Department of Psychiatry, University of Cambridge, Addenbrooke's Hospital, Cambridge

Professor Sallie Lamb, Research Professor in Physiotherapy/Co-Director, Interdisciplinary Research Centre in Health, Coventry University, Coventry

Dr Donna Lamping, Senior Lecturer, Health Services Research Unit, Public Health and Policy, London School of Hygiene and Tropical Medicine, London

Professor David Neal, Professor of Surgical Oncology, Oncology Centre, Addenbrooke's Hospital, Cambridge

Professor Tim Peters, Professor of Primary Care Health Services Research, Division of Primary Health Care, University of Bristol, Cotham House, Cotham Hill, Bristol

Professor Ian Roberts, Professor of Epidemiology & Public Health, Intervention Research Unit, London School of Hygiene and Tropical Medicine, London

Professor Peter Sandercock, Professor of Medical Neurology, Department of Clinical Neurosciences, University of Edinburgh, Western General Hospital NHS Trust, Bramwell Dott Building, Edinburgh

Professor Martin Severs, Professor in Elderly Health Care, Portsmouth Institute of Medicine, Health & Social Care, St George's Building, Portsmouth

Dr Jonathan Shapiro, Senior Fellow, Health Services Management Centre, Park House, Birmingham

Current and past membership details of all HTA 'committees' are available from the HTA website (www.ncchta.org)

Diagnostic Technologies & Screening Panel

Members

Chair,
Dr Ron Zimmern, Director of the Public Health Genetics Unit, Strangeways Research Laboratories, Cambridge

Dr Paul Cockcroft, Consultant Medical Microbiologist/ Laboratory Director, Public Health Laboratory, St Mary's Hospital, Portsmouth

Professor Adrian K Dixon, Professor of Radiology, Addenbrooke's Hospital, Cambridge

Dr David Elliman, Consultant in Community Child Health, London

Dr Andrew Farmer, Senior Lecturer in General Practice, Institute of Health Sciences, University of Oxford

Dr Karen N Foster, Clinical Lecturer, Dept of General Practice & Primary Care, University of Aberdeen

Professor Jane Franklyn, Professor of Medicine, University of Birmingham

Professor Antony J Franks, Deputy Medical Director, The Leeds Teaching Hospitals NHS Trust

Mr Tam Fry, Honorary Chairman, Child Growth Foundation, London

Dr Susanne M Ludgate, Medical Director, Medical Devices Agency, London

Dr William Rosenberg, Senior Lecturer and Consultant in Medicine, University of Southampton

Dr Susan Schonfield, CPHM Specialised Services Commissioning, Croydon Primary Care Trust

Dr Margaret Somerville, Director of Public Health, Teignbridge Primary Care Trust, Devon

Mr Tony Tester, Chief Officer, South Bedfordshire Community Health Council, Luton

Dr Andrew Walker, Senior Lecturer in Health Economics, University of Glasgow

Professor Martin J Whittle, Head of Division of Reproductive & Child Health, University of Birmingham

Dr Dennis Wright, Consultant Biochemist & Clinical Director, Pathology & The Kennedy Galton Centre, Northwick Park & St Mark's Hospitals, Harrow

Pharmaceuticals Panel

Members

Chair,
Dr John Reynolds, Clinical Director, Acute General Medicine SDU, Oxford Radcliffe Hospital

Professor Tony Avery, Professor of Primary Health Care, University of Nottingham

Professor Iain T Cameron, Professor of Obstetrics & Gynaecology, University of Southampton

Mr Peter Cardy, Chief Executive, Macmillan Cancer Relief, London

Dr Christopher Cates, GP and Cochrane Editor, Bushey Health Centre, Bushey, Herts.

Mr Charles Dobson, Special Projects Adviser, Department of Health

Dr Robin Ferner, Consultant Physician and Director, West Midlands Centre for Adverse Drug Reactions, City Hospital NHS Trust, Birmingham

Dr Karen A Fitzgerald, Pharmaceutical Adviser, Bro Taf Health Authority, Cardiff

Professor Alastair Gray, Professor of Health Economics, Institute of Health Sciences, University of Oxford

Mrs Sharon Hart, Managing Editor, *Drug & Therapeutics Bulletin*, London

Dr Christine Hine, Consultant in Public Health Medicine, Bristol South & West Primary Care Trust

Professor Robert Peveler, Professor of Liaison Psychiatry, Royal South Hants Hospital, Southampton

Dr Frances Rotblat, CPMP Delegate, Medicines Control Agency, London

Mrs Katrina Simister, New Products Manager, National Prescribing Centre, Liverpool

Dr Ken Stein, Senior Lecturer in Public Health, University of Exeter

Professor Terence Stephenson, Professor of Child Health, University of Nottingham

Dr Richard Tiner, Medical Director, Association of the British Pharmaceutical Industry, London

Professor Dame Jenifer Wilson-Barnett, Head of Florence Nightingale School of Nursing & Midwifery, King's College, London

Therapeutic Procedures Panel

Members

Chair,
Professor Bruce Campbell,
Consultant Vascular and General Surgeon, Royal Devon & Exeter Hospital

Dr Mahmood Adil, Head of Clinical Support & Health Protection, Directorate of Health and Social Care (North), Department of Health, Manchester

Professor John Bond, Head of Centre for Health Services Research, University of Newcastle upon Tyne

Mr Michael Clancy, Consultant in A & E Medicine, Southampton General Hospital

Dr Carl E Counsell, Senior Lecturer in Neurology, University of Aberdeen

Dr Keith Dodd, Consultant Paediatrician, Derbyshire Children's Hospital, Derby

Professor Gene Feder, Professor of Primary Care R&D, Barts & the London, Queen Mary's School of Medicine and Dentistry, University of London

Ms Bec Hanley, Freelance Consumer Advocate, Hurstpierpoint, West Sussex

Professor Alan Horwich, Director of Clinical R&D, The Institute of Cancer Research, London

Dr Phillip Leech, Principal Medical Officer for Primary Care, Department of Health, London

Mr George Levvy, Chief Executive, Motor Neurone Disease Association, Northampton

Professor James Lindesay, Professor of Psychiatry for the Elderly, University of Leicester

Dr Mike McGovern, Senior Medical Officer, Heart Team, Department of Health, London

Dr John C Pounsford, Consultant Physician, North Bristol NHS Trust

Professor Mark Sculpher, Professor of Health Economics, Institute for Research in the Social Services, University of York

Dr L David Smith, Consultant Cardiologist, Royal Devon & Exeter Hospital

Professor Norman Waugh, Professor of Public Health, University of Aberdeen

Expert Advisory Network

Members

Mr Gordon Aylward,
Chief Executive,
Association of British Health-Care Industries, London

Ms Judith Brodie,
Head of Cancer Support Service, Cancer BACUP, London

Mr Shaun Brogan,
Chief Executive, Ridgeway Primary Care Group, Aylesbury, Bucks

Ms Tracy Bury,
Project Manager, World Confederation for Physical Therapy, London

Mr John A Cairns,
Professor of Health Economics, Health Economics Research Unit, University of Aberdeen

Professor Howard Stephen Cuckle,
Professor of Reproductive Epidemiology, Department of Paediatrics, Obstetrics & Gynaecology, University of Leeds

Professor Nicky Cullum,
Director of Centre for Evidence Based Nursing, University of York

Dr Katherine Darton,
Information Unit, MIND – The Mental Health Charity, London

Professor Carol Dezateux,
Professor of Paediatric Epidemiology, London

Professor Martin Eccles,
Professor of Clinical Effectiveness, Centre for Health Services Research, University of Newcastle upon Tyne

Professor Pam Enderby,
Professor of Community Rehabilitation, Institute of General Practice and Primary Care, University of Sheffield

Mr Leonard R Fenwick,
Chief Executive, Newcastle upon Tyne Hospitals NHS Trust

Professor David Field,
Professor of Neonatal Medicine, Child Health, The Leicester Royal Infirmary NHS Trust

Mrs Gillian Fletcher,
Antenatal Teacher & Tutor and President, National Childbirth Trust, Henfield, West Sussex

Ms Grace Gibbs,
Deputy Chief Executive, Director for Nursing, Midwifery & Clinical Support Servs., West Middlesex University Hospital, Isleworth, Middlesex

Dr Neville Goodman,
Consultant Anaesthetist, Southmead Hospital, Bristol

Professor Robert E Hawkins,
CRC Professor and Director of Medical Oncology, Christie CRC Research Centre, Christie Hospital NHS Trust, Manchester

Professor F D Richard Hobbs,
Professor of Primary Care & General Practice, Department of Primary Care & General Practice, University of Birmingham

Professor Allen Hutchinson,
Director of Public Health & Deputy Dean of ScHARR, Department of Public Health, University of Sheffield

Professor Rajan Madhok,
Medical Director & Director of Public Health, Directorate of Clinical Strategy & Public Health, North & East Yorkshire & Northern Lincolnshire Health Authority, York

Professor David Mant,
Professor of General Practice, Department of Primary Care, University of Oxford

Professor Alexander Markham,
Director, Molecular Medicine Unit, St James's University Hospital, Leeds

Dr Chris McCall,
General Practitioner, The Hadleigh Practice, Castle Mullen, Dorset

Professor Alistair McGuire,
Professor of Health Economics, London School of Economics

Dr Peter Moore,
Freelance Science Writer, Ashtead, Surrey

Dr Andrew Mortimore,
Consultant in Public Health Medicine, Southampton City Primary Care Trust

Dr Sue Moss,
Associate Director, Cancer Screening Evaluation Unit, Institute of Cancer Research, Sutton, Surrey

Professor Jon Nicholl,
Director of Medical Care Research Unit, School of Health and Related Research, University of Sheffield

Mrs Julietta Patnick,
National Co-ordinator, NHS Cancer Screening Programmes, Sheffield

Professor Chris Price,
Visiting Chair – Oxford, Clinical Research, Bayer Diagnostics Europe, Cirencester

Ms Marianne Rigge,
Director, College of Health, London

Professor Sarah Stewart-Brown,
Director HSRU/Honorary Consultant in PH Medicine, Department of Public Health, University of Oxford

Professor Ala Szczepura,
Professor of Health Service Research, Centre for Health Services Studies, University of Warwick

Dr Ross Taylor,
Senior Lecturer, Department of General Practice and Primary Care, University of Aberdeen

Mrs Joan Webster,
Consumer member, HTA – Expert Advisory Network

Current and past membership details of all HTA 'committees' are available from the HTA website (www.ncchta.org)

Feedback

The HTA Programme and the authors would like to know your views about this report.

The Correspondence Page on the HTA website (http://www.ncchta.org) is a convenient way to publish your comments. If you prefer, you can send your comments to the address below, telling us whether you would like us to transfer them to the website.

We look forward to hearing from you.

The National Coordinating Centre for Health Technology Assessment,
Mailpoint 728, Boldrewood,
University of Southampton,
Southampton, SO16 7PX, UK.
Fax: +44 (0) 23 8059 5639 Email: hta@soton.ac.uk
http://www.ncchta.org

ISSN 1366-5278