Prophylactic removal of impacted mandibular third molars: a systematic review and economic evaluation

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Scientific summary

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Background

The four hindmost molars, known as third molars, are the last teeth to erupt in the upper (maxillary) and lower (mandibular) jaws; this usually happens during young adulthood between the ages of 18 and 24 years. Third molars can be either impacted or non-impacted, and an impacted third molar can be classed as erupted, partially erupted or unerupted. Impaction occurs when the eruption of the tooth is blocked by either soft tissue (gum) or bone. Impacted third molars can be potentially problematic to the individual by causing pain and disease; however, many impacted third molars are asymptomatic (trouble free) and/or disease free/pathology free.

Impacted third molars may be associated with pathological changes such as infection (pericoronitis), periodontal (gum) disease, dental caries, destruction of adjacent teeth, cysts and tumours.

The treatment options for people with impacted third molars are either surgical removal or standard care without prophylactic removal of the third molars.

The decision to remove or retain an impacted third molar depends on whether or not it is asymptomatic and/or pathology free. When there are pathological changes, the current National Institute for Health and Care Excellence guidance states that the impacted third molar should be removed. Even if an impacted third molar is pathology free, the dentist may decide to remove the tooth to prevent future risk of pathological changes; this is termed prophylactic removal.

Objectives

The remit of this review is to appraise the clinical effectiveness and cost-effectiveness of the prophylactic removal of impacted mandibular third molars compared with that of standard care without prophylactic removal of impacted mandibular third molars.

Methods

Clinical effectiveness review

Five electronic databases were searched (from 1999 to 29 April 2016) for clinical trials (randomised and non-randomised), observational studies, systematic reviews, decision analyses and UK costs. Studies that compared the prophylactic removal of impacted mandibular third molars with standard care without prophylactic removal or studies that assessed the outcomes of either approach were considered. The outcomes of interest were the pathology associated with the retention of third molars, post-operative complications following extraction, adverse effects of treatment and health-related quality of life. Two reviewers independently screened all titles and/or abstracts, including economic evaluations; applied inclusion criteria to the relevant publications; and quality assessed the included studies. The results of the data extraction and (clinical) quality assessment are summarised in structured tables and in a narrative description in the main report. No meta-analysis or network meta-analyses were undertaken.

Cost-effectiveness review

The search strategy that was developed for the clinical searches, with the addition of an economics filter, was used to identify studies reporting the costs and benefits associated with extracting/retaining impacted third molars. As part of the search strategy, the NHS Economics Evaluation Database located

within The Cochrane Library and EconLit (via EBSCO*host*) were also searched. Two reviewers independently screened all titles and/or abstracts and applied inclusion criteria to identify relevant studies.

Economic model

Owing to the absence of cost–utility analyses that were relevant to the decision problem and generalisable to the NHS in England, the assessment group constructed a de novo economic model. Two pathways are considered: (1) the intervention, namely prophylactic removal of impacted mandibular third molars, and (2) the comparator, namely current standard of care (watchful waiting). The pathways were modelled as a combination of Markov model processes and decision trees. The model perspective was that of the UK NHS, the time horizon was a lifetime (80 years), the outcomes were measured in quality-adjusted life-years and both costs and quality-adjusted life-years were discounted at an annual rate of 3.5%. A wide range of one-way sensitivity analyses were carried out to test parameter uncertainty and scenario analyses were carried out to test structural assumptions.

Results

Clinical effectiveness

In total, 13 studies from 22 publications were included in the systematic review (four cohort studies and nine systematic reviews).

Cohort studies

The four cohort studies included one observational cohort that investigated the prophylactic removal of pathology-free or asymptomatic impacted mandibular third molars in comparison with the standard care and retention of these pathology-free or asymptomatic impacted mandibular third molars. Annual assessment over 5 years identified patients as requiring and subsequently having an impacted mandibular third molar removed, requiring and refusing extraction of an impacted mandibular third molar and not requiring removal of the impacted mandibular third molar.

No serious surgical complications were reported in the 52 participants who had an impacted mandibular third molar removed. Of those requiring removal but refusing, five out of seven participants required extraction within the follow-up period. Finally, out of those not requiring removal, zero out of 25 participants required extraction within the follow-up period.

Two single-cohort studies investigated standard care without removal of pathology-free or asymptomatic impacted mandibular third molars. For one study, assessments were conducted over the telephone every 6 months for 5 years, and for the other study a clinician questioned and assessed clinical outcomes at 1 year. The difference in the length of follow-up periods explains the differences in the rates of extraction reported by each paper: 5.5% for the study with a 1-year follow-up and 31.4% for the study with a 5-year follow-up. The reasons for extraction also varied between the studies. One study reported that, at 1 year, 46% of participants did not know why the impacted mandibular third molar had been removed. Of those participants who did know why, 50% of the impacted mandibular third molars were removed for pain and 20% for symptoms of pericoronitis. The other study reported that, at 5 years, pericoronitis was the most frequent reason for removal (62.5%), followed by cosmetic/orthodontic reasons (12.5%).

One single prospective cohort study investigated the prophylactic removal of pathology-free or asymptomatic impacted mandibular third molars. An assessment of periodontal health was conducted prior to and at 6 months after removal and post-surgical complications were reported. There was no statistically significant change in plaque index and Gingival Index, but there was a statistically significant reduction in the mean probing pocket depth and probing attachment level. A total of 20 post-surgical complications were reported; the most frequently reported were intense pain for > 1 day (12/78 participants), post-operative infection (5/78 participants) and wound dehiscence (3/78 participants). No instances of secondary bleeding or nerve damage were reported.

Systematic reviews

Nine systematic reviews of the management of third molars were included in this review, although none was limited to impacted mandibular third molars. The inclusion criteria for the systematic reviews differed, resulting in a wide range of included primary studies. Despite the differences in systematic reviews, the conclusions were similar, with seven out of the nine systematic reviews stating that there was insufficient evidence on which to base a decision. One systematic review that looked at the risk of future extraction following the retention of trouble-free third molars found that the mean incidence rate of future extraction was 3% annually (range 1–9%), with a cumulative incidence rate of 5% at 1 year and 64% at 18 years.

Cost-effectiveness

Three studies were identified that provided economic evidence on the cost-effective prophylactic removal of impacted third molars. Two of the studies reported details about the cost-effectiveness of the prophylactic removal of impacted third molars. One of these studies is a cost-effectiveness study from a UK NHS perspective, whereas one study is of less direct relevance, as the estimates are based on the Australian health-care system and the results are presented in Australian dollars. The third study reports findings that relate to an assessment of oral health-related quality of life after the removal of impacted third molars.

Economic model

Comparing prophylactic removal with watchful waiting, exploratory model results show that the incremental cost per person that is associated with prophylactic extraction is £56 and the incremental quality-adjusted life-year gain is 0.005 per person. Combining the cost and the quality-adjusted life-year results that were generated by the model suggests an incremental cost-effectiveness ratio for the comparison of a prophylactic removal strategy with a watchful waiting strategy of £11,741 per quality-adjusted life-year gained for people aged 20 years with asymptomatic impacted mandibular third molars. The base-case incremental cost-effectiveness ratio per quality-adjusted life-year gained was found to be robust when a range of one-way sensitivity analyses were carried out to test parameter uncertainty and when scenario analyses were carried out to test structural assumptions.

Discussion

Despite extensive searching of the literature, the systematic review of clinical evidence found no randomised controlled trial data to support or refute the prophylactic removal of pathology-free/trouble-free impacted mandibular third molars. The review, however, did identify evidence from two longitudinal studies that demonstrated the outcomes when asymptomatic impacted mandibular third molars are left in situ. No studies reported the impact of retention on the status of the second molars, although this may have been a result of the narrow inclusion criteria, which included people with pathology-free or trouble-free impacted mandibular third molars. This criterion severely limited the number of studies that met the inclusion criteria of this review.

As there is very limited clinical effectiveness evidence comparing the prophylactic removal of pathology-free impacted mandibular third molars with a watchful waiting strategy, it is unsurprising that economic evidence relating to this comparison is also limited. The two published cost-effectiveness studies that directly consider this comparison concluded that there is currently no economic evidence to support the prophylactic removal of impacted third molars. This is in contrast to the results generated by the assessment group's economic model, which suggest that prophylactic removal may be the more cost-effective strategy.

The strengths of the assessment group's exploratory economic model include its simplicity and the minimal use of assumptions. It is constructed around two key parameters: (1) the annual rates of symptom development and (2) the extraction of pathology-free/trouble-free impacted mandibular third molars. Unfortunately, the economic model is limited by the lack of utility evidence around impacted mandibular third molar symptoms; however, suitable proxies were found for utility values and cost-effectiveness findings are robust across a range of utility values that could be used.

A further limitation of the assessment group's exploratory economic model is that head-to-head trial evidence of a closely adhered to policy of watchful waiting as opposed to prophylactic removal could not be found and is therefore not used to inform model assumptions. For this reason, real-world observational evidence on symptom development and extractions with NHS dentistry operating under a recommendation of watchful waiting were used in the model. The findings of the model should be interpreted as a comparison of a strategy to recommend watchful waiting with a strategy of recommending prophylactic removal of impacted mandibular third molars.

Conclusions

Clinical effectiveness conclusions

The findings from this review are consistent with previous systematic reviews in that there is no available randomised controlled trial evidence to support or refute the practice of the prophylactic removal of asymptomatic/pathology-free impacted mandibular third molars. However, the review did identify evidence from longitudinal studies demonstrating what happens when asymptomatic impacted mandibular third molars are left in situ.

Cost-effectiveness conclusions

Only two published cost-effectiveness studies that directly consider the study question were identified. In both cases, the authors concluded that there is currently no economic evidence to support the prophylactic removal of impacted third molars.

The base-case results generated by the assessment group economic model indicated that the incremental cost-effectiveness ratio per quality-adjusted life-year gained for the comparison of the cost-effectiveness of a prophylactic removal strategy with that of a watchful waiting strategy is markedly less than the £20,000 per quality-adjusted life-year gained threshold widely accepted by the National Institute for Health and Care Excellence's Appraisal Committees.

Implications for service provision

The reintroduction of the prophylactic removal of pathology-free/trouble-free impacted mandibular third molars will have resource implications in both primary care and secondary care settings, with the rate of pathology-free impacted mandibular third molar extractions increasing.

The results that were generated by the economic model, supported by published observational studies, suggest that most people with impacted mandibular third molars will have their impacted teeth removed at some point and that, although prophylactic removal is probably more costly than a watchful waiting strategy, the improvements in health-related quality of life for people from a reduction in impacted mandibular third molar symptoms suggest that prophylactic removal may, in the authors' opinion, be a cost-effective strategy for the NHS.

Suggested research priorities

There remains a lack of head-to-head trial evidence comparing a prophylactic removal strategy with a watchful waiting strategy. The practical difficulties (including time, cost and the need for extended follow-up) associated with undertaking such studies means that it is unlikely that this type of study will be conducted.

Future longitudinal studies on the pathology of retained impacted mandibular third molars could be designed to record the impaction status and health of the retained impacted mandibular third molar with results being presented separately for maxillary and mandibular teeth.

Study registration

This study is registered as PROSPERO CRD42016037776.

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This report

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