National Institute for Health and Care Excellence Guidance Executive:
Review of TA1; Guidance on the extraction of wisdom teeth.

Faculty of Dental Surgery response

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From Professor Tara Renton, on behalf of the Faculty of Dental Surgery, Royal College of Surgeons England

The Faculty of Dental Surgery welcomes the opportunity to respond to NICE's review proposal regarding its guidance on the extraction of wisdom teeth.

Executive summary

Based upon the critique provided below on this NICE 2014 review, we strongly disagree with the assessment that the NICE 2000 M3M Guidelines should not be revisited. In particular, we are concerned that the additional evidence published since 2000 and the evidence provided in Appendices I, II and III were not considered in this NICE assessment.

We strongly recommend that NICE re appraise the need to amend the 2000 version of M3M Guidelines in the light of evidence concerning;

- harm to patients occurring due to retention of M3Ms,
- that surgery in younger patients has significantly less morbidity
- and that the majority of M3Ms are removed prior to the age of 40 years

This evidence is sufficient for international Guidelines (Scandinavian, German and US) to have been amended in the last 12 months.

Our response takes the form of comments in *italics* to each paragraph of section *7 of NICE's review proposal, the* 'Summary of evidence and implications for review'

The recommendations for future research in TA1 highlighted 2 ongoing randomised controlled trials (in the United States and in Denmark) comparing prophylactic extraction of wisdom teeth with management by deliberate retention. Full information on the Danish randomised control trial remains unavailable and the review proposal in 2003 considered the information available from the conference abstract (Vondeling et al. 1999).

This paragraph confuses work undertaken in Denmark with a large body of work completed by Professor Irja Venta's team in Finland. In Denmark, Professor Andreasen started a follow-up study in the early 1990s but it was never finished. The reference to the work of Vondeling et al. 1999 is in no way related to the work of Professor Irja Venta's team in Finland which is referenced in Appendix I of this response. The Finnish third molar surgery (M3M) guidelines have recently been published supporting interventional surgery as most M3Ms end up being extracted and surgery in patients aged under 25 years has considerably less risk of morbidity.

At 38 years of age only 31% of wisdom teeth remain (Ventä I[1], Ylipaavalniemi P, Turtola L. Clinical outcome of third molars in adults followed during 18 years. J Oral Maxillofac Surg. 2004 Feb;62(2):182-5.).

In dentate Finns the prevalence of partially erupted or erupted wisdom teeth, from ages 30 to 65 of decreases from 30 % to less than 5 % in [Suominen - Taipale L and others. Edentulousness and the number of teeth . In: Suominen – Taipale L et al. Finnish adult

oral health . The Health 2000 survey. National Public Health Institute B16 / 2004 . Helsinki 2004 ; p. 65-72].

Therefore by 38 years 70% of M3Ms are missing and by the age of 65 years 95% of M3Ms are missing. On this basis the Finnish M3M guidelines recommend an interventional approach to M3M extraction to minimise risks of retention and the associated risks of surgery in older patients.

A recent study reports that in 293 patients over 79 years evaluation of their DPTs revealed that 21% had one or more maxillary and mandibular M3Ms. All M3Ms were associated with disease, carious (82%), periodontal disease (67%) or in relation to cysts or tumours (2%).Vent Irja, Kylatie Eeva, Hiltumen Katja. Pathology related to third molars in elderly persons. Clinical Oral Investigations 2014 *in press.*

The Finnish guidelines emphasise preventive removals in selected cases and this is summarised in the article: Ventä I. How often do asymptomatic, disease-free third molars need to be removed? J Oral Maxillofac Surg 2012;70, Suppl 1:41-47. The background and references of the four selected cases for preventive removals are very well explained in the Finnish third molar guideline http://www.kaypahoito.fi/web/kh/suositukset/suositus?id=hoi50074 The English version of the guidelines have not yet been released from the technical secretaries. The Finnish M3M Guidelines are adopted as the Scandinavian group Guidelines (Norway, Sweden, Iceland, finland and Denmark).

The trial based in the United States has resulted in several published papers examining the 329 patients in this trial who had at least 1 asymptomatic wisdom tooth visible. Based on these analyses, the American Association of Oral and Maxillofacial Surgeons (AAOMS) recommended that wisdom teeth be removed by the time the patient is a young adult in order to prevent future problems and to ensure optimal healing. However, these recommendations faced criticism and the American Association of Public Health issued a policy in 2008 in which they opposed prophylactic removal of third molars, stating that it subjects individuals and society to unnecessary costs, avoidable morbidity, and the risks of permanent injury. The AAOMS published another white paper in 2011 stating that the decision regarding the why, when or how to treat third molar teeth is extremely complex and the risks of complications involved with early treatment of third molar teeth that are likely to cause problems versus the morbidity caused by retained *third molar teeth and subsequent treatment in an older patient must be considered.*

There is missing evidence regarding AAOMS M3M guidance and recommendations in the NICE document.
Since the AAOMS paper in 2011 an international Consortium met at the end of 2011 and a series of 12 papers were published revisiting the AAOMS guidelines in the light of the criticism by the American Public Health Association (See attached PDF files and summary-Task Force for Third Molar Summary of the Third Molar Clinical Trials: report of the AAOMS Task Force for Third Molar Summary. J Oral Maxillofac Surg. 2012 Sep;70(9):2238-48)(Appendix II).

In response to the criticism by the American Association of Public Health, AAOMS re-evaluated the evidence and recommended routine extraction of all wisdom teeth erupted/partially erupted impacted wisdom teeth with pathology and at risk of developing pathology. Active surveillance of unerupted wisdom teeth bone impacted with no pathology would be regularly clinically and radiographically reviewed annually (23% of wisdom teeth at under 25 years). The key messages abstracted from the Third Molar Clinical Trials by Task Force members ***include:***

1 An absence of symptoms should not be equated with the absence of disease.

2 During the clinical examination, clinicians should include periodontal probing to determine if nonvisible M3s are communicating with the oral cavity and to measure PDs. This information is valuable in assessing and documenting the disease status of M3s, especially in the absence of symptoms.

3 Absent symptoms, retained M3s commonly develop disease, erupt, or change position over time. These changes are unpredictable. As such, monitoring retained M3s for the development of disease seems a prudent recommendation for patients electing to retain their M3s.

4 Removal of M3s generally causes no more significant discomfort than a single multiday episode of mild pericoronitis. Individuals who have even mild symptoms of pericoronitis usually seek to have M3s removed rather than experience these symptoms again.

5 Removal of M3s with periodontal pathology improves the periodontal status on adjacent M2s and on teeth more anterior whether or not the M3s were symptomatic.

6 In most patients who retain M3s with periodontal pathology, the periodontal disease affecting the M3 and adjacent M2 worsens.

7 If caries is present on M1s or M2s, it is highly likely that M3s will be affected with caries over time. Conversely, if M1s or M2s are not affected by caries, M3s are very unlikely to develop caries over time.

8 Older age predicts a delayed recovery from pain and disruption of lifestyle and oral function of about 2 days after M3 removal.

9 Adjunct measures such as corticosteroids, topical or short-term IV antibiotics, and continuous use of cold therapy decrease symptoms and improve quality of life after M3 removal.

The largest UK-based study assessed X-rays for 420 patients (776 third molars) who were referred over a five month period. Thirty-four percent of third molars were mesioangular and there was radiographic evidence of distal second molar caries in 42% of these. The study concluded that distal caries in lower second molars related to a mesioangular third molar is common especially if the third molar is fully or partially erupted. The authors also stated that if such third molars are left in situ, close monitoring and regular 'bitewing' radiographs (which provide an image of the crowns of the top and bottom teeth on a single film) are recommended.

Allen RT, Witherow H, Collyer J, Roper-Hall R, Nazir MA, Mathew G. The mesioangular third molar--to extract or not to extract? Analysis of 776 consecutive third molars. Br Dent J. 2009 Jun 13;206(11):E23; discussion 586-7. doi: 10.1038/sj.bdj.2009.517. Epub 2009 Jun 5. Concluded using the analysis of OPG X-rays for 420 consecutive patients (776 third molars) referred to three maxillofacial centres over a five month period. Results Thirty-four percent of third molars were mesioangular. There was radiographic evidence of distal second molar caries in 42% of these. When unerupted mesioangular third molars were excluded this increased to 54%. There was no difference in age or dental health of these patients compared to the whole group. There was no angulation of the mesioangular third molar for which distal caries in the second molar was more likely. Conclusion -Distal caries in lower second molars related to a mesioangular third molar is a common finding in oral and maxillofacial patients in secondary care.

*If interventional extractions were undertaken on erupted or partially erupted M3Ms, in this patient cohort, little no distocervical caries would develop in M2Ms. Nunn et al (*Nunn ME[1], Fish MD, Garcia RI, Kaye EK, Figueroa R, Gohel A, Ito M, Lee HJ, Williams DE, Miyamoto T. Retained asymptomatic third molars and risk for second molar pathology. J Dent Res. 2013 Dec;92(12):1095-9. doi:

10.1177/0022034513509281. Epub 2013 Oct 16.*). Illustrated in a prospective study that second molars adjacent to erupted third molars were at greater risk of incident distal caries (RR = 2.53) and incident distal probing depth > 4 mm (RR = 1.87) than were second molars adjacent to absent third molars.*

As long as the partially erupted tooth remains in situ, trapping food and making cleaning distal to the M2M impossible caries is likely to develop. Taking sequential LCPAs (which in practice is very difficult to do in patients due to discomfort and sectional panorals are often indicated resulting in increased radiation dose). Detection of M2M distocervical caries is difficult and late in presentation when diagnosed. This results in poor prognosis of the M2Ms and unnecessary loss of a second molar tooth in the quadrant. Thus the NICE M3M guidelines have 'condoned' supervised neglect resulting in harm in 48% of the patients in this study.

A Turkish study was identified which retrospectively reviewed clinical records and panoramic radiographs to evaluate the prevalence of second molar distal caries (in a Turkish population) and found that the prevalence rose from 20% to 47% when the third molar had an angulation of 31-70 degrees and 43% at 70-90 degrees. The authors concluded that these results justify the prophylactic removal of third molars erupted third molars that have an angulation of 30-90 degrees. However, the study did not study the effect of prophylactic removal itself.

Ozeç I, Hergüner Siso S, Taşdemir U, Ezirganli S, Göktolga G. Prevalence and factors affecting the formation of second molar distal caries in a Turkish population. Int J Oral Maxillofac Surg. 2009 Dec;38(12):1279-82. doi: 10.1016/j.ijom.2009.07.007. Epub 2009 Aug 7. Thus the non-interventional M3M guidelines have 'condoned' supervised neglect resulting in harm in 43-47% of the patients in this study.

Another study retrospectively assessed the records of 786 patients in South Korea who had their mandibular third molars removed over a 5 year period. The authors noted that among the 883 mandibular second molars, 152 (17.2%) had distal caries. Of these, 79.6% had mesial angulation of the third molars between 40 and 80 degrees.

Chang SW, Shin SY, Kum KY, Hong J. Correlation study between distal caries in the mandibular second molar and the eruption status of the mandibular third molar in the Korean population. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009 Dec;108(6):838-43. doi: 10.1016/j.tripleo.2009.07.025. Epub 2009 Oct 20. Among 883 M2Ms, 152 had distal caries (17.2%, caries group). In the caries group, 79.6% of M3Ms exhibited mesial angulation between 40 degrees and 80 degrees and 82.2% of M3Ms exhibited an impaction level in which the most coronal aspect of the M3M was located superior to the occlusal surface of the M2M. The distance between M2M and M3M (between cemento enamel junctions) was 7-9 mm for 57.2% of the caries group. In conclusion 152/883 M2Ms displayed second molar caries due the mesioangular impaction of the M3M and 7-9mm distance between M3M and M2M cemento dentinal providing factors for consideration in preventive extractions.

A Cochrane review evaluated the effects of prophylactic removal of asymptomatic impacted wisdom teeth in adolescents and adults compared with the retention (conservative management) of these wisdom teeth (Mettes et al., 2012). No randomised controlled trials were identified that compared the removal of asymptomatic wisdom teeth with retention and reported quality of life. Although it did not specifically assess the available evidence relating to mesioangulation or horizontal partially erupted third molars in compromising the prognosis of the adjacent second molar, the review concluded that there is insufficient evidence to support or refute prophylactic removal of impacted wisdom teeth in adults and that watchful monitoring might be a more prudent strategy.

Mettes TD, Ghaeminia H, Nienhuijs ME, Perry J, van der Sanden WJ, Plasschaert A. Surgical removal versus retention for the management of asymptomatic impacted wisdom teeth. Cochrane Database Syst Rev. 2012 Jun 13;6:CD003879. doi: 10.1002/14651858.CD003879.pub3. Highlight the insufficient evidence to support either prophylactic, interventional or therapeutic extractions for M3Ms.
Gaining sufficient evidence will remain a problem as NIHR is unlikely to fund prospective randomised studies in this area when other health priorities (such as cancer, stroke and diabetes take precedence). So realistically the evidence base for this area of work will remain a challenge similar to resuscitation and many other common areas of dentistry and medicine.

In 2012 the Faculty of Dental Surgery (the Royal College of Surgeons of England) wrote to NICE indicating that they were considering a review of their own 2004 clinical guideline on the management of patients with third molar teeth (this review is now ongoing). They noted that several members of their Clinical Standards Committee believe that there is increasing pressure for TA1 to be reviewed on the basis of evidence that retention of wisdom teeth (with or without pathology of the tooth itself) may result in second molar caries with subsequent additional treatment and loss of the second molar. They were also concerned that the guidance resulted in people undergoing surgery at a later age than was previously the case, resulting in additional complications. The studies highlighted by the Faculty of Dental Surgery were relatively small and of a retrospective observational nature. Although the studies might suggest a link between mesioangulation (and/or level of impaction) and distal caries in the second molar, the studies do not directly assess outcomes associated with prophylactic removal of wisdom teeth itself.

The Faculty of Dental Surgery at the Royal College of Surgeons of England has established a working group to review the "Current Clinical Practice and Parameters of Care for Patients with Third Molar Teeth (draft attached). As Chair of the working group, I can confirm that based upon minimising harm to patients, we recommend interventional extractions based upon the evidence base similar to the Finnish and AAOMS M3M guidelines. We believe the new evidence supports the following;

- *Over 80% of mandibular M3Ms require removal before the age of 38 years*
- *Removing low risk (of Inferior alveolar nerve injury) erupted or partially erupted impacted M3Ms to prevent damage to adjacent teeth (either due to caries or periodontal disease)*
- *Surgery undertaken on patients under the age of 25 years causes significantly lower morbidity (including; pain, nerve injury, jaw fractures, dry socket and infections) compared with surgery on patients over 25 years of age.*
- *Active surveillance of*
    - *Erupted or partially erupted impacted M3Ms crossing the Inferior dental canal*
    - *Unerupted mandibular M3Ms (estimated 20-23%) with no associated pathology.*

A recent publication in the British Dental Journal explored the effects of NICE TA1 on the management of third molar teeth (McArdle LW and Renton T, 2012). This study analysed data obtained from several NHS databases and explored the age of patients requiring third molar removal, the number of patients having third molars removed and the clinical indications for third molar surgery activity in secondary care between 1989 and 2009. The mean age of patients increased from 25 years in 2000 to 32 years in 2010. During the 1990s, the number of patients who had been admitted to hospital for either a day-case or in-patient procedure under general anaesthetic or intravenous sedation in England and Wales averaged approximately 60,000 patients per year for the whole of the decade. In the first half of the 2000s patient numbers started to decline and by

2003, the data suggested less than 40,000 patients per annum were having third molar treatment. Over the latter 5 years of the 2000s, the number of patients having their third molar removed increased to approximately 77,000 patients per annum (2009/10). The authors hypothesise 2 potential reasons for the increase in secondary care activity:

☐ The possible influence of the new General Dental Services contract in England and Wales in 2005 (which the authors suggest may incentivise dentists to refer patients requiring some of the more complex treatment items to other providers)

☐ A link between the increasing age of patients and the increasing incidence of caries related to third molars (which increased from 10% in 1995 to 30% by 2009 as the main clinical indication at diagnosis)

The authors concluded that the management of patients with third molars has been influenced by NICE TA1 but this has not resulted in reducing the number of patients requiring third molar removal. However, the authors acknowledged that coding and data collection for third molars is not uniform which may lead to potential misrepresentation of the data. Similar to the conclusion of the review of the studies highlighted by the Faculty of Dental Surgery, this publication may suggest a link between mesioangulation (and/or level of impaction) and distal caries, but does not directly assess outcomes associated with prophylactic removal of wisdom teeth itself.

As an author of this paper (McArdle LW, Renton T. The effects of NICE guidelines on the management of third molar teeth. Br Dent J. 2012 Sep;213(5):E8. doi: 10.1038/sj.bdj.2012.780. Erratum in: Br Dent J. 2012 Oct;213(8):394), I am concerned that the NICE reviewers have misinterpreted the findings of this study and have also not evaluated another study (Renton T, Al-Haboubi M, Pau A, Shepherd J, Gallagher JE. What has been the United Kingdom's experience with retention of third molars? J Oral Maxillofac Surg. 2012 Sep;70(9 Suppl 1):S48-57. doi: 10.1016/j.joms.2012.04.040. Epub 2012 Jul 3).

The evidence provided by both papers illustrates that NICE guidelines

- *have only delayed necessary surgery with the average age of patient at surgery rising from 23 years to-32 years*
- *have not reduced the prevalence of M3M surgery (only delayed it)*
- *have resulted in significant damage to second molars due to caries (and resultant patient harm). The prognosis of M2Ms affected by distocervical caries is poor due to the proximity of the lesion to the dental pulp and resultant high frequency of subsequent root canal therapy and/or extraction of the M2M. Observations on this problem have been published 'This common finding of distal caries in this pre-selected population would suggest long-term close monitoring and informed consent as to the risks of leaving erupted mesioangular wisdom teeth in situ. This should be undertaken if the patient is to avoid the unnecessary loss of a functional second molar tooth. I agree with the authors that disease or potential disease in the adjacent second molar teeth is an oversight of the NICE guidelines'. Banks R.J. Summary of: The mesioangular third molar – to extract or not to extract? Analysis of 776 consecutive third molars British Dental Journal **206**, 586 - 587 (2009)*

The significant limitation of the epidemiological study was the inadequate and disparate coding systems for M3M surgical activity; this cannot be utilised by NICE to refute these findings.

As there are no codes to separate the need for surgery (diagnosis) for;

Caries in M2M

Pericoronitis (having to use a code for chronic periodontal disease

It is impossible to accurately assess the need for surgery.

Thus there is non-alignment and discordance between the diagnostic ICDN 10 coding to NICE indications for surgery preventing accurate natural experimental assessment of ongoing surgical activity need and outcomes. We hope this will be addressed in intelligent commissioning guidance future NHS care.

Secondly secondary care activity coding and primary care activity coding are different systems and the UDA system has made assessment of specific activity impossible.

The finding that caries being the increasing and predominant cause for indication for M3M surgery in an older patient cohort confirms the findings of many of the studies alluded to in the NICE technical review, that M2M caries is a problem and should be prevented.

A recent opinion piece by Mansoor et al (2013) highlighted that there may be growing evidence of people developing caries in an adjacent tooth the treatment of which is not being met because of the existing NICE guideline.

This report alludes to many reservations shared by dental professionals regarding the existing NICE guidelines. They report an incidence of need for M3M surgery due to M2M distocervical caries in 38% or cases at Manchester dental Hospital.
Our recent Audit indicates that M2M distocervical caries is the cause for 36% of cases at Kings College Hospital (unpublished) A previous study (Ayse Nazli Ozgun, Martyn Sherriff, Tara Renton An assessment of lower third molar treatment needs. BAOS Poster Abstract J Oral Surg J Oral Surgery 2011) reported that risk factors for M2M caries in relation to M3Ms included all impaction types of M3Ms but particularly horizontal and mesial. In this audit of 1000 patients the prevalence of M3Ms presented with distal decay was:

- *70% of M2Ms adjacent to horizontally angulated M3Ms*
- *45.29% of M2Ms adjacent to mesially angulated*
- *20.63% of M2Ms adjacent to distally angulated M3Ms*
- *19.67% of M2Ms adjacent to vertically aligned M3Ms*

However, Fernandes et al (2013) that although the research base for what happens if third molars are left may not be strong, we do know that taking out asymptomatic wisdom teeth is often associated with some fairly unpleasant side effects.

We have not been able to find a reference for Fernandes et al 2013 pertaining to wisdom teeth. The references that this NICE review section may refer to is the 2 following papers

1. *Fernandes MJ, Ogden GR, Pitts NB, Ogston SA, Ruta DA. Actuarial life-table analysis of lower impacted wisdom teeth in general dental practice. Community Dent Oral Epidemiol. 2010 Feb;38(1):58-67*

Prospective review of 573 patients attending 21 dentists in primary care in UK.83.13% wisdom teeth survived 1 year review. The reason for extraction was unknown in 46% of cases 3% M2M caries 27% pain (a clinical sign not an indication) and 5.5% caries in M3M. In conclusion older patients are less likely to complain of symptoms related to M3Ms but this may in part be related to loss of M3Ms with time.

2. *Fernandes MJ, Ogden GR, Pitts NB, Ogston SA, Ruta DA. Incidence of symptoms in previously symptom-free impacted lower third molars assessed in general dental practice. Br Dent J. 2009 Sep 12;207(5):E10; discussion 218-9*

A prospective primary care patient cohort review, over 7 years, regarding symptoms related to M3Ms in 421 patients. Significantly distal impacted M3Ms were more likely to become symptomatic (31%). 23% of partially erupted and 11% of unerupted M3Ms became symptomatic and required removal over the period. Significantly 23% of patients aged 18-34 years are more likely to suffer symptoms related to M3Ms.

These prospective patient cohort studies confirm that the majority of M3Ms require removal during the patient's life. We are concerned that both of these studies depend on patients to report symptoms from M3Ms or adjacent dentition to dictate intervention. Most pathology (caries, periodontal disease and cysts) are asymptomatic in the main until late disease. This study weakness significantly undermines the study conclusion quoted in the NICE document 'that further research is clearly still required to improve the evidence base from which to make the conclusion that asymptomatic third molars should be left alone.'

NICE conclusion from 2014 review

Overall, there does not appear to be any strong or robust evidence since publication of the original guidance to warrant a review of the recommendations in TA1, under the current methods that underpin the technology appraisals process.

Based upon the critique provided about the NICE 2014 review, we strongly disagree with this assessment. In particular, we are concerned that the additional evidence published since 2000 and the evidence provided in Appendix III were not considered in the NICE assessment. We strongly recommend that NICE re appraise the need to amend the 2000 version of M3M Guidelines.

It is important to note that the NICE Guide to the Methods of Technology Appraisal 2013 states that:

"Section 2.1 The Appraisal Committee makes recommendations to the Institute regarding the clinical and cost effectiveness of treatments for use within the NHS. It also notes the role of the Appraisal Committee is not to recommend treatments if the benefits to patients are unproven."

We suggest this statement is counterintuitive as currently TA1 does recommend treatment on an unproven basis. Since 2000 the evidence has emerged that all NICE M3M guidelines achieve is delaying surgery for 8 years in which time the adjacent molar is jeopardised.

Therefore the guidance should remain static, but it is acknowledged that there are some articles expressing disagreement with the guidance.

We strongly disagree that the guidance should remain static and urge NICE to consider the evidence provided in Appendix III.

Appendix I

Professor Venta's team references

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3. Ventä I, Meurman J, Murtomaa H, Turtola L. Effect of erupting third molars on dental caries and gingival health in Finnish students. *Caries Res* 1993;27:438-443.

4. Ventä I, Turtola L, Murtomaa H, Ylipaavalniemi P. Third molars as an acute problem in Finnish university students. *Oral Surg Oral Med Oral Pathol* 1993;76:135-140.

5. Ventä I. Predictive model for impaction of lower third molars. *Oral Surg Oral Med Oral Pathol* 1993;76:699-703.

6. Ventä I, Murtomaa H, Ylipaavalniemi P. A device to predict lower third molar eruption. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1997;84:598-603.

7. Ventä I, Lindqvist C, Ylipaavalniemi P. Malpractice claims for permanent nerve injuries related to third molar removals. *Acta Odontol Scand* 1998;56:193-196.

8. Ventä I, Turtola L, Ylipaavalniemi P. Change in clinical status of third molars in adults during 12 years of observation. *J Oral Maxillofac Surg* 1999;57:386-389.

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13. Ventä I, Ylipaavalniemi P, Turtola L. Clinical outcome of third molars in adults followed during 18 years. *J Oral Maxillofac Surg* 2004;62:182-185.

14. Suomalainen A, Ventä I, Mattila M, Turtola L, Vehmas T, Peltola JS. Reliability of CBCT and other radiographic methods in pre-operative evaluation of lower third molars. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2010;109:276-284.

15. Ventä I. How often do asymptomatic, disease-free third molars need to be removed? *J Oral Maxillofac Surg* 2012;70, Suppl 1:41-47.

16. Suomalainen A, Apajalahti S, Vehmas T, Ventä I. Availability of CBCT and iatrogenic alveolar nerve injuries. *Acta Odontol Scand* 2013;71:151-156.

17. Vent Irja, Kylatie Eeva, Hiltumen Katja. Pathology related to third molars in elderly persons. Clinical Oral Investogations 2014 in press

Appendix II

Summary of the Third Molar Clinical Trials: Report of the AAOMS Task Force for Third Molar Summary

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- The Task Force for Third Molar Summary

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In 1993, the American Association of Oral and Maxillofacial Surgeons (AAOMS) convened a 2.5-day workshop charged with the following tasks: *1)* to review and analyze the current third molar (M3) literature;*2)* to develop recommendations for management of M3 patients; and *3)* to identify research questions and strategies. An exhaustive search and analysis of the M3 literature was conducted by the 24 workshop participants and the deliberations published in 1994.[1] One key finding of the workshop was that more data were required to improve the management of patients with M3s. Toward this end, the Oral and Maxillofacial Surgery Foundation (OMSF), the AAOMS Board of Trustees, and the AAOMS House of Delegates coupled with OMS departmental funds from the University of Kentucky and the University of North Carolina supported a comprehensive set of clinical studies to assess the risks of retaining M3s and data on recovery after M3 removal. Based on having prior productive experience with a longitudinal study over 2 decades involving orthognathic surgical patients, investigators at the University of North Carolina were asked to undertake the project. The umbrella project became known as the Third Molar Clinical Trials.

Although the timeframe required to generate adequate data was projected by some to be quite lengthy, the initial study targeting subjects with asymptomatic M3s was planned for 5 years. Prospective cohort studies with primary data collection involving 24 nonsurgeon investigators from multiple disciplines and oral and maxillofacial surgeons (OMSs) have led to a wealth of data on asymptomatic M3 pathology and management. The longitudinal study of subjects enrolled with asymptomatic M3s was a first for the United States population. Subsequent to this longitudinal study, for comparison purposes, the investigators launched a longitudinal institutional review board (IRB)-approved study of subjects with minor symptoms of pericoronitis. Subjects in the pericoronitis study were followed for at least 1 year after enrollment or at least 3 months after M3 removal. Although the Third Molar Clinical Trials were initially planned as a 5-year effort, these collective “exploratory studies ” led to meaningful clinical data and the Third Molar Clinical Trials have been continuously funded since 1997.

The 2 longitudinal studies involving subjects retaining asymptomatic M3s and subjects with minor symptoms of pericoronitis are a unique aspect of Third Molar Clinical Trials. No similar studies with this extensive degree of data collected have been reported to date. The Third Molar Clinical Trials,

however, are much more than these 2 longitudinal studies. The investigators implemented prospective, multisite clinical trials addressing clinical and health-related quality of life outcomes after M3 surgery. In addition to these studies collecting primary data, the investigators conducted secondary analyses of M3 data from subjects enrolled in population or clinical studies for other purposes. This effort to expand knowledge pertaining to M3s by formal clinical investigation was necessary because M3 data were routinely not collected from clinical and population studies or, if data were collected, they were not analyzed. These data support conclusions reached from analyses of primary data from the longitudinal studies noted earlier.

The investigators have attempted a comprehensive approach to generating data on M3 management. To date more than 120 publications have evolved from the Third Molar Clinical Trials, divided almost evenly among abstracts of studies presented at AAOMS, American Association for Dental Research, and American Association of Orthodontists meetings and articles in peer-reviewed journals. As an analogy, the effort might be viewed as a vacationer who at the outset attempts to complete a jig-saw puzzle with no picture of the end product and only limited information about the outcome. The completed picture would display a beach with a lighthouse and some large boulders, a sailboat anchored nearby, and a skyline depicting a sunset. Over time, as the puzzle progressed, many details became apparent and many important features were still missing. For example, few Asian or Latino subjects were included in the exploratory study of subjects with asymptomatic M3s, suggesting that a larger multisite clinical study be implemented with an enrolled group of subjects that mimic the age group in the United States population. The collective investigators for the Third Molar Clinical Trials believe they have reached a stage in this project that suggests more should be done to add detail to the important findings generated to date.

Section 1—Design and Conduct of Third Molar Clinical Trials

To increase data-based decision making for management of M3s, the investigators emphasized primary data collection by gathering data directly from subjects in IRB-approved clinical studies. A collective group of investigators (Drs George H. Blakey, Steven Offenbacher, Ceib Phillips, Raymond P. White, and Robert Marciani) contributed to the design and the implementation of the initial studies. All but Dr Marciani, who at the time was at the University of Kentucky, were faculty at the University of North Carolina. The clinical coordinators, Ms Robin Hambly and Ms Tiffany Hambright, were responsible for clinical data collection and had the most direct ongoing contact with the study subjects.

Data collected concerning the patients' perceptions of their health-related quality of life were considered in these studies to be as important as data collected based on clinical measurements and observations. Four categories were selected within which to collect data: oral function, general function, pain, and symptoms. The patients' responses were analyzed to display the average perception of patients to a particular M3 experience, including operative intervention or nonintervention, eg, symptoms from pericoronitis.

A. Assessing Outcomes of Retained M3s

The primary study was designed as a noninterventional observational prospective cohort study. The investigators enrolled subjects at the University of North Carolina and University of Kentucky who were encouraged to retain their M3s as long as practical. To be included, subjects had to be healthy (American Society of Anesthesiologists physical classification I or II), not taking antibiotics in the previous 3 months, and not pregnant. Subjects with the most severe periodontal disease were excluded. Subjects (n = 413) 14 to 45 years of age with 4 asymptomatic M3s and adjacent second molars (M2s) were enrolled from 1998 through 2002.

At enrollment, demographic, clinical, and quality-of-life data were collected. Caries experience data on all molars reflected existing restorations and untreated caries. Periodontal data included full-mouth periodontal probing, with 6 probing sites for each visible tooth. Because the link between local oral inflammation and systemic disease was only beginning to be recognized, gingival crevicular fluid samples and subgingival biofilm samples were taken from first molars (M1s) and M3s in addition to serum samples to help characterize the local and systemic expressions of periodontal inflammatory disease. Panoramic radiographs were used to assess the M3 position relative to the occlusal plane and the angulation of the M3 relative to adjacent M2s. These radiographs also allowed screening for other jaw pathologies such as cysts or tumors. Subjects were encouraged to maintain regular visits with their dentist. To maintain a degree of uniformity in the study, each subject had a full-mouth dental prophylaxis, including mechanical debridement of biofilm, at the completion of each data-collection visit. Please see Garaas et al[2] for additional details about the data analyses for the study.

After each study visit, subjects were advised of their periodontal status and caries risk and encouraged to seek advice about M3 management from their dentists. Subjects could be seen as often as annually for examination and data collection as long as M3s were retained. If subjects elected to have M3s removed, they were encouraged to return at least once 3 months after surgery for examination and data collection. Per protocol, all return visits were voluntary and subjects did not repeat consent after enrollment. The study flow schema (Fig 1) summarizes the follow-up for the subjects enrolled with asymptomatic M3s. The follow-up of a median 6.9 years (interquartile range, 4.6 to 7.7 years) for 179 subjects represents the longest follow-up reported to date for a cohort of subjects retaining all M3s.[3]

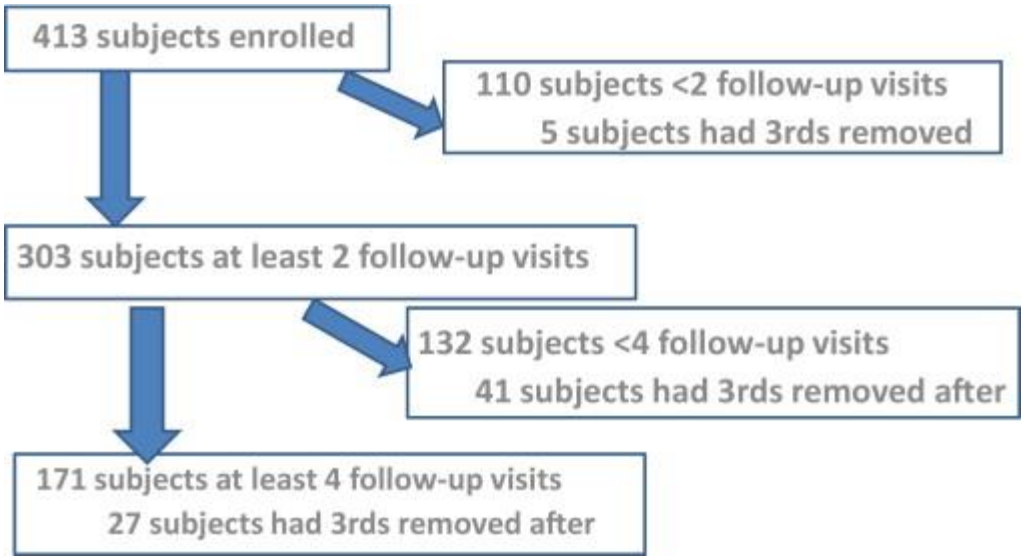

Figure 1.

Subjects with 4 asymptomatic third molars and adjacent second molars enrolled over a 4-year period ending in 2002 in an institutional review board-approved exploratory study at the University of Kentucky and the University of North Carolina.

Task Force for Third Molar Summary. Task Force for Third Molar Summary. J Oral Maxillofac Surg 2012.

Figure options

B. Outcomes of Symptomatic M3s

The investigators designed a second prospective observational clinical study to obtain data from subjects with symptomatic pericoronitis involving the M3s. Healthy subjects 18 to 35 years old with mild symptoms of pericoronitis affecting at least 1 mandibular M3 were recruited for an IRB-approved study from 2006 to 2012. Inclusion criteria were American Society of Anesthesiologists physical classification I or II and minor symptoms of pericoronitis such as pain controlled with oral analgesics or localized swelling affecting at least 1 mandibular M3. Subjects with major symptoms of pericoronitis, such as facial swelling, difficulty swallowing, or increased body temperature were excluded. Other exclusion criteria were generalized periodontal disease; body mass index higher than 29 kg/m^2; use of antibiotics; or use of tobacco were excluded. At enrollment, quality-of-life data were collected to assess the levels of pain and the impact of symptoms on lifestyle or oral function. Clinical data collection for these subjects with symptomatic M3s was similar to that for subjects with asymptomatic M3s. After data collection, the symptomatic M3 site was irrigated and gross debris removed. No attempt was made to mechanically remove biofilm. Subjects were advised to have M3s removed, but no specific timeframe for surgery was discussed. The subjects' decision regarding M3 removal was not a component of the study. Subjects who elected M3 retention were recalled 3 months after enrollment for data collection similar to the initial visit and again at 1 year after enrollment. If subjects had M3s removed, similar quality-of-life and clinical data were collected at least 3 months later.

C. Assessing Outcomes After M3 Removal

The investigators implemented a third prospective, observational clinical trial to measure outcomes after M3 removal. The sample was composed of subjects with asymptomatic and symptomatic M3s scheduled for extraction. The study focused on the short-term recovery (14 days) after M3 removal. Because no postsurgery quality-of-life data had been systematically collected with respect to patients' M3 postoperative experience in the United States before this study, an appropriate instrument had to be developed and validated.[4] The instrument used in the study consisted of a 14-item recovery diary representing 4 specific dimensions of dental quality-of-life outcomes: pain, oral function, general function/lifestyle, and other symptoms. Pain levels were assessed with 7-point Likert-type and Gracely scales, and outcomes for lifestyle, oral function, and other symptoms were assessed with 5-point Likert-type scales. Clinical details from the operation were collected. Subjects were enrolled according to an IRB-approved study protocol with consent and surgery was performed by trained surgeons, representing almost equally practices in the community and academic practices. Data from more than 1,000 subjects were obtained and exploratory studies on the impact of interventions on recovery, including intravenous (IV) and topical antibiotics, IV corticosteroids, and cold therapy, were completed.

D. M3 Outcomes Derived From Population or Other Clinical Trials

Because few M3 data have been reported from population or clinical studies in the United States or abroad, the investigators sought M3-related data from previous studies. Cross-sectional data were analyzed from the Third National Health and Nutrition Estimates Survey (NHANES III) in the United States and the National Institutes of Health (NIH)-sponsored Atherosclerosis Risk in Communities Study (ARIC). In addition, longitudinal data from seniors in the NIH-sponsored Piedmont 65+ Study and from pregnant subjects in the NIH-sponsored Oral Conditions and Pregnancy Clinical Trial (OCAP) were analyzed. In these studies, the trained examiners, absent radiographic imaging, designated M3 status as visible or not. Of the 6,793 subjects in ARIC (average age, 62 years old), 30% had at least 1 visible M3. Of the 818 subjects in the Piedmont 65+ Study (average age, 73 years old), 42% had at least 1 visible M3. Of the 1,020 subjects in the OCAP (average age, 27 years old), 35% had at least 1 visible M3.[5,6 and 7] No data were reported regarding the etiology of M3s not visualized, eg, extraction, congenital absence, or impacted M3s not visible to the examiner. These valuable data from subjects (age range, 18 to 72 years) have complemented the findings from the Third Molar Clinical Trials.

The investigators would be remiss to not recognize the important contribution of the subjects who volunteered time to participate in these clinical investigations. In addition, OMSs in community practices and academic centers and non-OMS investigators volunteered their time, effort, and specific expertise without compensation. These extraordinary contributions made the outcomes reported from the Third Molar Clinical Trials possible and compounded the impact of the grant support from the OMSF, the AAOMS, and funds from the OMS departments at the University of Kentucky and University of North Carolina.

Section 2—Summary of Third Molar Clinical Trials

The Third Molar Clinical Trials, initiated in 1997, have generated a substantial quantity of valuable data and produced more than 120 publications. This project has been a monumental undertaking and the investigators are grateful for the time and energy committed by the study team composed of more than 20 investigators and research assistants.

Such a large body of information can be difficult to digest. At the 2011 annual meeting of the AAOMS, the House of Delegates requested that a summary report of the Third Molar Clinical Trials be prepared. This request was assigned to the AAOMS Task Force on Third Molar Summary. The task force met in February 2012 and developed and implemented a plan for preparing this summary report. The strategy was to use a question-and-answer format. Specifically, each member of the task force generated a list of questions that could be answered from at least 1 publication generated by the Third Molar Clinical Trial team. The answers were designed to be short, declarative sentences followed by the data and references to support the answers.

The questions were grouped as follows: *1)* in asymptomatic patients, what are the frequencies of various acute and chronic conditions such as periodontal inflammatory disease or caries affecting M3s; *2)* in asymptomatic patients who elect to retain their M3s, what happens to retained M3s over time; and *3)* when M3 removal is indicated, what are outcomes associated with removing M3s?

Part A—Baseline Estimates of Frequencies of Disease in Patients With Asymptomatic M3s

1

In patients reporting asymptomatic M3s, how common is periodontal inflammatory disease?

Answer: Numerous studies have shown that periodontal inflammatory disease affecting M3s is commonly present in patients reporting asymptomatic M3s.

Twenty-five percent to 60% of asymptomatic patients, depending on their age or gender, had clinical evidence of periodontal inflammatory disease as evidenced by periodontal probing depths (PDs) of at least 4 mm. At a baseline examination of a sample of pregnant women with asymptomatic M3s, inflammatory periodontal disease was evident in 42% in those with and 26% of those without visible M3s.[8] In older subjects (≥65 years old), more than two thirds of subjects with visible M3s had clinical evidence of periodontal disease in at least 1 of their visible M3s.[9] In a sample of asymptomatic young adult subjects, 25% had evidence of inflammatory periodontal disease as measured by PDs of at least 5 mm.[10]

2

In patients with asymptomatic M3s visible in the mouth, what percentage will have caries?

Answer: Depending on age, 28% to 77% of patients with asymptomatic M3s will have caries.

At the baseline examination, 28% of patients enrolled in the Third Molar Clinical Trials had occlusal caries.[11] Patients with caries in M1s or M2s were more likely to have caries in adjacent M3s than

patients who did not have caries in those molars. This was more evident in patients older than 26 years and may be related to the period the M3 is exposed to the oral cavity. In older patients (52 to 72 years), 77% of patients with erupted M3s had caries.[12] Divaris et al[13] noted that if caries were present on the M1s or M2s, there was an 80% chance that the M3s would also have caries. Conversely, if there were no caries on the M1s or M2s, finding caries on the M3s in the future would be unlikely.

Part B—Summary of Outcomes of Retained M3s

1

> In patients electing to retain their M3s, do the M3s change position over time?

Answer: Retained M3s do change position over time. The change, however, cannot be reliably predicted. Vertical and distal impacted M3s are more likely to erupt to the occlusal plane than mesial or horizontal impacted M3s.

At baseline, in a sample of 237 subjects with asymptomatic M3s, 44% had impacted maxillary M3s and 26% had impacted mandibular M3s. The subjects were followed for 2, and 33% of vertical or distal impacted M3s in the maxilla and mandible and only 11% of mesial or horizontal impacted M3s in the mandible erupted to the occlusal plane.[14] Eruption to the occlusal plane as seen on a panoramic radiograph does not mean the tooth was completely visible, functional, or hygienic.

A longitudinal study of 146 subjects with asymptomatic M3s found that one third of unerupted M3s changed position and erupted to the occlusal plane.[15] Three fourths of the erupted teeth had periodontal pathology.

2

> In patients with visible M3s, does mechanical debridement lower the levels of pathogenic bacteria or inflammatory mediators?

Answer: Mechanical debridement does not lower the levels of pathogenic bacteria or inflammatory mediators.

In a study of pregnant subjects having mechanical debridement of biofilm in the second trimester, pathogen counts were not decreased postpartum in subjects with a visible M3.[16]

If no visible M3s were present, pathogen counts were decreased postpartum for all pathogens studied. Similarly, inflammatory mediator levels remained unchanged postpartum when M3s were visible, whereas they were decreased in those patients without visible M3s.

In a study of 262 healthy young adults over a 2-year period, dental prophylaxis, which included mechanical removal of subgingival biofilm at yearly intervals, had minimal or no impact on clinical indicators of M3 periodontal pathology.[17]

3

> In patients with retained M3s, how do mild symptoms or signs of pericoronitis affect a patient's quality of life?

Answer: Patients with even mild pericoronitis report significantly decreased oral function due to pain. Over one third of patients with a history of pericoronitis elect M3 extraction so they would never have to experience a recurrence of symptoms.

Most patients (68%) reported experiencing moderate or severe pain during the episode. One fourth of patients (23%) experienced “quite a bit/lots” of difficulty with eating.[18]

In a sample of 480 patients with pericoronitis, 37% wanted to have the M3s removed before symptoms recurred.[19] One fourth of symptomatic patients reported on a 12-item Global Oral Health Impact Profile before surgery that their lifestyle measurements were adversely affected “fairly often” or “very often.” Difficulty relaxing, feeling irritable, feeling tense, and interruptions to meals were the lifestyle disruptions reported most frequently.

4

> In patients with retained M3s, do those patients with a history of pericoronitis compared with those without a history of pericoronitis have more significant periodontal inflammatory disease?

Answer: Yes.

Patients who presented with mild pericoronitis had significantly more periodontal pockets around their M3s than patients who did not have pericoronitis.[20] When examining the entire mouth, they also had more pathologic periodontal pocketing (PD >4 mm) overall than patients who presented without pericoronitis. On average, patients without pericoronitis were older than patients with pericoronitis. This is an unexpected finding because older patients are more predisposed to periodontal disease than their younger counterparts.

5

> In patients with asymptomatic M3s and no evidence of periodontal disease at baseline, what percentage develops periodontal inflammatory disease?

Answer: Depending on the duration of follow-up, 30% to 40% of patients develop periodontal inflammatory disease.

After an average of 4 years of follow-up, one third of patients developed clinically significant (PDs > 4 mm) periodontal disease in at least 1 M3.[21] After an average of 5 years of follow-up, 40% of these patients developed clinically significant periodontal disease in at least 1 M3.[22]

6

> In patients with visible M3s and periodontal disease present, as evidenced by PDs of at least 4 mm, what is the long-term prognosis from a periodontal standpoint for the M3s and for the adjacent teeth?

Answer: For the M3s and adjacent M2s, the periodontal status is expected to get worse for a substantial proportion of patients.

Almost 40% of patients with periodontal disease present at baseline will have clinically significant progression of periodontal disease within 2 years of follow-up.[22 and 23]

7

In pregnant patients with M3s visible in the mouth, are PDs of at least 4 mm associated with a progression of periodontal disease during pregnancy?

Answer: Yes.

Clinical signs of inflammatory periodontal disease in pregnant patients with visible M3s were associated with a greater progression of periodontal disease during pregnancy compared with those with no visible M3s.

Pregnant patients who had visible M3s with PDs of at least 4 mm or bleeding on probing showed a greater progression of periodontal disease during pregnancy. Incidentally, progression of periodontal disease during pregnancy in subjects with visible M3s was associated with a twofold increased risk for adverse obstetric outcomes.[8]

8

In pregnant patients, are those with visible M3s compared with those without visible M3s more likely to have severe periodontal disease?

Answer: Yes.

Pregnant patients with visible M3s were 3 times more likely to have moderate to severe periodontal disease compared with those without visible M3s. After delivery, women with visible M3s were twice as likely to have moderate to advanced periodontal disease compared to women without visible M3s.[24]

9

In patients with erupted M3s with healthy periodontal status (PDs <4 mm) or no caries, how frequently will periodontal disease or caries occur?

Answer: Depending on the duration of follow-up, 3% to 40% of patients with erupted M3s and healthy periodontal tissues will develop clinical signs of periodontal inflammatory disease. M3 caries risk is associated with patient age.

In the setting of healthy periodontal tissues (ie, no M3s with PD >4 mm), a small fraction (3%) of patients have a clinically significant progression of periodontal disease, defined as an increase in PDs deeper than 2 mm after 2 years of follow-up.[23] After a median follow-up of 4.1 years, almost 40% of patients with no M3s affected at enrollment will have signs of periodontal disease (≥1 PD >4 mm).[15]

Caries risk increases over time, with older patients (>25 years old) having a 2.5-fold increased risk for caries compared with patients younger than 25 years.[11]

10

In patients with retained M3s, what factors are associated with the development or progression of dental disease?

Answer: Older age, pre-existing periodontal disease, and caries on adjacent teeth are factors associated with the development or progression of dental disease such as periodontitis and caries.

Increasing age is a risk factor for developing periodontal disease or caries.[25 and 26] Pre-existing periodontal disease is associated with the progression of periodontal disease at the M3s and adjacent teeth.[25] Caries experience in adjacent teeth is associated with the development of M3 caries.[26]

11

In young and adolescent patients, do those with visible M3s compared with those without visible M3s have an increased risk for developing periodontal inflammatory disease in the adjacent teeth?

Answer: Yes.

Periodontal inflammatory disease was more prevalent around the M1s and M2s in young patients if an erupted M3 was present.[15, 22 and 27]

12

In patients 14 to 45 years old with 4 asymptomatic M3s (and adjacent M2s present) at baseline, what is the risk for M3 extraction within 5 years?

Answer: Based on life-table analyses, the risk for having at least 1 M3 removed within 5 years of the baseline examination was 35% (standard error, 4%; personal communication with R.P. White, Jr; Dr White provided the raw data [March 1, 2012] and Dr Dodson computed the risk for M3 extraction using Kaplan-Meier survival methods; Dr White approved publication of these data).

13

In patients with asymptomatic M3s that are unerupted, what proportion are asymptomatic and disease free?

Answer: Approximately 80% of unerupted M3s, ie, M3s not at the occlusal plane as seen on radiographs, are asymptomatic and disease free.

One cohort study evaluated 146 subjects with asymptomatic M3s with at least 1 unerupted M3.[15] The total sample size of M3s was 584. At the baseline examination, 80% (k = 462) of the M3s in the sample were unerupted. Of the unerupted M3s, 80% (k = 369) were asymptomatic and disease free. The converse of this finding is that 20% of unerupted asymptomatic M3s have clinical evidence of disease present.

14

In patients with asymptomatic M3s that are not visible, what proportion of M3s erupts to the occlusal plane?

Answer: After 4 years of following retained, unerupted, asymptomatic M3s, 25% of the M3s erupted to the occlusal plane.[15] Eruption to the occlusal plane, however, is a radiographic, not a clinical, outcome. Eruption to the radiographic occlusal plane should not be interpreted to mean that the M3 is a functional, well-positioned, and healthy tooth.

15

In patients with asymptomatic M3s that are disease free at baseline, what proportion develops disease?

Answer: After 4 years of follow-up, approximately 35% of previously asymptomatic, disease-free M3s continue to be asymptomatic but develop clinical evidence of disease.[15]

Part C—Summary of Outcomes After M3 Removal

1

In patients with asymptomatic M3s with periodontal pathology in their asymptomatic M3s, does removal of the M3 have a positive impact on the periodontal health of adjacent teeth?

Answer: Removing M3s significantly improves the periodontal health of adjacent teeth. Removal of M3s resulted in a threefold reduction in the proportion of adjacent M2s with periodontal disease.

Asymptomatic M3s were removed in 69 patients. Removal of the M3s significantly improved the periodontal status on the adjacent second molars.[28]

At baseline, 71% of 75 subjects with asymptomatic M3s had evidence of periodontal inflammatory disease at the adjacent M2. After removing the M3s, 24% of the adjacent M2s had periodontal inflammatory disease, a threefold improvement in periodontal status.[29]

2

In patients with a history of pericoronitis, how do the symptoms of pericoronitis compare with the symptoms of M3 removal?

Answer: Patients report that symptoms experienced during recovery after M3 removal are similar to problems experienced during an episode of symptomatic pericoronitis.[30] M3 removal improves quality of life (5 to 7 days postoperatively) and decreases the burden of pathogenic bacteria on adjacent teeth. Improvements in quality of life are especially significant for pain and oral function. Quality of life with symptomatic pericoronitis was similar to quality of life during recovery after M3 surgery.[18] Removal of M3s eliminated the “orange complex” pathogenic bacteria from the patients' biofilm.[31] In brief, “orange complex” bacteria and “red complex” bacteria are known pathogens eliciting a local and sometimes systemic inflammatory response. Usually, “orange complex” bacteria colonize before “red complex” bacteria. Thus, increased levels of “orange complex” pathogens without increased levels of “red complex” pathogenic bacteria may distinguish acute pericoronitis from periodontitis.

3

What should patients electing M3 removal expect during postoperative recovery in terms of oral function, lifestyle, and pain?

Answer: Most young, healthy adults may expect to experience recovery of oral function in 5 days or less after M3 removal.[4, 32, 33 and 34]

Difficulty in talking is experienced by most patients primarily on the first postoperative day. Bleeding and nausea are usually minimal and limited to the first 2 days after surgery. Swelling peaks on postoperative day 2 and then resolves quickly.

Difficulties in chewing and mouth opening generally resolve within 3 to 5 days after M3 surgery. Interference with routine daily activities, social activities, work, and school may be expected to persist for the first 3 days after surgery. Recreational activities are generally resumed in 4 days. Sleeping is affected least in terms of lifestyle parameters. In most patients, pain will decrease steadily over the first 5 postoperative days, but in some patients pain may persist for 9 days, requiring oral analgesic medication absent evidence of a surgical site infection or other inflammatory complications.

Some patients develop late problems due to food impaction. Food collection at the surgical site may increase gradually and then taper off toward the end of a 2-week period.

4

In patients who elect M3 removal, what factors influence the recovery period?

Answer: Age (>24 years), gender (female), level of impaction (M3 below the occlusal plane), duration of operation (>30 minutes), and bone removal are associated with delayed recovery for early and late side effects of M3 removal.[32, 35, 36, 37, 38 and 39]

Age older than 24 years, female gender, position of the 2 mandibular M3s below the occlusal plane, surgery longer than 30 minutes, and removal of bone during the surgery are significantly associated with prolonged recovery from early side effects such as swelling, bleeding, nausea, bruising, oral function (difficulty talking chewing, mouth opening, diet restrictions), and pain. Prolonged delay in lifestyle recovery (daily activity, recreation, social life) is related to an age older than 24 years and M3s located below the occlusal plane.

The occurrence of late symptoms (food collection, bad taste/breath) is significantly related to an age older than 24 years. Bone removal from at least the 2 lower molars and a procedure longer than 30 minutes are significant predictors of a prolonged recovery from early symptoms, lifestyle disruption, and pain. The position of the M3s in close proximity to the inferior alveolar nerve is a clinical predictor of delayed lifestyle, oral function, and pain recovery. There is an association between a patient's perception of pain (the requirement of analgesic medications to control pain) and prolonged recovery in terms of lifestyle and oral function.

5

In patients electing M3 removal, what is the frequency of postoperative visits and what are the reasons for follow-up?[33 and 35]

Answer: About 1 in 5 young healthy patients require a postoperative visit (POV) after M3 removal. About half of patients with POVs require only 1 visit. The most frequent reason for POVs is pain. The most common findings at the first POV are debris in the wound followed by exposed bone or purulence. Patients report altered sensation of the inferior alveolar or lingual nerves at a frequency of 1% or 0.3%, respectively. The most common treatment performed at POVs is the placement of a dressing. Prescribing antibiotics or wound manipulation is performed less frequently. Patients reported altered sensation of the inferior alveolar or lingual nerves at a frequency of 1% and 0.3%, respectively. No data on the neurosensory outcomes were collected after the two-week follow-up time frame.

6

In patients electing M3 removal, what are the risk factors for delayed clinical healing?

Answer: Age (>18 years), gender (female), pre-existing M3 inflammatory symptoms, and the surgeon's report of a more difficult procedure are factors associated with delayed clinical healing.[35] Older patients (>24 years) were 50% more likely to have delayed clinical healing. Female patients or those who had pre-existing inflammatory symptoms were 2 times more likely to have delayed clinical healing. Patients with difficult extractions were 7 times more likely to have delayed clinical healing. Patients with all risk factors were 15 times more likely to have delayed healing.

7

Will a patient with delayed clinical healing also have delayed health-related quality-of-life recovery?

Answer: Not surprisingly, delayed clinical healing significantly increases the risk for delayed recovery for lifestyle (daily activity, recreation, social life), oral function (talking, chewing, mouth opening, resuming normal diet), late symptoms (food collection, bad taste, bad breath), and pain.[40]

8

In patients electing M3 removal, what procedures or medications may enhance the postoperative experience in terms of healing or quality of life?

Answer: Antibiotics, corticosteroids, and ice packs enhance postoperative recovery after M3 removal.[41, 42, 43 and 44] For patients with all 4 M3s below the occlusal plane, preoperative IV antibiotics or inserting topical minocycline in the extraction sockets improved recovery as evidenced by fewer POVs. Patients receiving IV corticosteroids reported better sleep and less postoperative nausea after M3 removal. Patients who were treated with topical minocycline and used ice packs for 24 hours after M3 removal had decreased pain during the early (0 to 3 days) postoperative period.

Section 3—Conclusions and Directions for Future Research

The investigators managing the Third Molar Clinical Trials have generated a treasure trove of information to produce data-driven recommendations for managing patients with wisdom teeth. Many times, decision making regarding M3 management is quite straightforward because of the presence of symptoms or disease. The management of patients with asymptomatic, disease-free M3s, however, is challenging and controversial.

Key messages abstracted from the Third Molar Clinical Trials by Task Force members include:

1

An absence of symptoms should not be equated with the absence of disease.

2

During the clinical examination, clinicians should include periodontal probing to determine if nonvisible M3s are communicating with the oral cavity and to measure PDs. This information is valuable in assessing and documenting the disease status of M3s, especially in the absence of symptoms.

3

Absent symptoms, retained M3s commonly develop disease, erupt, or change position over time. These changes are unpredictable. As such, monitoring retained M3s for the development of disease seems a prudent recommendation for patients electing to retain their M3s.

4

Removal of M3s generally causes no more significant discomfort than a single multiday episode of mild pericoronitis. Individuals who have even mild symptoms of pericoronitis usually seek to have M3s removed rather than experience these symptoms again.

5

Removal of M3s with periodontal pathology improves the periodontal status on adjacent M2s and on teeth more anterior whether or not the M3s were symptomatic.

6

In most patients who retain M3s with periodontal pathology, the periodontal disease affecting the M3 and adjacent M2 worsens.

7

If caries is present on M1s or M2s, it is highly likely that M3s will be affected with caries over time. Conversely, if M1s or M2s are not affected by caries, M3s are very unlikely to develop caries over time.

8

Older age predicts a delayed recovery from pain and disruption of lifestyle and oral function of about 2 days after M3 removal.

9

Adjunct measures such as corticosteroids, topical or short-term IV antibiotics, and continuous use of cold therapy decrease symptoms and improve quality of life after M3 removal.

An ongoing area of clinical and basic research is assessing the contribution of chronic oral inflammation to systemic diseases. Paralleling these efforts, the investigators in the Third Molar Clinical Trials have found that gingival crevicular fluid in pockets around M3s, even in pockets shallower than 5 mm, harbor inflammatory mediators.[45] These inflammatory mediators have been associated with systemic health risks such as negative obstetric outcomes.[45] and [46] Other researchers have tied these inflammatory mediators to increased risks of cardiovascular disease, nonhemorrhagic stroke, and kidney disease.[47], [48], [49], [50] and [51]

The Third Molar Clinical Trials exceeded expectations in terms of stated goals and objectives. Designed as a prospective cohort study, the trials provided high levels of evidence regarding outcomes of the primary treatment options associated with asymptomatic M3s, ie, extraction or retention. These studies have provided clinicians with valuable, practical information to help guide patients through the challenging decision-making process of managing M3s.

However, one should not be satisfied with the status quo. The enigma and challenge of optimally managing asymptomatic, disease-free M3s persists. As evidenced by the most current Cochrane Report on M3 management, continued debate using currently available data is not useful.[52]

The best way to generate new data to inform M3 management will be to design and implement a randomized clinical trial. Patients with asymptomatic, disease-free M3s would be randomly assigned to extraction or retention cohorts. The investigators would then measure and compare patient-specific, economic, and quality-of-life outcomes of the 2 groups. This is not a trivial undertaking. Efforts of lesser magnitude, however, are doomed to result in continued speculation and controversy regarding optimal management of asymptomatic, disease-free M3s.

As the chair of the Task Force for Third Molar Summary, I must take this opportunity to thank the Task Force members for their efforts in preparing this report. Each member contributed actively and aggressively to this ambitious assignment. The report could not have been completed without the help and support of the AAOMS staff. The past and present leadership of the AAOMS, House of Delegates, and OMSF should be recognized for their vision and support of this ambitious research effort. The specialty should offer a deep and heartfelt thanks to the investigators and support staff at

each of the participating institutions who contributed to the design, implementation, execution, analyses, and dissemination of the Third Molar Clinical Trials. Each day, data derived from the trials help provide better patient care.

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- **Surgical removal versus retention for the management of asymptomatic impacted wisdom teeth**
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Appendix III

Responders Additional evidence

The key question that must be raised is how do we minimise patient harm related to M3M surgery? Essentially what is the risk benefit of retention of M3Ms (therapeutic extraction) versus removal of M3Ms (interventional removal)? What is the best strategy?

The main questions are;

- What is the fate of M3Ms? Are they extracted anyway?
- Is surgical morbidity increased with age?
- Does retaining M3Ms cause patient harm?
- What is the best strategy for M3M intervention?
- Cost effectivity?

- **What is the fate of M3Ms? Are most extracted anyway? YES**

Very few studies have reported on long term follow up of M3Ms, however the Finnish group lead by Professor Irja Venta whom have reported robust follow up data on students (Ventä I, Turtola L, Ylipaavalniemi P. Change in clinical status of third molars in adults during 12 years of observation. J Oral Maxillofac Surg. 1999 Apr;57(4):386-9; discussion 389-91.), confirming that by 38 years of age most wisdom teeth require removal. Ventä I, Ylipaavalniemi P, Turtola L. Long-term evaluation of estimates of need for third molar removal. J Oral Maxillofac Surg. 2000 Mar;58(3):288-91.

In 2002, Finnish M3M working group reported that at least one wisdom tooth removal is needed in 68% of those 20 years of age [Ventä I, et al. Wisdom teeth surgical treatment recommendation . Student Health Service research 41 Helsinki 2005 .

At least one mandibular wisdom tooth had been removed before 32 years of age in 67 % of patients [Ventä I[1], Ylipaavalniemi P, Turtola L. Long-term evaluation of estimates of need for third molar removal. J Oral Maxillofac Surg. 2000 Mar;58(3):288-91.]. The aim of this study was to evaluate the estimates on need for third molar removals in 81 university students followed from age 20 to 32 years. At baseline and at study end, these students were clinically examined, and panoramic radiographs were taken. During the follow-up, one or more third molars had been removed from 67% of the former students. A total of 155 third molar removals had been estimated, but by age 32 years the percentage actually removed was only 59%. Of the 79 third molars taken out at the Finnish Student Health Service, 77% were initially estimated to need a surgical procedure, but actually 66% were extracted. Most were removed at around age 27 years. According to the questionnaire, 67% of the students were asymptomatic in the third molar region during 12 years related to undiagnosed caries development.

In a study aimed to follow the clinical changes in third molar status during an 18-year period in patients aged 20 to 38 years. The series consisted of 118 subjects (37 men and 81 women). In the beginning of the study, the mean age was 20.2 years (SD, +/-0.6 year), and at the end, it was 38.6 years (SD, +/-0.6 year). Panoramic radiographs were taken at baseline and at age 38. Most of the initially unerupted third molars were removed during the follow-up period (73%, maxilla and mandible together). Two thirds of the initially partially erupted third molars were removed during the follow-up period (64%, maxilla and mandible together). The percentage of erupted third molars found in

the mouth at age 38 increased significantly depending on the initial status. Of the initially unerupted, partially erupted, or erupted third molars, 10%, 33%, and 50%, respectively, were erupted at age 38 (maxilla and mandible together). Changes in the status of third molars continued from age 32 to age 38, although to a lesser extent (8%). At 38 years of age only 31% of wisdom teeth remain (Ventä I[1], Ylipaavalniemi P, Turtola L. Clinical outcome of third molars in adults followed during 18 years. J Oral Maxillofac Surg. 2004 Feb;62(2):182-5.).

In dentate Finns the prevalence of partially erupted or erupted wisdom teeth, from ages 30 to 65 of decreases from 30 % to less than 5 % in [Suominen - Taipale L and others. Edentulousness and the number of teeth . In: Suominen – Taipale L et al. Finnish adult oral health . The Health 2000 survey. National Public Health Institute B16 / 2004. Helsinki 2004 ; p. 65-72]. A recent study reports that in 293 patients over 79 years evaluation of their DPTs revealed that 21% had one or more maxillary and mandibular M3Ms. All M3Ms were associated with disease, carious (82%), periodontal disease (67%) or in relation to cysts or tumours (2%).Vent Irja, Kylatie Eeva, Hiltumen Katja. Pathology related to third molars in elderly persons. Clinical Oral Investigations 2014 *in press.*

Thus the Finnish and Scandinavian Guidelines recommend an interventional risk based assessment approach to remove M3Ms earlier rather than later, particularly in the light that 80% of M3Ms are removed by 65 years and all are associated with pathology at 79 years requiring remval with significantly higher surgical morbidity.

The Finnish guideline (http://www.kaypahoito.fi/web/kh/suositukset/suositus?id=hoi50074 The English version has not yet released from the technical secretaries) emphasizes preventive removals in selected cases and this is summarized very well in the article: Ventä I. How often do asymptomatic, disease-free third molars need to be removed? J Oral Maxillofac Surg 2012;70, Suppl 1:41-47.

Essentially based upon this evidence it is apparent that all third molars are removed anyway (page 42 from http://www.terveys2000.fi/julkaisut/oral_health.pdf; M.J. Fernandes, G.R. Ogden, N.B. Pitts et al., Actuarial life-table analysis of lower impacted wisdom teeth in general dental practice. Community Dent Oral Epidemiol, 38 (2010), p. 58; N. von Wowern, H.O. Nielsen. The fate of impacted lower third molars after the age of 20: A four-year clinical follow-up. Int J Oral Maxillofac Surg, 18 (1989), p. 277), so why not remove the M3M when the risks are minimal? However, there is growing evidence, that this may not be in the best interest of the patient resulting in delay of inevitable surgery with additional damage to the adjacent second molars (Renton et al 2012, McArdle and Renton 2013 Mansoor et al 2013).

Conclusion 70-80% of M3Ms (mandibular) are removed by the age of 38 years.

- **Does retaining M3Ms cause harm?** ***Recent evidence of patient harm as a result of supervised neglect. Risks of retention are;***

The implications of M3 retention are less well detailed. Recent studies involving patient cohorts who elected to retain their M3 teeth demonstrated that retained M3s frequently and unpredictably change position, eruption status, and periodontal status. Depending on the duration of follow-up, up to 63-78% of retained M3s will be extracted at some future time.

Several studies have reported on the increased incidence of M2M caries in relation to retained M3Ms

- *Caries in M3M* C.M. Hill, R.V. Walker. Conservative, non-surgical management of patients presenting with impacted lower third molars: A 5-year study. Br J Oral Maxillofac Surg, 44 (2006), p. 347
- *Perio disease* M2/lower quadrant/whole mouth?)C. Phillips, J. Norman, M. Jaskolka et al. Changes over time in position and periodontal probing status of retained third molars. J Oral Maxillofac Surg, 65 (2007), p. 2011; G.H. Blakey, M.T. Jacks, S. Offenbacher et al. Progression of periodontal disease in the second/third molar region in subjects with asymptomatic third molars. J Oral Maxillofac Surg, 64 (2006), p. 189
- *Local non caries or perio pathology* (cysts, resorption, tumours etc) Hugoson A, Kugelberg CF. The prevalence of third molars in a Swedish population. An epidemiological study. Comm Dent Health 1988;5:121-38.
- *Interference with required surgery* (pathology, orthognathic, preprosthetic) no evidence
- *M2M caries* The recurrent observation in this older cohort of patients was the apparent increase in the incidence of caries arising in the distal aspect of a second molar as a consequence of the presence of the third molar McArdle LW. NICE and the third molar debate. FDJ 2013: Vol 4, issue 4: 166-171. Doi 10.1308/204268513X13776914744718; McArdle LW, Renton TF. Distal cervical caries in the mandibular second molar: an indication for the prophylactic removal of the third molar? BJOMS 2005. 44: 42-45; Ozeç I, Hergüner Siso S, Taşdemir U, Ezirganli S, Göktolga G. Prevalence and factors affecting the formation of second molar distal caries in a Turkish population. Int J Oral Maxillofac Surg. 2009 Dec;38(12):1279-82; Chang SW, Shin SY, Kum KY, Hong J. Correlation study between distal caries in the mandibular second molar and the eruption status of the mandibular third molar in the Korean population. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009 Dec;108(6):838-43; Allen RT, Witherow H, Collyer J, Roper-Hall R, Nazir MA, Mathew G.The mesioangular third molar--to extract or not to extract? Analysis of 776 consecutive third molars. Br Dent J. 2009 Jun 13;206(11):E23; discussion 586-7; Falci SG, de Castro CR, Santos RC, de Souza Lima LD, Ramos-Jorge ML, Botelho AM, Dos Santos CR. Association between the presence of a partially erupted mandibular third molar and the existence of caries in the distal of the second molars. Conclusion erupted or partially erupted M3Ms at 31 degree angulation or more warrents prophylactic extraction
- Int J Oral Maxillofac Surg. 2012 Mar 30; Oderinu OH, Adeyemo WL, Adeyemi MO, Nwathor O, Adeyemi MF. Distal cervical caries in second molars associated with impacted mandibular third molars: a case-control study. Oral Surg Oral Med Oral Pathol Oral Radiol. 2012 Sep 11. doi:pii: S2212-4403(12)00395-1. 10.1016/j.oooo.2012.03.039).). The nature of this type of caries (Distal Cervical caries/DCC) is predominantly seen with mesio-angular but occasionally with horizontally impacted third molars (35-40). The consequent formation of DCC will necessitate the removal of the third molar with the addition of potentially complex and expensive restoration of the second molar tooth and in some situations the loss of the second molar tooth as well (McArdle LW, Renton TF. Distal cervical caries in the mandibular second molar: an indication for the prophylactic removal of the third molar? BJOMS 2005. 44: 42-45;). If we regress from this endpoint it would suggest that if the third molar has a definitive causal influence on the formation of DCC on the second molar then the removal of the third molar before DCC forms will have an overall benefit for the patient. This suggests a possible clinical indication for targeted prophylactic removal of mandibular third molar teeth (McArdle LW, Renton

TF. Distal cervical caries in the mandibular second molar: an indication for the prophylactic removal of the third molar? BJOMS 2005. Allen RT, Witherow H, Collyer J, Roper-Hall R, Nazir MA, Mathew G.The mesioangular third molar--to extract or not to extract? Analysis of 776 consecutive third molars. Br Dent J. 2009 Jun 13;206(11):E23; discussion 586-7; Falci SG, de Castro CR, Santos RC, de Souza Lima LD, Ramos-Jorge ML, Botelho AM, Dos Santos CR. Association between the presence of a partially erupted mandibular third molar and the existence of caries in the distal of the second molars. Int J Oral Maxillofac Surg. 2012 Mar 30; Oderinu OH, Adeyemo WL, Adeyemi MO, Nwathor O, Adeyemi MF. Distal cervical caries in second molars associated with impacted mandibular third molars: a case-control study. Oral Surg Oral Med Oral Pathol Oral Radiol. 2012 Sep 11. doi:pii: S2212-4403(12)00395-1. 10.1016/j.oooo.2012.03.039;).

- Ozeç I, Hergüner Siso S, Taşdemir U, Ezirganli S, Göktolga G. Prevalence and factors affecting the formation of second molar distal caries in a Turkish population. Int J Oral Maxillofac Surg. 2009 Dec;38(12):1279-82. Reported 20% of patients presented with M2M distal caries in relation to M3Ms. Risk factors include; mesioangulation (47% adjacent M2Ms had DC caries angulation 70-90 degree angulation M3M (43% Adjacent M2Ms DC caries) Conlsuion that angulation of erupted M3M 30-90 degrees justifies preventative extraction
- Ozgen N Renton T. *BAOS Poster Abstract J Oral Surg 2011) reported that risk factors for M2M caries in relation to M3Ms included all impaction types of M3Ms but particularly horizontal and mesial. In this audit of 1000 patients the prevalence of M3Ms presented with distal decay was: 70% of M2Ms adjacent to horizontally angulated M3Ms 45.29% of M2Ms adjacent to mesially angulated, 20.63% of M2Ms adjacent to distally angulated M3Ms and 19.67% of M2Ms adjacent to vertically aligned M3Ms*
- Polat HB, Ozan F, Kara I, Ozdemir H, Ay S. Prevalence of commonly found pathoses associated with mandibular impacted third molars based on panoramic radiographs in Turkish population. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008 Jun;105(6):e41-7. Reports 12.7% M2M DC caries rate, 9.7% distal bone loss to M3M, 5% M3M caries and 9% periodontal pocketing M2M. Risk factors for M2M caries related to Class A impaction, eruption, mesioangular and horizontal angulated M3Ms.
- BMJ Clinical evidence Dodson TB, Susarla SM. Impacted wisdom teeth. Clin Evid (Online). 2014 Aug 29;2014. pii: 1302. This systematic review supports effectiveness amd safety of active surveillance and prophylactic extractions combined in managing M3Ms.

Conclusion This updated evidence highlights the issue of the harm global non-intervention M3M strategy causes patients. Many patients suffer from M2M caries with resultant restorative costs and subsequent loss of the second molar tooth resulting in further treatment and cost implications for the patient

    - Is surgical morbidity increased with age? **Based upon high level evidence surgery in younger patients significantly reduces complications**
- **Age of patient < 25 years less complications post M3M surgery**

- Obimakinde O, Okoje V, Ijarogbe OA, Obimakinde A. Role of patients' demographic characteristics and spatial orientation in predicting operative difficulty of impacted mandibular third molar. Ann Med Health Sci Res. 2013 Jan;3(1):81-4.

- de Carvalho RW, de Araújo Filho RC, do Egito Vasconcelos BC. Assessment of factors associated with surgical difficulty during removal of impacted maxillary thirdmolars. J Oral Maxillofac Surg. 2013 May;71(5):839-45
- Cheung LK, Leung YY, Chow LK, Wong MC, Chan EK, Fok YH. Incidence of neurosensory deficits and recovery after lower third molar surgery: a prospective clinical study of 4338 cases. Int J Oral Maxillofac Surg. 2010 Apr;39(4):320-6.
- Gbotolorun OM, Arotiba GT, Ladeinde AL.The role of preoperative and intraoperative variables in predicting post operative complications after impacted mandibular third molar exodontia. Nig Q J Hosp Med. 2008 Apr-Jun;18(2):72-8
- Gbotolorun OM, Arotiba GT, Ladeinde AL. Assessment of factors associated with surgical difficulty in impacted mandibular third molar extraction. J Oral Maxillofac Surg. 2007 Oct;65(10):1977-83
- Blondeau F, Daniel NG. Extraction of impacted mandibular third molars: postoperative complications and their risk factors. J Can Dent Assoc. 2007 May;73(4):325. Surgical removal of impacted mandibular third molars should be carried out well before the age of 24 years, especially for female patients. Older patients are at greater risk of postoperative complications and permanent sequelae. A surgeon's lack of experience could also be a major factor in the development of postoperative complications
- Susarla SM, Dodson TB. Predicting third molar surgery operative time: a validated model. J Oral Maxillofac Surg. 2013 Jan;71(1):5-13.
- Chuang SK, Perrott DH, Susarla SM, Dodson TB. Risk factors for inflammatory complications following third molar surgery in adults. J Oral Maxillofac Surg. 2008 Nov;66(11):2213-8. The study sample consisted of 4,004 subjects with a mean age of 39.8 +/- 13.6 years having 8,748 M3s extracted. Level of impaction, pre-existing infection, and pathology were associated with increased risk for postoperative inflammatory complications following M3 surgery.
- Chuang SK[1], Perrott DH, Susarla SM, Dodson TB.Age as a risk factor for third molar surgery complications. J Oral Maxillofac Surg. 2007 Sep;65(9):1685-92. The study sample consisted of 4,004 subjects with a mean age of 39.8 +/- 13.6 years having 8,748 M3s extracted. The results of these analyses suggest that increased age (>25 years) appears to be associated with a higher complication rate for M3 extractions.
- Baqain ZH[1], Karaky AA, Sawair F, Khraisat A, Duaibis R, Rajab LD. Frequency estimates and risk factors for postoperative morbidity after third molar removal: a prospective cohort study. J Oral Maxillofac Surg. 2008 Nov;66(11):2276-83. doi: 10.1016/j.joms.2008.06.047. The study sample was comprised of 149 patients who had 245 extractions. The mean age was 21.6 +/- 3.32 years; Postoperative morbidity increases with older age, deeper impaction, M3 side differing from the handedness of the operator, and longer procedures.
- Susarla SM, Dodson TB. Risk factors for third molar extraction difficulty. J Oral Maxillofac Surg. 2004 Nov;62(11):1363-71. The sample was composed of 82 subjects, having 250 M3s (53.2% mandibular) extracted, with a mean age of 26.2 +/- 10.7 years. The mean operating time per M3 extraction was 6.9 +/- 7.6 minutes. The mean estimate of difficulty was 39.6 +/- 24.7 mm and was significantly correlated (r = 0.68) with extraction time (P < .01). Surgical experience, M3 location (maxillary versus mandibular), procedure type, tooth position, number of teeth extracted, and tooth morphology were statistically associated (P < or = .05) with extraction time in a multivariate model.
- Yuasa H, Sugiura M. Clinical postoperative findings after removal of impacted mandibular third molars: prediction of postoperative facial swelling and pain

based on preoperative variables. Br J Oral Maxillofac Surg. 2004 Jun;42(3):209-14 In conclusion, we consider that the short-term outcomes of third molar operations (swelling and pain) differ depending on patients' characteristics (age and sex) and preoperative index of difficulty. Further mega-trial studies of the association between preoperative findings and short-term outcome will help to elucidate the true nature and magnitude of the association

- Phillips C, White RP Jr, Shugars DA, Zhou X. Risk factors associated with prolonged recovery and delayed healing after third molar surgery. J Oral Maxillofac Surg. 2003 Dec;61(12):1436-48. Age, gender, and occlusal plane position were statistically significantly associated with prolonged recovery for early symptoms, oral function, and pain.
- Renton T, Smeeton N, McGurk M. Factors predictive of difficulty of mandibular third molar surgery. Br Dent J. 2001 Jun 9;190(11):607-10. Multivariate analysis showed that increasing age (P = 0.014), patient weight (P = 0.024), ethnicity (P = 0.019), application depth (P = 0.001), bone impaction (p=0.008) and unfavourable root formation (P = 0.009) were independent predictors for difficulty of extraction.
- Renton T, McGurk M. Evaluation of factors predictive of lingual nerve injury in third molar surgery. Br J Oral Maxillofac Surg. 2001 Dec;39(6):423-8. The predictors for permanent lingual nerve injury in order of importance were perforation of the lingual plate, surgeon, increased difficulty of operation, exposure of the nerve and increased age of the patient.

Conclusion Increasing age (> 21-25 years) of patient is significantly related to increased complication rates post M3M surgery including; dry socket. Pain, swelling, infection and nerve injury

- **What is the best strategy- Should we recommend Interventional removal?**

Previously the strongest evidence does not support prophylactic surgery (Mettes TD, Ghaeminia H, Nienhuijs ME, Perry J, van der Sanden WJ, Plasschaert A.Surgical removal versus retention for the management of asymptomatic impacted wisdom teeth.Cochrane Database Syst Rev. 2012 Jun 13;6:CD003879. doi: 10.1002/14651858.CD003879.pub3.

Review; Mettes TG, Nienhuijs ME, van der Sanden WJ, Verdonschot EH, Plasschaert AJ. Interventions for treating asymptomatic impacted wisdom teeth in adolescents and adults. Cochrane Database Syst Rev. 2005 Apr 18;(2):CD003879. Review. Update in: Cochrane Database Syst Rev. 2012;6:CD003879).

However based upon the emerging evidence that NICE 2000 Guidelines delay the surgery rThe question remains that if over 80% of mandibular third molars are removed by the age of 40 years (page 42 from http://www.terveys2000.fi/julkaisut/oral_health.pdf). Why not undertake the surgery when the risks are minimal? (Ventä I. How often do asymptomatic, disease-free third molars need to be removed? J Oral Maxillofac Surg 2012;70, Suppl 1:41-47).

The question remains that if over 80% of mandibular third molars are removed by the age of 40 years (page 42 from http://www.terveys2000.fi/julkaisut/oral_health.pdf). Why not undertake the surgery when the risks are minimal? (Ventä I. How often do asymptomatic, disease-free third molars need to be removed? J Oral Maxillofac Surg 2012;70, Suppl 1:41-47).

Based upon the evidence in this section we support interventional extraction of M3Ms with surveillance of those teeth non erupted with no pathology at assessment 20-25 years of age (suggested decision tree Figure 1).
Recommend interventional extractions to prevent

1) Pericoronitis
   Remove vertical teeth before 25 years of age if M3Ms low risk of IAN injury
1) Bone defects
   Remove horizontal teeth before 25-30 years of age if M3Ms low risk of IAN injury
1) Nerve injury
   Remove all close to canal before root completed before 19-21 years of age
1) Caries
   Remove partially erupted (if M3Ms low risk of IAN injury)

Conclusion Metanalysis does support interventional removal of certain M3Ms when risk of developing adjacent M2M caries is high and risk of causing inferior alveolar nerve injury is not elevated.

Cost effectivity
A recent study evaluated 3 scenarios were as follows: scenario 1 (non-operative management), retention of asymptomatic, disease-free M3s and monitoring for 20 years from age 18 to 38 years; scenario 2 (operative management), removal of 2 asymptomatic, disease-free, bony impacted M3s for 18-year-old patients using general anesthesia (30 minutes) in an office-based ambulatory setting; and scenario 3 (failure of non-operative management), removal of 1 previously asymptomatic, disease-free, bony impacted M3 after 10 years of follow-up in a now 28-year-old patient using general anesthesia (30 minutes) in an office-based ambulatory setting. The estimated charges for managing M3s were $2,342, $1,184, and $1,997 for scenarios 1, 2, and 3, respectively.

In conclusion a simplified financial analysis derived from the dental claims data suggests that during the course of the patient's lifetime, the charges associated with non-operative management of asymptomatic, disease-free M3s will exceed the charges of operative management. The difference in costs might be important to patients when choosing between operative and non-operative management of their M3s (Koumaras GM. What costs are associated with the management of third molars? J Oral Maxillofac Surg. 2012 Sep;70(9 Suppl 1):S8-10. doi: 10.1016/j.joms.2012.04.023.).

Problems with improving evidence for this high volume surgical sector

- **There is no NIHR or research council priority to fund large prospective clinical trials in wisdom tooth surgery to address evidence base**
- **The high patient volume needed for such studies would be a significant challenge with follow up in this patient cohort ages 20-35 years**
- **Using existing practice as a 'natural experiment' –Lack of Activity data recording**
    - Lack of parity in collection of activity data in primary and secondary care sectors
    - There is no routine outcome data collected currently (in any health care sector) commissioned to ensure appropriate monitoring of quality of care
    - There are significant deficiencies in clinical coding for this activity in all aspects including; diagnostic, intervention and outcome coding
        - **Missing codes-** Diagnosis
- Re alignment with NICE guidelines the obvious declared deficiencies include;

- no codes for acute or chronic pericoronitis (only chronic perio)
- no ability to differentiate if caries is in the tooth itself or adjacent teeth
- No codes for local spreading infection
- no code for high risk of development of caries /damage in adjacent tooth (cheeky I know but watch this space)
- **Adjunctive Treatment** No codes of LA Sedatiion GA or additional operative Medication
- **Treatment**
- No code for coronectomy

Figure 1 Decision tree for M3M SURGERY