Health Technology Assessment
HTA-rapport 2010:30

Removal of impacted wisdom teeth

F Suska, G Kjeller, A Molander, O Samuelsson,
T Svanberg, A Liljegren

VÄSTRA GÖTALANDSREGIONEN
SAHLGRENSKA UNIVERSITETSSJUKHUSET

Utlåtande och sammanfattande bedömning från Kvalitetssäkringsgruppen

EXTRAKTION AV VISDOMSTÄNDER

HTA-kvalitetssäkringsgruppen har ett uppdrag att yttra sig över genomförda HTA i Västra Götalands-regionen. Yttrandet skall innefatta sammanfattning av frågeställning, samlat evidensläge, patientnytta, risker samt ekonomiska och etiska aspekter för den studerande teknologin.

Denna HTA har genomförts på begäran av verksamhetschef Mats Wallström, Odontologiska kliniken, Käkkirurgi, Göteborg.
En arbetsgrupp bestående av Felicia Suska, odont.dr. och Göran Kjeller, docent, båda vid Odontologiska kliniken, Käkkirurgi, Göteborg, samt Anders Molander, docent, Specialistkliniken för Endodonti, Odontologen, Folktandvården, Västra Götaland har tillsammans med HTA-centrum tagit fram HTA rapporten.

Resurspersoner från HTA-centrum har varit Ola Samuelsson, docent, Therese Svanberg, HTA-bibliotekarie, Ann Liljegren, bibliotekarie.

HTA-rapporten samt åberopad och förtecknad litteratur har granskats av professor Magnus Hakeberg, Odontologisk folkhälsovetenskap vid Odontologiska institutionen, Göteborg, och professor Jüri Kartus, överläkare Ortopedkliniken, Uddevalla sjukhus, FoU-chef NU-sjukvården.

Slutsatser har diskuterats vid möten mellan HTA-centrum och HTA-projektgruppen. Ett utlåtande har tagits fram, diskuterats och fastställts vid Kvalitetssäkringsgruppens möte 2010-09-22.

Projektet har pågått under perioden 2009-09-09– 2010-07-08.
Den systematiska litteratursökningen sträckte sig från maj 2003 fram till och med december 2009.

Kvalitetssäkringsgruppen

Christina Bergh Professor	Lennart Jivegård, Universitetslektor	Maria Skogby M.dr, Vårdenhetschef
Magnus Hakeberg, Professor	Anders Larsson Överläkare	Annika Strandell Docent
Hans Hedelin, Professor	Ola Samuelson, Docent	Therese Svanberg HTA-bibliotekarie
Peter Johansson Med.dr, Överläkare	Henrik Sjövall Professor	Margareta Warrén Stomberg Universitetslektor

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Frågeställning:
Minskar profylaktisk extraktion av visdomständer hos symptomfria individer respektive hos individer med lokala symptom den framtida risken för infektioner och lokala patologiska förändringar?

PICO: ("Patient, Intervention, Comparison, Outcome")

P1 = Friska personer av alla åldrar med helt eller delvis retinerade visdomständer utan lokala symtom
P2 = Friska personer av alla åldrar med helt eller delvis retinerade visdomständer med lokala symtom (smärta, pus, svullnad, patologiska laboratorievärden, trismus, dysfagi, pericoronit, "crowding", eller cystor)
I = Extraktion av visdomstand
C = Ingen extraktion eller annan behandling av visdomstand
O = Primär utfallsvariabel: Infektion
Sekundär utfallsvariabel: Rot resorption, "crowding", karies i närliggande tand, tandlossning av närliggande tand, komplikationer till följd av den kirurgiska extraktionen

Resultatet av HTA-processen:

Metod och målgrupp
Personer med retinerade visdomständer diagnostiseras relativt ofta i den allmänna befolkningen. Hos de allra flesta av individer leder detta inte till några direkta symtom. Profylaktisk extraktion av visdomständer med avsikt att förhindra eventuella framtida problem förekommer emellertid fortfarande trots att personen i fråga är symptomfri och i avsaknad av patologiska förändringar.

Evidensläge för studerad patientnytta
Den systematiska litteratursökningen fann två systematiska översikter, 16 studier som rapporterat resultat efter extraktion av visdomständer och en översiktsartikel om ovanliga komplikationer till extraktioner av visdomständer. Alla 16 studierna var fallserier. Litteratursökningen fann ingen randomiserad, kontrollerad studie eller någon icke-randomiserad studie med adekvat kontrollgrupp där effekterna av profylaktisk extraktion av visdomständer jämförts med att avstå från extraktion.

Båda systematiska översikterna var av god kvalitet enligt AMSTAR kriterierna. Den norska HTA-rapporten konstaterade att "Symptomfrie visdommstenner som er retinerte anbefales ikke å fjernes", och Cochrane-rapporten konkluderade att "no evidence was found to support or refute routine prophylactic removal of asymptomatic impacted wisdom teeth in adults."

Den vetenskapliga dokumentationen för eventuella positiva eller negativa effekter till följd av extraktion av symptomfria respektive av symptomgivande retinerade visdomständer är otillräcklig (Grade ⊕).

Risker
Samtliga fallserier rapporterade biverkningar och komplikationer. Kirurgisk extraktion av visdomständer är förenade med både korttids- och långtidskomplikationer. Den totala komplikationsfrekvensen varierade mellan 4,6 – 36 %. Frekvensen postoperativa infektioner varierade mellan 0,5 – 2,8 %, och frekvensen av lokala nervskador eller symptom varierade mellan 0,4 – 1,5 %.

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Etiska aspekter:
Man måste starkt ifrågasätta om friska, symptomfria personer ska utsättas för en tandkirurgisk åtgärd med avsikt att förebygga komplikationer som kanske kan komma att inträffa längre fram i tiden när det helt saknas vetenskaplig dokumentation om eventuell nytta.

Ekonomiska aspekter
Den totala årliga kostnaden i Sverige för extraktioner av visdomständer uppskattas till 103 miljoner kronor. Huvuddelen av denna kostnad betalas av patienterna själva. Andelen som belastar Tandvårdsförsäkringen är inte klarlagd. Från såväl den individuella ekonomiska aspekten som samhällekonomisk aspekt är kostnaderna för dessa extraktioner höga.

Sammanfattning och slutsats
Profylaktisk extraktion av retinerade visdomständer i avsikt att förhindra eventuella framtida komplikationer förekommer fortfarande relativt ofta i Sverige. Denna åtgärd har starkt ifrågasatts då det saknas vetenskapligt stöd för dess preventiva effekt och på grund av de komplikationer som kan uppstå.
En systematisk litteraturgenomgång visar att det fortfarande helt saknas vetenskaplig dokumentation såväl till stöd för profylaktisk extraktion som att avstå från sådan åtgärd.

För HTA-kvalitetssäkringsgruppen 2010-10-06

Christina Bergh
Ordförande
HTA-kvalitetssäkringsgruppen

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Statement from the Regional HTA Centre of the Region Västra Götaland in Sweden

REMOVAL OF IMPACTED WISDOM TEETH

The Regional Health Technology Assessment Centre (HTA-centrum) of the Region Västra Götaland, VGR, in Sweden has the task to make statements on HTA reports carried out in VGR. The statement should summarise the question at issue, level of evidence, efficacy, risks, and economical and ethical aspects of the particular health technology that has been assessed in the report.

Mats Wallström, Clinical Director, Department of Oral and Maxillofacial Surgery Göteborg, Public Dental Service, and Chairman of the Council of Oral and Maxillofacial Surgery, Region Västra Götaland, Sweden requested the present HTA.

A working group under the chairmanship of Felicia Suska, Resident, Ph.D., Department of Oral and Maxillofacial Surgery in Göteborg, Public Dental Service, Region Västra Götaland, Sweden produced the HTA report. The other members of the working group were Göran Kjeller, Consultant, Ph.D., Associate professor, Department of Oral and Maxillofacial Surgery, the Sahlgrenska Academy, University of Göteborg, Sweden, and Anders Molander, Associate professor, Public Dental Service, Region Västra Götaland, Sweden.

The participants from the HTA centre were Ola Samuelsson, MD, PhD, Therese Svanberg, HTA-librarian, and Ann Liljegren, librarian.

Magnus Hakeberg, Professor, Department of Behavioral and Community Dentistry, Institute of Odontology, the Sahlgrenska Academy, University of Göteborg, Sweden, and Jüri Kartus, Professor, Consultant, Department of Orthopaedic Surgery, Uddevalla Hospital, Uddevalla, Sweden, have critically appraised the report.

The project lasted during the time period 2009-09-09– 2010-07-08.
The literature search covered the time from May 2003 up to December 2009.

The HTA-centre:

Christina Bergh Professor	Lennart Jivegård, PhD, MD	Maria Skogby PhD, RN
Magnus Hakeberg, Professor, OD	Anders Larsson PhD, MD	Annika Strandell PhD, MD
Hans Hedelin, Professor, MD	Ola Samuelson, PhD, MD	Therese Svanberg HTA-librarian
Peter Johansson PhD, MD	Henrik Sjövall Professor, MD	Margareta Warrén Stomberg PhD

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Question at issue:
Does removal of third molar teeth reduce the risk of infections and other local disease/pathological conditions in subjects with asymptomatic or symptomatic impacted third molars compared with no intervention?

Patients, Intervention, Comparison, and Outcome (PICO):

P1: Healthy individuals of all ages with totally or partially impacted wisdom teeth without symptoms
P2: Healthy individuals of all ages with totally or partially impacted wisdom teeth with any kind of symptom or condition (i.e. pain, pus, swelling, increased laboratory parameters, trismus, dysphagia, pericoronitis, crowding, or cysts)
I: Extraction of third molar tooth
C: No extraction or any other treatment of third molar tooth
O: Primary outcome variable: Infection
Secondary outcome variables: Root resorption, crowding, caries on adjacent tooth, loss of adjacent tooth, complications related to the surgical procedure

SUMMARY OF THE HEALTH TECHNOLOGY ASSESSMENT

Impacted third molar teeth are frequently observed in the general population. In the great majority of subjects they do not cause any significant symptoms. However, prophylactic removal of the third molars to prevent possible future complications is sometimes advocated, and also performed, despite the absence of pathological changes or clinical symptoms.

Level of evidence
The systematic literature search identified two systematic reviews, 16 studies that have reported the outcome following the extraction of third molar teeth, and one review article on unusual complications. All of the 16 studies were case series. The literature search did not find any randomised or non-randomised, adequately controlled trial in which prophylactic removal of third molar teeth has been compared with no intervention.

Both the systematic reviews were of adequate quality according to the AMSTAR criteria. The Norwegian HTA-report stated “removal of asymptomatic fully retained wisdom teeth is not recommended”, whereas the Cochrane review concluded that “no evidence was found to support or refute routine prophylactic removal of asymptomatic impacted wisdom teeth in adults.”

The level of evidence of prophylactic removal of asymptomatic third molar teeth as well as for removal of symptomatic third molar teeth is very low according to the GRADE system (GRADE ⊕).

Risks
All the case series reported adverse effects and complications. Surgical removal of third molar teeth is associated with both short-term and long-term complications. The overall complication rate varied between 4.6 – 36 %. The frequency of postoperative infections varied between 0.5 – 2.8 %, and the frequency of nerve damages or symptoms varied between 0.4 – 1.5 %.

Ethical aspects
To expose healthy asymptomatic young people to an oral surgical procedure in order to prevent disease or a pathological condition that may occur in the future must be seriously questioned when there is no documented evidence of a beneficial effect.

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Economical aspects

The total annual cost for removal of impacted third molars is estimated to be nearly SEK 103 millions. The patients themselves will have to pay the major part of these costs. The expenses for the dental insurance system are not available. From both the economical aspect of each individual as well as from a socio-economical aspect, the cost for prophylactic removal of asymptomatic impacted third molar would be high on the individual basis and substantial from the society point of view.

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Concluding remarks

Prophylactic removal of third molar teeth to prevent possible future complications is still frequently performed in Sweden. This intervention has been seriously questioned due to lack of supporting data of beneficial effects and the documented complications.

A systematic literature search and review of published data has revealed that there is still no scientific documentation available to either support or refute routine prophylactic removal of asymptomatic impacted wisdom teeth in adults.

On behalf of HTA-centrum Göteborg, Sweden, 2010-09-22.

Christina Bergh, Professor, MD.
Head of HTA-centre

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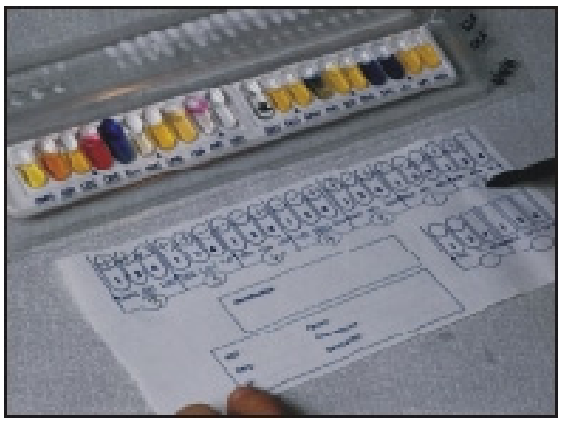
HTA-centrum



HTA

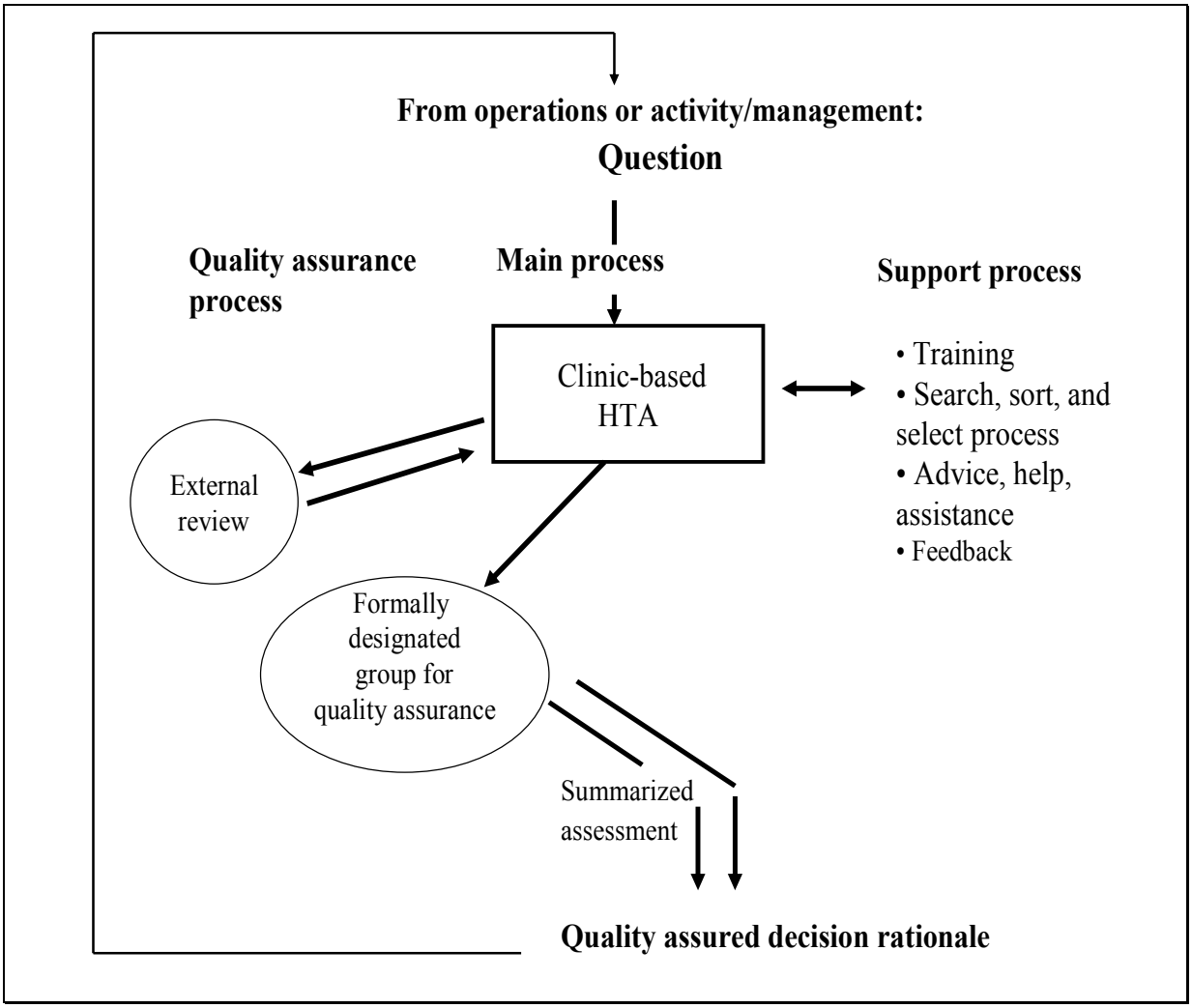
Health technology assessment (HTA) is the systematic evaluation of properties, effects, and/or impacts of health care technologies, i.e. interventions that may be used to promote health, to prevent, diagnose or treat disease or for rehabilitation or long-term care. It may address the direct, intended consequences of technologies as well as their indirect, unintended consequences. Its main purpose is to inform technology-related policymaking in health care.

To evaluate the quality of evidence the Centre of Health Technology Assessment in Region Västra Götaland is currently using the GRADE system, which has been developed by a widely representative group of international guideline developers. According to GRADE the level of evidence is graded in four categories:

High quality of evidence	⊕⊕⊕⊕	(Previously Level of evidence 1)
Moderate quality of evidence	⊕⊕⊕	(Previously Level of evidence 2)
Low quality of evidence	⊕⊕	(Previously Level of evidence 3)
Very low quality of evidence	⊕	(Previously Level of evidence 4)

In GRADE there is also a system to rate the strength of recommendation of a technology as either “strong” or “weak”. This is presently not used by the Centre of Health Technology Assessment in Region Västra Götaland. However, the assessments still offer some guidance to decision makers in the health care system. If the level of evidence of a positive effect of a technology is of high or moderate quality it most probably qualifies to be used in routine medical care. If the level of evidence is of low quality the use of the technology may be motivated provided there is an acceptable balance between benefits and risks, cost-effectiveness and ethical considerations. Promising technologies, but a very low quality of evidence, motivate further research but should not be used in everyday routine clinical work. (GRADE 2004, GRADE List of publications)

Christina Bergh, Professor, MD.
Head of HTA-centre



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Which health technology or method will be assessed?

REMOVAL OF IMPACTED WISDOM TEETH

1a. Who will lead the project?

Felicia Suska, Resident, Ph.D., Department of Oral and Maxillofacial Surgery in Göteborg, Public Dental Service, Region Västra Götaland, Sweden

1b. Who posed the question?

Mats Wallström, Clinical Director, Department of Oral and Maxillofacial Surgery Göteborg, Public Dental Service, and Chairman of the Council of Oral and Maxillofacial Surgery, Region Västra Götaland, Sweden

1c. Additional parties who posed the question?

The Council of Oral and Maxillofacial surgery, Region Västra Götaland, Sweden

Co-workers:
Göran Kjeller, Consultant, Ph.D., Associate professor, Department of Oral and Maxillofacial Surgery, the Sahlgrenska Academy, University of Göteborg, Sweden
Anders Molander, Associate professor, Public Dental Service, Region Västra Götaland, Sweden

1d. Other participants, from the HTA-centre and external reviewers HTA-centre

Ola Samuelsson, MD, Ph.D., Sahlgrenska Universitetssjukhuset, Sahlgrenska sjukhuset
Therese Svanberg, HTA-librarian, Sahlgrenska Universitetssjukhuset, Sahlgrenska sjukhuset
Ann Liljegren, librarian, Sahlgrenska Universitetssjukhuset, Sahlgrenska sjukhuset

External reviewer
Magnus Hakeberg, Professor, Department of Behavioral and Community Dentistry, Institute of Odontology, the Sahlgrenska Academy, University of Göteborg, Sweden
Jüri Kartus, Professor, Consultant, Department of Orthopaedic Surgery, Uddevalla Hospital, Uddevalla, Sweden

1e. Are there any conflicts of interest for the proposer or any of the participants in the work group?

There are no conflicts of interest.

Disease/disorder of Interest and Present Treatment

2a. Disease/disorder of interest and its degree of severity

Third molar teeth, or "wisdom teeth", generally erupt into the mouth in late adolescence or in the early twenties. However, wisdom teeth often fail to erupt or erupt only partially. When a complete eruption into a normal position is prevented, although the growth of the root is complete, the third molar is referred to as an impacted wisdom tooth. Impacted third molar teeth are frequently observed in the general population. In the great majority of subjects they do not cause any significant symptoms. However, prophylactic removal of the third molars to prevent possible future complications is sometimes advocated, and also performed, despite the absence of pathological changes or clinical symptoms.

- ☐ a) Risk of premature death
- ☑ b) Risk of permanent illness or damage, or reduced quality of life
- ☐ c) Risk of disability and health-related quality of life

2b. Prevalence and incidence of the disease/disorder

The prevalence of third molars is not known. In a Swedish study published in 1988 (Hugoson and Kugelberg) it was found that in 693 individuals (15 – 80 years of age), 1/3 did not have any third molar tooth, whereas 1/3 had all four third molars. The number differs between individuals due to several reasons, such as agenesia, previous extractions etc.

Although data are lacking there are reasons to believe that the incidence of asymptomatic pathological changes in conjunction with impacted third molars is very low.

2c. Present treatment of the disease/disorder in the outpatient setting/ in-patient setting

The generally accepted indications for removal of a third molar tooth are many and include dental caries, partial impaction associated with recurrent infection, cystic formations, resorption of adjacent teeth. Another advocated reason for removal is "prophylaxis", i.e. to prevent possible future complications.

The technique to remove an impacted third molar is surgical extraction. A gingival flap is raised, and the bone-coverage of the impacted wisdom tooth is removed. The tooth is then divided into at least two or three parts before it is removed together with the surrounding soft tissue. The wound is rinsed with saline, and finally, the soft tissue gingival flap is repositioned and secured by sutures. The technique is the same irrespective of whether the tooth is associated with pathological changes or not. The great majority of these procedures are performed under local anaesthesia in the outpatient setting.

2d. Number of patients per year who undergo current treatment regimen?

According to the records of the Swedish Social Insurance Agency a total of 226,667 notices of dental extractions associated with third molars were registered between July 1, 2008, and March 31 2010, i.e. during a 21 month long period. 15,662 of the teeth (6.9 %) were classified as being impacted. However, the number of impacted teeth that was associated with concomitant pathological changes or not was not registered. All the extracted erupted third molar teeth must be considered as associated with pathological changes.

In the database of the Public Dental Service of the Region Västra Götaland, the number of extractions of third molar teeth was 12,039 in 2007; 13,047 in 2008; and 13,375 in 2009. However, the number of extracted impacted teeth that was associated with concomitant pathological changes or not is not known.

In the Public Dental Service of the Region Västra Götaland, approximately 10 % of all dental extractions of third molars were performed at specialist clinics.

2e. The normal pathway of a patient through the health care system

The patient normally gets his/her dental care at the office of either a private or public dentist (GP = general practitioner). An impacted third molar is frequently diagnosed "en passent" during a routine check-up, or in conjunction with some degree of infection. The patient may then be referred to an oral and maxillofacial surgeon, or the GP removes the tooth him/herself if he/she is familiar with the procedure.

2f. Actual wait time in days for medical assessment /treatment

The wait time varies from within a week up to approximately 3 – 6 months, depending on the severity of symptoms, and the presence or absence of pathological changes.

Present Health Technology

3a. Name/description of the health technology at issue

Surgical removal of impacted wisdom teeth (third molar).

3b. The work group's understanding of the potential value of the health technology

The surgical or traditional removal, i.e. extraction, of third molar teeth has been a matter of debate for a long time. Until the mid 1980's the common opinion among both general dentists as well as oral and maxillofacial surgeons was that all third molars should be removed irrespective if pathological changes or clinical symptoms were present or not. During the last two decades many surgeons have challenged this view. Furthermore, today many surgeons also question whether pericoronitis in conjunction with an erupting third molar, or an abnormal position of the tooth should be a reason for removal. However, a significant number of patients with impacted or partially erupted third molars are still referred to specialist clinics by GPs.

3c. The central question for the current HTA project in one sentence

Does removal of third molar teeth reduce the risk of infections and other local disease/pathological conditions in subjects with asymptomatic or symptomatic impacted third molars compared with no intervention?

3d. PICO

P1: Healthy individuals of all ages with totally or partially impacted wisdom teeth without symptoms

P2: Healthy individuals of all ages with totally or partially impacted wisdom teeth with any kind of symptom or condition (i.e. pain, pus, swelling, increased laboratory parameters, trismus, dysphagia, pericoronitis, crowding, or cysts)

I: Extraction of third molar tooth

C: No extraction or any other treatment of third molar tooth

O: Primary outcome variable: Infection
Secondary outcome variables: Root resorption, crowding, caries on adjacent tooth, loss of adjacent tooth, complications related to the surgical procedure

3e. Key words

Impacted third molar, complications, quality of life

Review of the Level of Evidence

4. Search strategy, study selection and references – appendix 3

This report is based on two systematic reviews (one Cochrane review, Mettes et al., 2005, and one Norwegian HTA-report, NOKC, 2003), and articles published after May 2003, which was the final date of the literature search in the Norwegian report.

During October and November 2009, literature searches were performed in PubMed, The Cochrane Library, CINAHL, EMBASE and a number of HTA-databases (see appendix 3 for details). All the searches were made by two librarians (TS and AL) in consultation with the work group. The reference lists of relevant articles were also scanned for additional references. A total of 2,067 articles were identified, of which 1,995 abstracts were excluded by the librarians. Another 38 articles were excluded after having been read in full text. Thirty-four articles were sent to the work group. In addition to the Cochrane review and the Norwegian HTA-report, 17 of these 34 articles are included in this report. The two systematic reviews have been appraised using the AMSTAR checklist.

The search strategies, eligibility criteria, a graphic presentation of the selection process, and reference lists are presented in appendix 3.

5a. Describe briefly the present knowledge of the health technology

The systematic literature search identified two systematic reviews. One was an HTA-report from Norway published in 2003. It included the literature published before September 2002. The second one was a Cochrane review published in 2005. It included randomised, controlled trials published before August 2004. The literature search after this latter date identified 16 studies that have reported the outcome following the extraction of third molar teeth. All of these 16 studies were case series. Furthermore, the literature search identified one review article on unusual complications. After August 2004 no randomised or non-randomised, adequately controlled trial, in which prophylactic removal of third molar teeth has been compared with no intervention has been found in any of the searched databases (see 4).

Both the systematic reviews were of adequate quality according to the AMSTAR criteria.

The Norwegian HTA-report from 2003 was based on 25 studies. Two of these 25 studies were non-randomised, controlled studies with rather small sample sizes. The HTA-report concluded that “This report is based on evidence from studies that use small selected patient groups, and therefore it is difficult to draw firm conclusions

and give recommendations". However, the final conclusion was that "Removal of asymptomatic fully retained wisdom teeth is not recommended".

The Cochrane review from 2005 included two randomised, controlled trials (RCTs) and had identified a third ongoing randomised, controlled trial. The results of the third trial, which started in 1999, have not yet been published. Both RCTs included only adolescents (13-19 years of age) and were rather small. The conclusions of the Cochrane review were that "no evidence was found to support or refute routine prophylactic removal of asymptomatic impacted wisdom teeth in adults. There is some reliable evidence that suggest that the prophylactic removal of asymptomatic impacted wisdom teeth in adolescents does not reduce or prevent late lower incisor crowding"

The patient populations in the 16 case series were heterogeneous with regard to the number of patients, varying from 327 up to 34,491 (median 1057). The time of follow-up also varied to a great extent in the 8 studies that have reported their observation period, from 1 week up to 5 years (median 6 months). None of the case series reported the distribution of asymptomatic and symptomatic patients or the outcome of the extraction according to the presence or absence of symptoms at the time of the procedure.

The level of evidence for prophylactic removal of asymptomatic third molar teeth regarding all outcome measures is very low (GRADE ⊕) according to the GRADE system.

The level of evidence for removal of symptomatic third molar teeth regarding all outcome measures is very low (GRADE ⊕) according to the GRADE system.

All the case series reported adverse effects and complications. However, the definitions and the methods of reporting the adverse effects and complications differed substantially in the different studies. The overall complication rate varied between 4.6 – 36 %. The frequency of postoperative infections varied between 0.5 – 2.8 %, and the frequency of nerve damages or symptoms varied between 0.4 – 1.5 %.

All the case series reported that removal of third molar teeth was associated with different kinds of complications. Many of them were relatively frequent, such as infection and nerve dysfunction, whereas some were rare (reviewed by Brauer 2009). Occasional cases with subperiosteal abscess of the orbit, epidural and brain abscesses, subdural empyema have been reported as well as herpes zoster syndrome. Also displacement of hand piece bur, and displacement of root or tooth to the lingual soft tissue, maxillary sinus, pterygomandibular space, infratemporal fossa and pharyngeal space have been described. Furthermore, life-threatening complications with extensive haemorrhage, emphysema and pneumothorax have also been reported, and there has been one fatal case of asphyxial death caused by postextraction hematoma. Thus, surgery of wisdom teeth is a common procedure that can be associated with serious complications.

5b. **Outcome tables – appendix 1**.

5c. **Excluded articles – appendix 2**

5d. **Ongoing research**

A search in Clinicaltrials.gov (May 25th, 2010) using the search terms *(extraction OR extractions OR surgical OR surgery OR removal OR remove)* ***AND*** *(third molar OR third molars OR wisdom tooth OR wisdom teeth)* identified 66 trials. None of them compared the removal with the retention of wisdom teeth, and none of them were relevant for our question.

One of the authors of this HTA report is presently chairing an ongoing study with the aim to analyze the prevalence and incidence of alveolar nerve dysfunction after lower third molar extraction in relation to both location as well as presence of pathological changes. It is both a retrospective as well as a prospective study. There are no results available at present time.

6. **Which medical societies or health authorities recommend the new health technology?**

Presently, there are no national treatment recommendations available.

Ethical aspects

7a. Ethical consequences

To expose healthy asymptomatic young people to an oral surgical procedure in order to prevent disease or a pathological condition that may occur in the future must be seriously questioned. A surgical procedure is always associated with some risks. A period of postoperative discomfort will always occur, and its severity depends on the individual as well as on the conditions associated with the intervention. In addition, there is also a risk of permanent discomfort, primarily in terms of nerve dysfunction, i.e. numbness in the lip, tongue or cheek. The magnitude of this risk depends primarily on the location of the impacted tooth, but also on the skills of the dentist/surgeon.

Although data are lacking there are reasons to believe that the incidence of asymptomatic pathological changes in conjunction with impacted third molars is low. If such changes are present they are mild, and definitely not lethal to the patient. Thus, prophylactic extraction of asymptomatic impacted third molars cannot be justified from these points of view.

It is the opinion of the work group that it is unethical to remove asymptomatic fully retained wisdom teeth.

In contrast, if a subject has pathological findings or he/she has had episodes of illness or discomfort due to a third molar tooth, an intervention that may result in permanent discomfort may be acceptable.

7b. Will other patient groups or other treatments be adversely affected (pushed aside) due to an introduction of the new health technology?

According to the general policy and current guidelines, only impacted third molars with pathological changes and/or clinical symptoms should be removed. In most dental clinics in which surgery is performed, approximately 50 % of all surgical interventions are associated with third molar teeth (in some clinics even more). If all impacted third molars are to be removed, the number of surgeons/dentists trained to perform these procedures must increase significantly, or other treatments such as implant dentistry, and orthognatic surgery must be reduced to the same degree. Also treatments of high priority such as trauma and cancer may be negatively affected. Consequently, if only symptomatic impacted third molars are to be removed leaving asymptomatic teeth without intervention more resources will be available for other ortho-maxillar surgical procedures.

Organisation

8a. **When can this new health technology be put into practice?**

Not applicable.

8b. **Is this technology used in other hospitals in Region Västra Götaland?**

Not applicable.

8c. **According to the work group, will there be any consequences of the health technology for personnel?**

Not applicable.

8d. **Will there be any consequences for other clinics or supporting functions at the hospital or in the whole Region Västra Götaland?**

Not applicable.

Economy

9a. Present costs of currently used technologies.

The exact actual cost of removal of impacted, asymptomatic third molar teeth is not possible to calculate since the cost of the procedure depends on a lot of various factors.

The removal of third molars is (almost) always covered by the Swedish dental insurance system. This is a very complex national dental insurance. If a treatment costs up to SEK 3,000, the patient will pay the entire amount. If the cost of treatment is between SEK 3,001 – 15,000, the patient will pay 50 %, and the remaining 50 % will be covered by the national dental insurance. Of all costs above SEK 15,000, the dental insurance will cover 75 % of the amount. This compensation is based on a, so-called, "reference price list", which is defined by the Swedish Social Insurance Agency. However, the setting of price of dental care is free and the dentist must not follow the reference list. Almost no dental practice, irrespective of public or private, follows this "reference price list" but normally charges a higher price. The difference between the price of the dental care provider and the reference price has to be paid fully by the patient.

In Sweden, approximately 198,000 third molar teeth (includes both erupted and completely or partially impacted teeth) are removed annually (based on the number of removed third molars between July 1, 2008 and March 2010, = 21/24 x 226,667 = 198,333, see above 2d). The annual cost would then be approximately SEK 247 millions when the calculation is based on the price in the "reference price list". Due to the higher prices charged by the dental providers this is an underestimation of the actual cost.

Using the reference list price for impacted molars and the assumption that 7 % of all removed third molars are impacted wisdom teeth the annual cost in Sweden for removal of impacted third molars would be at least SEK 103 millions. The patients themselves will have to pay the major part of these costs. The expenses for the dental insurance system are not available.

9b. Expected costs of the new health technology

Not applicable.

9c. Total change of cost

It is not possible to calculate the change of cost if all impacted asymptomatic third molar are removed. Most probably the cost will increase significantly in comparison to the present situation.

9d. Can the new technology be adopted and used within the present budget (clinic budget/hospital budget)?

Not applicable.

9e. Are there any available analyses of health economy? Cost advantages or disadvantages?

A British study published in 1999 concluded that retention of impacted third molars was more cost-effective than prophylactic removal (Edwards et al. 1999). The Norwegian HTA-report from 2003 did not confirm this, but could neither dispute this conclusion. Since the costs and methods of compensation vary in different national systems it is very difficult to extrapolate a health economy analysis from one country to another.

Unanswered Questions

10a. **Important gaps in scientific knowledge?**

It is still not clarified whether prophylactic removal of asymptomatic impacted third molars is beneficial, without any effects or even harmful.

10b. **Is there any interest in your own clinic/research group/organisation to start studies/trials within the research field at issue?**

At the present time, there is no interest to conduct clinical trials in order to investigate the question posed in this HTA report.

Summary of the Health Technology Assessment

- **Method and patient group:**

  Impacted third molar teeth are frequently observed in the general population. In the great majority of subjects they do not cause any significant symptoms. However, prophylactic removal of the third molars to prevent possible future complications is sometimes advocated, and also performed, despite the absence of pathological changes or clinical symptoms.

- **Question at issue:**

- Does removal of third molar teeth reduce the risk of infections and other local disease/pathological conditions in subjects with asymptomatic or symptomatic impacted third molars compared with no intervention?

- **PICO:**

  P1: Healthy individuals of all ages with totally or partially impacted wisdom teeth without symptoms
  P2: Healthy individuals of all ages with totally or partially impacted wisdom teeth with any kind of symptom or condition (i.e. pain, pus, swelling, increased laboratory parameters, trismus, dysphagia, pericoronitis, crowding, or cysts)
  I: Extraction of third molar tooth
  C: No extraction or any other treatment of third molar tooth
  O: Primary outcome variable: Infection
  Secondary outcome variables*:* Root resorption, crowding, caries on adjacent tooth, loss of adjacent tooth, complications related to the surgical procedure

- **Studied risks and benefits for patients of the new health technology**

  The systematic literature search identified two systematic reviews. One Norwegian HTA-report included the literature published before September 2002, and the other was a Cochrane review that included randomised, controlled trials published before August 2004. The literature search after this latter date identified 16 studies that have reported the outcome following the extraction of third molar teeth. All of the 16 studies were case series. After August 2004 no randomised or non-randomised, adequately controlled, trial has been published in which prophylactic removal of third molar teeth has been compared with no intervention

  Both the systematic reviews were of adequate quality according to the AMSTAR criteria. The Norwegian HTA-report stated “removal of asymptomatic fully retained wisdom teeth is not recommended”, whereas the Cochrane review concluded that “no evidence was found to support or refute routine prophylactic removal of asymptomatic impacted wisdom teeth in adults”, and that “There is some reliable evidence that suggest that the prophylactic removal of asymptomatic impacted wisdom teeth in adolescents does not reduce or prevent late lower incisor crowding.”

All the 16 case series reported adverse effects and complications. The overall complication rate varied between 4.6 – 36 %. The frequency of postoperative infections varied between 0.5 – 2.8 %, and the frequency of nerve damages or symptoms varied between 0.4 – 1.5 %.

The level of evidence for prophylactic removal of asymptomatic third molar teeth as well as for removal of symptomatic third molar teeth is very low (GRADE ⊕) according to the GRADE system.

- **Ethical questions:**

  To expose healthy asymptomatic young people to an oral surgical procedure in order to prevent disease or a pathological condition that may occur in the future must be seriously questioned when there is no documented evidence of a beneficial effect.

  It is the opinion of the work group that it is unethical to remove asymptomatic fully retained wisdom teeth.

- **Economical aspects:**

  The total annual cost for removal of impacted third molars is estimated to be at least SEK 103 millions. The patients themselves will have to pay the major part of these costs. The expenses for the dental insurance system are not available.

  The cost for prophylactic removal of asymptomatic impacted third molar would be high on an individual basis and substantial from a society point of view.

Appendix 1. - Table 1. Study design and main results in 16 case series.

Study 1	Study characteristics	Results	Comments and conclusions
Author, year of publication and country: Benediktsdottir I.S. et al. 2004, Denmark Journal: Oral Surgery, Oral Medicine, Oral Pathology Title: Mandibular third molar removal: Risk indicators for extended operation time, postoperative pain, and complications Aims: Identify risk indicators for extended operation time, postoperative pain, and complications	Study design: Prospective observational cohort study Intervention: Removal in general Local anesthesia with citanest and octapressin No preoperative antibiotics or analgesics Population: 335 healthy patients, 388 3rd molar teeth. Patients with fully or semierupted molars were excluded. Presence or absence of pre-existing oral pathology not reported. Age: Mean age of 25 years (range: 18 - 44) Observation time: One week. If complications-up to 12 months Risk indicators for extended operation time, severe pain /VAS 4 hours postoperatively, postoperative pain, infection, dry socket, paresthesia	*Extended operation time.* Rate of operation time longer than 31 minutes: 5% of patients. Risk factors: 1.Age < 23 years;lower risk 2. Horisontally positioned teeth; longer operation 3. Teeth with 2 roots; longer operation time ex. *Severe pain 4 h postoperatively.* Rate marked pain more than 75% on VAS score 5 % of patients Risk factors: 1.Molars with curved roots. 2.Semi-impacted teeth scored 3. Visible mandibular nerve postoperatively *Postoperative pain.* Rate of more severe pain than during postoperative week 15.2 % of patients Risk factors: 1. Males;lower risk. 2 Curved roots; lower risk. 3. Visible nerve postoperatively; higher risk. *General infection.* Rate postoperative general infection 2.8% of patients 1. Fully impacted teeth; higher risk. 2. Visible nerve operatively; higher risk *Dry socket.* Rate 5.9% of patients, Risk factors: Females; five times higher. *Paresthesia* Not specifically analysed due to low rate (5 patient, 1.8%)	The study was part of a larger study on a pain relief drug, which was administrated i.v. immediately after the recovery of sensation. Incidence of preoperative third molar pathology is not reported Definitions of general infection, dry socket, paresthesia are missing. Different surgeons Conclusion by author Older age increases the risk of extended operation time. Females are at higher risk of developing postoperative complications than males. Radiographically fully impacted molars increases the risk of postoperative general infection. Exposure of the nerve during the operation increases risk for postoperative complications.

Study 2	**Study characteristics**	**Results**	**Comments and conclusions**
Author, year of publication and country: Blondeau F. et al. 2007, Canada Journal: Journal of the Canadian Dental Association Title: Extraction of Impacted Mandibular Third Molars: Postoperative Complications and Their Risk Factors Aims: Evaluate the incidence of complications: alveolitis, infection, paresthesia in association with removal of impacted mandibular third molars	Study design: Prospective observational cohort study Phone questionnaire with follow-up clinic visits if symptoms Intervention: One surgeon Local anesthesia with or without sedation Gelfoam with tetracycline placed in the socket postoperatively Preoperative antibiotic treatment in some patients Presence or absence of pre-existing oral pathology not reported. Population: 327 patients referred to a special clinic for extraction of 3rd molar Age: Mean 24.4 years (12 - 55) Observation time: 4 weeks Outcome: Rate of complications according to gender, age, degree of impaction, position and the use of oral contraceptives by females	The overall complication rate was 6.9% Incidence of paresthesia inferior alveolar nerve was 1.1%, of alveolitis 3.6%, and of infection 2.2%. Most of the complications were associated with degree of impaction. Females were predominant in all complication groups. .	Inclusion and exclusion criteria not specifically stated. Conclusions about age and surgical experience are not based on results. Conclusion by author: Surgical removal of impacted mandibular third molars should be carried out before the age of 24 years, especially for female patients. Older patients are at greater risk of postoperative complications and permanent sequelae.

Study 3	Study characteristics	Results	Comments and conclusions
Author, year of publication and country: Bui C. et al. 2003, USA Journal: American Association of Oral and Maxillofacial Surgeons Title: Types, Frequencies, and Risk Factors for Complications After Third Molar Extraction Aims: To identify types, frequencies and risk factors for complications after third molar (M3) extractions	Study design: Retrospective observational cohort study Inclusion criteria: one or more maxillary or mandibular third molar extracted and evidence of postoperative follow-up. Exclusion criteria: no evidence of postoperative follow-up. Intervention: Removal of 3rd molar Population: 583 patients (87 % of 687 patients) with follow-up visit. 1587 teeth. 48.2% maxillary third molars and 51.6% in the mandible. 71.6 % of the patients had a previous "positive" dental history. Age Mean 26,4±8,4 years Observation time Not reported Outcome Any kind of complication.	The overall complication rate was 4.6% by tooth and 9.8% by subject. Factors associated with complications were: age, positive medical history (occurrence of disorders) and position of mandibular molar relative to inferior alveolar nerve.	Both mandibular and maxillary third molars are investigated Incidence of pre-existing third molar pathology is not reported Conclusion by author Age, medical history and third molars anatomy may be modified indirectly. Thus, there is a potential for decrease of postoperative complications.

Study 4	**Study characteristics**	**Results**	**Comments and conclusions**
Author, year of publication and country: Chuang S. et al, 2008, USA Journal: J Oral Maxillofac Surgery Title: Risk Factors for Inflammatory Complications Following Third Molar Surgery in Adults Aims: Estimate the frequency of inflammatory complications (surgical site infections and alveolar osteitis) following third molar extraction and identify risk factors for such complications	Study design: Prospective observational cohort study Inclusion criteria: more than 1 third molar extracted and ≥1 post-operative visit. . Intervention: Total removal of 3rd molar Population: 4004 patients, 8748 teeth Inclusion criteria: more than 1 third molar extracted and ≥1 post-operative visit. Presence or absence of pre-existing oral pathology not reported. Age: Mean 39.8 ± 13.6 years (13 - 98) Observation time: Not reported Outcome: Primary outcome variable: presence or absence of inflammatory complications (SSI=surgical site infection, AO=alveolar osteitis)	Overall postoperative incidence of inflammation was 8.5% (SSI=1.1%, AO=7.4%). Females, sum of health risks, level of impaction, pre-existing periodontal pathology, pre-existing infection and pre-existing pathology were associated with inflammatory complications.	The study was a part of the American Association of Oral and Maxillofacial Surgeons Age-Related Third Molar Study No definition of SSI and AO? Pre-existing pathology in tables? Conclusion by author: Pre-existing infection should be eradicated before extraction. The non-modifiable risk factors should be known by clinicians, who should tailor their clinical approach (eg. administration of perioperative antibiotics) based on the likelihood of postoperative inflammatory complications.

Study 5	Study characteristics	Results	Comments and conclusions
Author, year of publication and country: Contar C. et al. 2009, Brazil Journal: Med Oral Patol Oral Cir Bucal. Title: Complications in third molar removal: A retrospective study of 588 patients Aims: Analyze the incidence of complications and their relationship with the surgical difficulty	Study design: Retrospective observational cohort study Intervention: One surgeon Total removal of 3rd molar Local anesthesia with or without nitrous oxide sedation Amoxycillin postoperatively Dexamethason pre- and postoperatively Chlorhexidine postoperatively Paracetamol with codein in case of pain Population: 588 patients, 1699 teeth. Maxillary (49% maxillary and 51 % mandibular 3rd molar. Presence or absence of pre-existing oral pathology not reported. Age: Mean 26.1 years (14-54) Observation time: Not reported Outcome: Frequency of surgical procedures. The teeth were grouped into 6-class scale of surgical difficulty Any kind of complication.	The most frequent surgical problems occurred in osteotomy, of mandibular 3rd molar followed by osteotomy of maxillary 3rd molar. Total incidence of complications was 3.5 %. Most of them (3.1%) occurred following osteotomy of the 3rd mandibular molar o and after tooth sectioning. Pain was associated with postoperative local food impaction and presence of traumatic oral ulcers under the suture.	Both maxillary and mandibular 3rd molars are included. No patient had pericoronitis or periodontal disease at the time of the surgery. Conclusion by author: The risk of complications in 3rd molar surgery increases in proportion to the surgical difficulty. Osteotomy of 3rd mandibular molar and tooth section have the highest risk of complications

Study 6	Study characteristics	Results	Comments and conclusions
Author, year of publication and country: del Rey-Santamaria, M. et al. 2006, Spain Journal: Med Oral Patol Oral Cir Bucal Title: Incidence of oral sinus communications in 389 upper third molar extraction Aims: Determine the incidence of oral sinus communication (OSC) following the extraction of upper third molars	Study design Prospective observational cohort study. Variables: age, sex, third molar angulation, radiological sinus proximity, surgical technique employed, existing OSC, cause of letter Intervention Surgical or conventional tooth extraction. Local anesthesia. Amoxicillin, sodium diclofenac and chlorhexidine postoperatively. Population 353 surgical and 36 conventional extractions. Presence or absence of pre-existing oral pathology not reported. Age Mean 21 years Observation time 7 days Outcome: Oral sinus communications (OSC).	The intraoperative incidence of OSC was 5,1%. All cases were associated with surgical extractions. No patient with conventional extraction had OSC. 4.4% of OSC were observed in women. The risk of intraoperative OSC was similar in all age groups All OSC were absent at the 7-day follow-up.	Unclear if the study was prospective The two groups differed considerably in the size. The diagnosis of the OSC is based only on Valsalva maneuver (sensitivity 52%) Conclusion by author Only 5% of the surgical extractions produced intraoperative OSC, and they were all absent after 7 days.

Study 7	**Study characteristics**	**Results**	**Comments and conclusions**
Author, year of publication and country: Di Dio M. et al. 2004, Italy Journal: Minerva Stomatol Title: The "piercing technique", A new procedure in impacted lower third molar surgery Aims: Rationalize the odontomic phase during the extraction of lower third molars Evaluate the side effects and complications after the piercing technique utilized for surgery	Study design: Prospective observational cohort study Intervention: Piercing technique. One surgeon Antibiotics preoperatively. Nonsteroidal anti-inflammatory analgesic and chlorhexidine postoperatively. Population: 506 consecutively recruited patients (802 teeth) Presence or absence of pre-existing oral pathology not reported. Age: Mean 27 years (12 - 84) Observation time: 10 - 180 days Outcome: Any kind of complication.	Incidence of permanent loss of sensibility of the inferior alveolar nerve was 0.2%. Incidence of temporary loss of sensibility of the inferior alveolar nerve after up to 60 days was 1.3%, band after 180 days 0% Incidence of secondary infections after 10 days was 1.6%, and after 0% Incidence of trismus after 10 days was 1.5%, and after 20 days 0% Incidence of swelling or skin discolouring after 10 days was 5.5%, and after 20 days 0% Incidence of temporomandibular disorders after 10 days was 1.6%, and after 20 days 0%. Incidence of 2nd molar loss of sensitivity after 180 days was 0.5%. Incidence of gingival retraction=42,6% after 180 days was 42.6%. Smokers had a 5.2 higher risk of any post-operative complication compared to non-smokers	Conclusion by author: "Piercing technique" is safe. It is a minimally invasive and easy to apply in impacted lower 3rd molars. This surgical procedure permits to have a point of dental reference, that makes odontoectomy similar to what is planned, and it is possible to inject anaesthetic into the dental pulp in cases of hypersensibility, and to have a point for insertion of angular elevators.

Study 8	Study characteristics	Results	Comments and conclusions
Author, year of publication and country: Fiqueiredo R. et al, 2005, Spain Journal: Oral Surg Oral Med Oral Pathol Oral Radiol Endod Title: Incidence and clinical features of delayed-onset infections after extraction of lower third teeth Aims: Detect delayed-onset wound infections occurring after suture removal in extractions of the lower third molars, calculate their incidence and describe the mail clinical features of the infected patients	Study design: Retrospective observational cohort study Intervention: Total removal of 3rd molar Local anesthesia. 18 different surgeons. Antibiotic , non steroidal antiinflammatory drug, analgesic and chrolhexidine postoperatively. Population: 772 consecutive patients, 958 lower 3rd molars Presence or absence of pre-existing oral pathology not reported. Age: Not reported Observation time: Not reported Outcome: Incidence of delayed wound infection (after 1 week)	The incidence of delayed infections was 2.4%. Infection appeared as early as 10 days after operation and up to 84 days postoperatively. In most cases osteotomy and tooth sectioning were performed.	386 extractions were excluded from the analysis as those “did not required follow-up”. Conclusion by author: Delayed-onset infections of the lower third molar site were a rare postoperative complication. Patients should be warned that infection can occur several weeks after the extraction

Study 9	Study characteristics	Results	Comments and conclusions
Author, year of publication and country: Halpern L. et al. 2003, USA Journal: J Oral Maxillofacial Surgery Title: A Comparison of 2 Consultation and Treatment Strategies to Manage Impacted Third Molars Aims: To compare the postoperative complication rates of two strategies for the evaluation and operative management of patients with impacted third molars	Study design: Retrospective observational cohort study Intervention: Complete removal of 3rd mandibular or/and maxillary molar Intravenous sedation/general anesthesia or local anestesia Population: 5 993 patients Presence or absence of pre-existing oral pathology not reported. Age: Mean 23.7±7.6 years Observation time: Not reported Outcome: Any complication. Complications were classified as either major (nerve injury, osteomyelitis) or minor (bleeding, infection or localized alveolitis), and analysed according to 1) same-day surgery (SDS), consultation and procedure were performed on the same day 2) consult prior to surgery (CPS), consultation and procedure separated in time more then 24 hours	The incidence of any complication was 36 %. 42 % were classified as minor with no significant differences between SDS and CPS. The complication rates of SDS and CPS were 50% and 45.8% respectively. Patients with a consultation prior to surgery (CPS) were 8% less likely to have a complication compared to SDS. Other risk factors for complications were: more likely to be referred by a physician, older age, female, smoking, intravenous sedation or general anesthesia	General anesthesia/sedation 99.1%, local anesthesia 0.9% Both mandibular and maxillar third molars Conclusion by author: A treatment protocol that includes SDS and extraction of all indicated 3rd molars at the same visit minimizes the number of visits, and maximizes the operator efficiency without an increased risk for complications.

Study 10	**Study characteristics**	**Results**	**Comments and conclusions**
Author, year of publication and country: Haug, R.H. 2005, USA Journal: J Oral Maxillofac Surg Title: The American Association of Oral and Maxillofacial Surgeons Age-Related Third Molar Study Aims: To assess the complication frequency of third molar surgery, both intraoperatively and postoperatively in patients 25 years or older	Study design: Prospective observational cohort study Intervention: 63 surgeons Total removal of 3rd molar. Both maxillary and mandibular 3rd molars Population 3 760 patients Inclusion criteria (age 25 or older, follow-up) Presence or absence of pre-existing oral pathology not reported. Age 25 years or older Observation time Not reported Outcome: Postoperative complications, the need of hospitalisation, additional surgical procedure, quality of life	Incidence of intraoperative complications was less than 1% Alveolar osteitis was the most commonly complication following extraction of maxillary 3rd molars (0.2% to 0.3%) and 3rd mandibular molars (11.9% to 12.7%). Inferior alveolar nerve anesthesia/paresthesia occurred in 1,1% to 1.7%, respectively. 31.2% to 34.1% of patients had minimal inconvenience associated with the extraction but neither group missed work nor had normal activities curtailed Some pathology or abnormality was associated with 43.5% to 53.3% of the third molars.	Conclusion by author: The removal of 3rd molars in an adult patient population is a safe surgical procedure with minimal morbidity, no mortality and no long-term negative impact on the patients quality of life

Study 11	Study characteristics	Results	Comments and conclusions
Author, year of publication and country: Huang, G.J., 2006, USA Journal: J American Dental Association Title: Third- molar extraction as a risk factor for temporomandibular disorder Aims: To investigate the potential association between third molar extraction and temporomandibular disorder (TMD)	Study design: Prospective observational cohort study Intervention: Total removal of 3rd molar. Insured patients. Population: 34 491 patients Presence or absence of pre-existing oral pathology not reported. Age: 15 years Observation time: 5 years Outcome: First indication of TMJ after extraction.	50% of subjects had a 3rd molar extracted. 1.1 % of all subjects had TMD treatment during 5 years follow-up. After adjusting for sex and use of dental care the extraction of 3rd molars was significantly and independently associated with TMD. 23% of all TMD cases in this age group might be due to third molar extractions	Insured patients Database information The extraction of upper or lower molar can give different implications on TMJ Conclusion by author: 3rd molar extraction appears to be associated with a substantially increased risk of experiencing subsequent TMD

Study 12	Study characteristics	Results	Comments and conclusions
Author, year of publication and country: Jerjes, W et al, 2006, London Journal: Oral Surg Oral Med Oral Pathol Oral Radiol Endod Title: Permanent sensory nerve impairment following third molar surgery: a prospective study Aims: To studye the proportion of sensory nerve impairment of the inferior alveolar and lingual nerves, and the factors influencing such complications.	Study design: Prospective observational cohort study Intervention: Total removal of 3rd molar. Local anesthesia. Antibiotics and non-steroid anti-inflammatory drugs post-operatively. Population: 1 087 patients;1 087 third molar Presence or absence of pre-existing oral pathology not reported. Age: Mean age of 23.3 (SD 4.2) years Observation time: 2 years Outcome: Incidence of inferior alveolar or lingual nerve paresthesia	4.1 % of patients experienced paresthesia of the inferior alveolar nerve, and 6.5 % of the lingual nerve 1 week after extraction. After 2 years the respective rates were 0.7% and 1.0 %, respectively. The rate of permanent nerve impairment was inversely related to the experience of the surgeon.	Conclusion by author: The experience of the surgeon had a significant impact on the risk of nerve damage.

Study 13	Study characteristics	Results	Comments and conclusions
Author, year of publication and country: Queral-Godoy E. et al, 2006, Spain Journal: J Oral Maxillofac Surg Title: Frequency and Evolution of Lingual Nerve Lesions Following Lower Third Molar Extractions Aims: To calculate the frequency of lingual nerve (LN) damage caused by lower third molar extraction and describe the evolution of LN sensitivity and prognosis of LN damage	Study design: Retrospective observational cohort study. Intervention: Total removal of 3rd molar. Local anesthesia. Antibiotics, anti-inflammatory drugs, and chlorhexidine postoperatively Population: 3 513 patients, 4 995 third molar extractions. Presence or absence of pre-existing oral pathology not reported. Age: Median 25.8 years (16 - 43) Observation time: 6 months Outcome: Two-point discrimination, pin prick, light touch, tingling sensation. Classification of the lesion: dysesthesia, hypoesthesia, anesthesia	The incidence of lingual nerve damage was 0.5 %. 1 patient had anesthesia, 2 patients had dysesthesia, and 21 patients had- hypoesthesia. LN damage was generally associated with osteotomy and tooth sectioning	Conclusion by author: Lingual nerve impairment usually recovers, with a faster rate during the first months.

Study 14	Study characteristics	Results	Comments and conclusions
Author, year of publication and country: Queral-Godoy, E. et al, 2005, Spain Journal: Oral Surg Oral Med Oral Pathol Oral Radiol Endod Title: Incidence and evolution of inferior alveolar nerve lesions following lower third molar extraction Aims: To calculate the incidence of inferior alveolar nerve (IAN) damage due to lower third molar extraction and to describe the evolution of IAN sensitivity and the prognosis of IAN damage	Study design: Retrospective observational cohort study. Intervention: Total removal of 3rd molar. Local anesthesia. Antibiotics, anti-inflammatory drugs, and chlorhexidine postoperatively. Population: 3 513 patients; 4 995 teeth Presence or absence of pre-existing oral pathology not reported. Age: Median 25.8 years (16 - 43) Observation time: 6 months Outcome: 2-point discrimination pin-prick, light touch. Lesion classification: dysesthesia, hypoesthesia, anesthesia	The incidence of inferior alveolar nerve damage was 1.1% (total anesthesia 2%, dysesthesia 16%, hypoesthesia 82%). 47 % of the patients with inferior alveolar nerve damage were lost to follow-up. Of the remaining 53 % half of the patients fully recovered after 6 months. The longest duration to recovery was 1.5 years. Age was associated with persistence of IAN injury.	Conclusion by author: Most cases of IAN impairment following lower 3rd molar extraction recover within 6 months Older patients are at increased risk of incomplete recovery.

Study 15	Study characteristics	Results	Comments and conclusions
Author, year of publication and country: Rothamel D. et al. 2006, Germany Journal: British Journal of Oral and Maxillofacial Surgery Title: Incidence and predictive factors for perforation of the maxillary antrum in operations to remove upper wisdom teeth: Prospective multicenter study Aims: To evaluate incidence of perforations of the sinuses and their related treatment after the removal of upper wisdom teeth depending on various anatomical and clinical variables	Study design Restrospective observational cohort study. Anonymised questionnaire. Intervention Total removal of maxillar 3rd molar, with or without osteotomy. Local anesthesia. Diagnosis was based on Valsalve maneuver and blunt sinus probe. Population 1057 teeth. Presence or absence of pre-existing oral pathology not reported. Age Mean 28 years (11 – 83). Observation time Not reported Outcome Incidence of perforations to maxillary sinus	Incidence of maxillary sinus perforation was 13 %. Incidence of preoperative complaints was 21 %. Risk factors for perforation were age, eruption status of the tooth and peroperative root fracture. Conclusions Intraoperative fracture of the root, higher degree of impaction, and higher age of patient are associated with a greater likelihood of oro-antral perforation	Conclusion by author Intraoperative fracture of the root, higher degree of impaction, and higher age of patient are associated with a greater likelihood of oro-antral perforation

Study 16	Study characteristics	Results	Comments and conclusions
Author, year of publication and country: Waite, P.D. et al, 2006, UK? Journal: J Oral Maxillofacial Surg Title: Surgical Outcomes for Suture-Less Surgery in 366 Impacted Third Molar Patients Aims: To identify surgical outcomes in third molar surgery when no sutures are used for primary closure	Study design: Retrospective observational cohort study. Intervention: Total removal of 3rd molar. Maxillary and mandibular teeth Intravenous sedation and local anesthesia. Prophylactic intravenous antibiotic. Intravenous dexamethazone Small V-shaped flarp in the mandible, sutureless technique Population: 366 patients. Presence or absence of pre-existing oral pathology not reported. Age: Mean age 22,14 years Observation time: 1-2 weeks Outcome: Incidence of alveolar osteitis (extended pain, loss of blood clot, dressing treatment). Incidence of poor healing.	Incidence of alveolar osteitis was 2.8 % (after lower 3rd molar removal 8.7%)**,** Incidence of alveolar osteitis in class IV mandibular third molars was 10.7%.	Maxillary and mandibular molars No evaluation of long-term infection, nerve injury. Conclusion by author: The outcome of 1 280 extractions demonstrated good results.

Appendix 1. – Table 2. Incidence of complications. Note that the time of follow-up ranges from 1 week to 5 years (median 6 months)

Study Follow-up	Infection	Alveolitis/ dry socket	Paresthesia/ anesthesia	Pain	Bleeding	Oroantral communi-cation	TMJ disorder	Other
Benediktsdottir et al. 2004 FU: 1 week	2.8%	5.9%	1.5%	15.2%				Extended operation time 5%
Blondeau et al. 2007 FU: 4 weeks	2.2%	3.6%	1.1%					
Bui et al. 2003 FU: Not reported	0.5%	1.4%	0.4%	0.3%	0.6%	0.2%		Incomplete tooth removal 0.06% Delayed healing 0.7% Infected subperiosteal hematoma 0.3% Swelling 0.06% Bone spicule 0.06%
Chuang et al. 2008 FU: Not reported	1.1%	7.4%						
Contar et al. 2010 FU: Not reported		0.1%	0.4%	1.5%		0.05%	0.1%	Root tip fracture 1.2%
Santamaria et al. 2006 FU: 1 week						5.1%		
Di Dio et al. 2004 FU: 6 months	1.6%		1.5%				1.6%	Trismus up to 10 days 1.6% Swelling or skin discolouring up to 10 days 5.5% Second molar loss of sensitivity 0.5% Gingival retraction 42.6%
Fiqueiredo et al. 2005 FU: Not reported	2.4%							
Haug 2005 FU: Not reported	1 %	12.6%	1.4% (IAN) 0.3% (LN)		0.1%	0.1%	0.6%	Facial/Trigeminal nerve dysfunction 0.1% Trismus 0.6% Retention, aspiration, migration, ingestion 0.1%

Study Follow-up	Infection	Alveolitis/ dry socket	Paresthesia/ anesthesia	Pain	Bleeding	Oroantral communi-cation	TMJ disorder	Other
Huang 2006 FU: 5 years							1.6%	
Jerjes et al. 2006 FU: 2 years			0.7% (IAN) 1 % (LN)					
Queral-Godoy et al. 2006 FU: 6 months			0.5% (LN)					
Queral-Godoy et al. 2005 FU: 6 months			1.1% (IAN)					
Rothamel et al. 2006 FU: Not reported						13%		
Waite et al. 2006 FU: 2 weeks		14.9%		26.4%				

Footnote: IAN = inferior alveolar nerve, LN = lingual nerve

Appendix 2

Study (author, publication year)	Reason for exclusion
Baqain et al., 2008	Case series, < 300 patients
Chaparro-Avendaño et al., 2005	Case series, < 300 patients
Costantinides et al., 2009	Case series, < 300 patients
Figueiredo et al., 2007	Wrong comparison, all patients have their third molars extracted, < 300 patients
Huang, 2008	Mix of asymptomatic and symptomatic teeth in both the intervention group and the control group. Not possible to distinguish relevant results.
Juhl, 2009	Not clear if control group and intervention group are truly comparable
Kim et al., 2006	Case series, < 300 patients
Krausz, 2005	Wrong comparison, asymptomatic teeth vs symptomatic teeth
Kunkel et al., 2007	Case series, < 300 patients
Leung et al., 2009	Wrong comparison, coronectomy vs excision, < 300 patients
Renton et al., 2005	Wrong comparison, coronectomy vs extraction, < 300 patients
Sato et al., 2009	Case series, < 300 patients
Sortino et al., 2008	Wrong comparison, piezoelectric vs rotatory osteotomy technique, < 300 patients
Tay et al., 2004	Case series, < 300 patients
Yuasa et al., 2004	Case series, < 300 patients

Appendix 3: Search strategy, study selection and references

Question(s) at issue:

Does removal of third molar teeth reduce the risk of infections and other local disease/pathological conditions in subjects with asymptomatic or symptomatic impacted third molars compared with no intervention?

PICO

P1: Healthy individuals of all ages with totally or partially impacted wisdom teeth without symptoms

P2: Healthy individuals of all ages with totally or partially impacted wisdom teeth with any kind of symptom or condition (i.e. pain, pus, swelling, increased laboratory parameters, trismus, dysphagia, pericoronitis, crowding, or cysts)

I: Extraction of third molar tooth

C: No extraction or any other treatment of third molar tooth

O: Primary outcome variable: Infection
Secondary outcome variables: Root resorption, crowding, caries on adjacent tooth, loss of adjacent tooth, complications related to the surgical procedure.

Search strategy:

PubMed 2009-10-26
tooth extraction OR tooth extractions OR extraction OR extractions OR surgical extraction OR surgical extractions OR third molar surgery OR third molar surgical extraction OR third molar extraction OR removal OR remove
AND
third molar OR third molars OR wisdom tooth OR wisdom teeth
NOT
Editorial[ptyp] OR Letter[ptyp] OR Comment[ptyp]

Limits: Publication Date from 2003/05/01 to 2009/10/26, English, Danish, Norwegian, Swedish

1032 results

Cochrane 2009-10-26
tooth extraction OR tooth extractions OR extraction OR extractions OR surgical extraction OR surgical extractions OR third molar surgery OR third molar surgical extraction OR third molar extraction OR removal OR remove (In: title, abstract, keywords)
AND
third molar OR third molars OR wisdom tooth OR wisdom teeth (In: title, abstract, keywords)
Limits: 2003 to 2009

341 results

Cochrane reviews	14
Other reviews	4
Clinical Trials	320
Economic evaluations	2
Technology assessments	1

CRD 2009-10-26
third molar OR third molars OR wisdom tooth OR wisdom teeth In: All these words

43 results

DARE	34
NHS EED	5
HTA	4

Cinahl (EBSCO) 2009-11-12
tooth extraction OR tooth extractions OR extraction OR extractions OR surgical extraction OR surgical extractions OR third molar surgery OR third molar surgical extraction OR third molar extraction OR removal OR remove
AND
third molar OR third molars OR wisdom tooth OR wisdom teeth
Limits: Publication Date from 2003 to 2009, English, Danish, Norwegian, Swedish
Exclude Medline records

58 results

EMBASE (OvidSP) 2009-11-12
tooth extraction or tooth extractions or extraction or extractions or surgical extraction or surgical extractions or third molar surgery or third molar surgical extraction or third molar extraction or removal or remove .af or tooth extraction/
AND
third molar or third molars or wisdom tooth or wisdom teeth.af or molar tooth/
Limits: Publication Date from 2003 to 2009/11/12, English, Danish, Norwegian, Swedish, Human

593 results

Other HTA-databases 2009-10-26
Searches have also been made in the national HTA-databases in the Scandinavian countries; The Swedish Council on Health Technology Assessment (SBU), Norwegian Knowledge Centre for the Health Services (NOKC), Danish Centre for Health Technology Assessment (DACEHTA) and the SBU's comments of foreign research reviews (SBU's comments) Nothing new was identified.

NIHR Health Technology Assessment programme 2009-10-26
Nothing new was identified.

Reference lists:
A comprehensive review of reference lists brought no new references.

Eligibility criteria

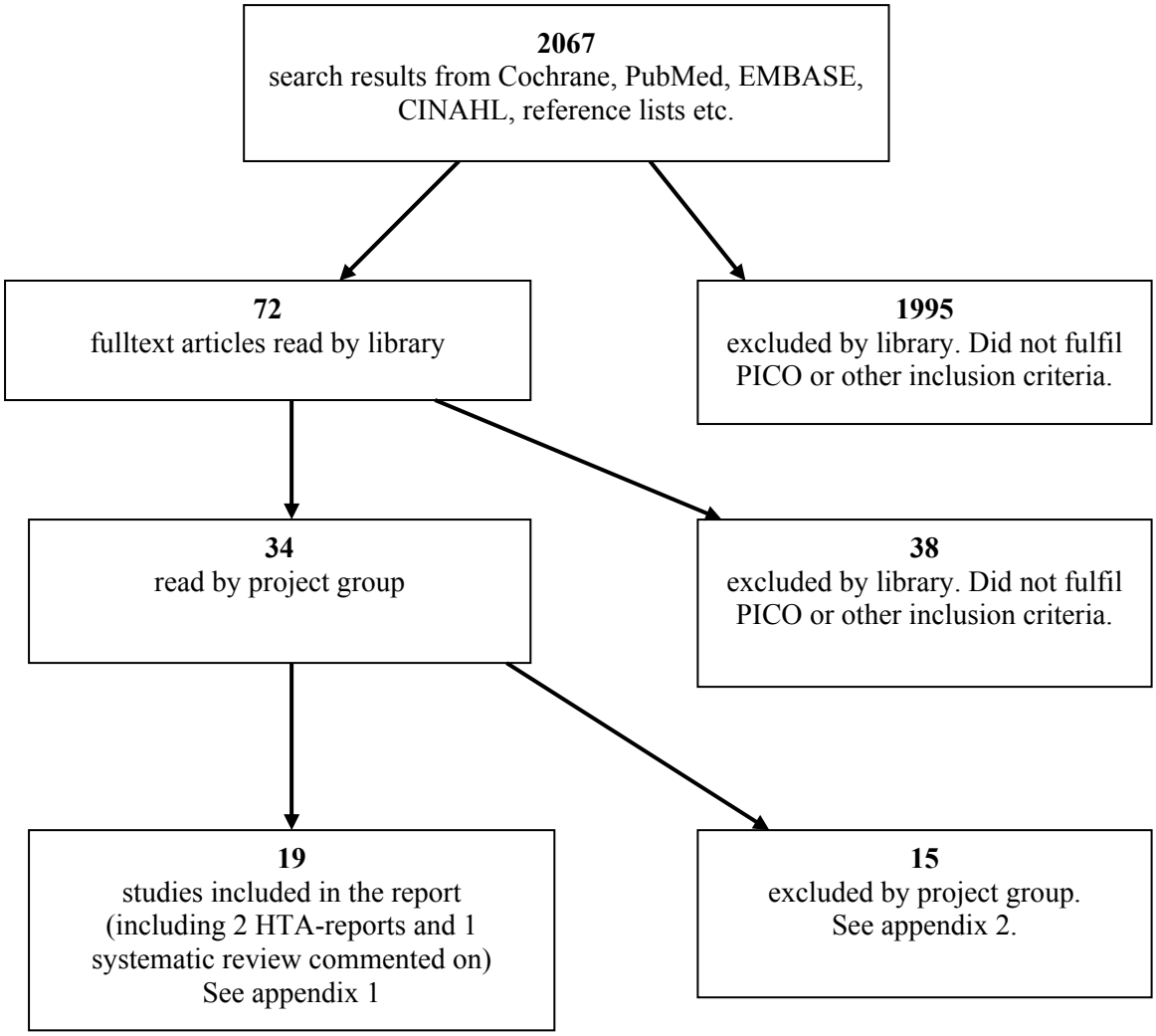
Study design:
- Studies with some kind of control group
- Case series etc. if ≥ 300 patients (for reporting complications/adverse effects)
- No case reports or review articles

Language: English, Danish, Norwegian, Swedish

Publication date: May 2003-

Comment: Since this assessment is based on a Norwegian HTA-report, (SMM-rapport), published 2003, the search was done for all studies published after May 2003.

Selection process – flow diagram



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