**KATHOLIEKE UNIVERSITEIT LEUVEN**

**FACULTEIT GENEESKUNDE  
DEPT. MONDGEZONDHEIDSWETENSCHAPPEN**

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**Welke wijsheidstanden worden op MKA geweigerd ter verwijdering?**

**Which wisdom teeth are contraindicated for removal according to the oral and maxillofacial department?**

Afdeling Mond-, kaak- en aangezichtschirurgie Masterproef ingediend

Prof. Dr. Constantinus Politis tot het behalen van het

Diploma van Master

in de Tandheelkunde door

**Lieselotte DE BRUYN**

**Academiejaar 2017 – 2018**

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*De auteur en de promotor(en) geven de toelating deze scriptie voor consultatie beschikbaar te stellen en delen ervan te kopiëren voor persoonlijk gebruik. Elk ander gebruik valt onder de beperkingen van het auteursrecht, in het bijzonder met betrekking tot de verplichting uitdrukkelijk de bron te vermelden bij het aanhalen van de resultaten uit deze scriptie. De auteurs en de promotor(en) behouden zich het recht delen van deze scriptie aan te wenden voor wetenschappelijke publicaties.*

Opgesteld op 23 april 2018

Lieselotte De Bruyn Prof. Dr. Constantinus Politis

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**Abstract**

**Purpose:** This project’s primary goal was to identify contraindications associated with adverse outcomes after third molar (M3) surgery.   
**Patients and Methods:** This was a retrospective cohort study of 1682 patients (818 male and 864 female, mean age 30,86 ± 15,57 standard deviation, age range 12-87) who came to the Oral and Maxillofacial Department of the University Hospitals of the Catholic University of Leuven for advice on wisdom teeth removal, between January and December 2016. Based on the very limited current literature and the experience in the Oral and Maxillofacial Department a list of 8 possible contraindications for wisdom teeth removal was assembled. These included: 1) possible damage to adjacent structures, 2) compromised health status, 3) adequate space for eruption, 4) abutment tooth, 5) orthodontic reasons, 6) eruption into proper occlusion, 7) symptomless third molars in patients over 30 years of age and 8) unwillingness of the patient. We took contraindications into account individually for each molar. Combinations of multiple contraindications were also possible. The contraindications were determined by comparing the panoramic radiographs and the clinical data from consultation letters and operative reports. The prevalence of the contraindications for wisdom teeth removal was determined for each age group.  
**Results**: In 1134 patients (67,42%) all the remaining wisdom teeth were removed. These patients were excluded from further analysis. We found that 548 patients (32,58%) had 1149 wisdom teeth with one or more contra-indication for removal. The mean age of this patient group was 37,65 ± 16,22 SD and the age range was 13-86. A total of 1271 contraindications was recorded for these third molars. In 1050 third molars one contraindication for removal was recorded, in 76 two, in 21 three and in 2 third molars four.  
There were 209 patients (38,14%) in the group with contraindications younger than 30 years old. The age group of 30-49 years consisted of 212 patients (38,69%) and the age group of 50-70 years consisted of 101 patients (18,43%). We found 26 patients (4,74%) aged more than 70 with contraindications for third molar removal.   
Overall we found that eruption into proper occlusion was the most frequent contraindication (31,86%), followed by unwillingness of the patient (31,47%) and symptomless third molars in patients over 30 years of age (17,55%). In patients younger than 30 years we found that the most common contraindication for removal of the wisdom teeth was unwillingness of the patient. In patients aged 30-49 years eruption into proper occlusion and erupted, disease-free, symptomless third molars were the most frequent contraindications. In patients aged 50-70 years and patients older than 70 years eruption into proper occlusion was again the most frequent contraindication.  **Conclusions**: We found that eruption into proper occlusion was the most prevalent contraindication for third molar removal, followed by unwillingness of the patient and symptomless third molars in patients over 30 years of age*.*

**Introduction**

Wisdom teeth, or third molars, normally erupt between the ages of 17 and 26 years. [1] These are the last teeth to erupt, and they generally erupt into a position closely behind the second molars. Space for these teeth to erupt can be restricted and wisdom teeth often fail to erupt or erupt only partially. In most cases, this occurs when second molars are interfering with the path of eruption of third molar teeth and act as a physical obstruction, preventing complete eruption.   
A partially erupted tooth failed to erupt fully into a normal position and is only partially covered by soft tissue, which causes a communication with the oral cavity. The wisdom tooth is completely impacted if it is not visible and remains entirely covered by soft tissue and partially or completely covered by bone.   
Third molar extraction is one of the most common procedures performed in oral and maxillofacial surgery. The overall complication rate is low and most complications are mild, but wisdom teeth removal is so common that the morbidity of complications can be significant. Efforts to limit intraoperative or postoperative complications may have a great impact in terms of enhancing patient outcome. [2]   
General agreement exists that removal of wisdom teeth is indicated if signs or symptoms of disease related to the wisdom teeth are present. Wisdom teeth can cause pericoronitis, damage to the roots of second molars, decay in adjacent teeth, gum and bone disease around second molars and development of cysts or tumours. [1] Less agreement exists about the contraindications for removal of wisdom teeth. Ventä I stated that there are only two contraindications for removal: 1) an unerupted, disease-free, symptomless third molar totally covered with bone and 2) when removal constitutes an unreasonable risk to the general or local health of the patient). [14]   
In the absence of clear evidence or consensus statements about what conditions should be included as contraindications, this project’s primary goal was to identify contraindications for wisdom teeth removal associated with adverse outcomes. The risks of third molar removal are well documented. [3] [4] Severe complications include inferior alveolar nerve injury, postoperative infection, excessive bleeding, periodontal defects, oroantral communication and fracture of the maxillary tuberosity or mandible. [5]   
Commonly cited risk factors for complications arising from M3 extraction include age, anatomic position and medical history. [6] [7] [8] Age is frequently named as a risk factor for postextraction complications. This correlation may be associated with increased bone density, which results in more manipulation during surgery. [9] Above changes in bone density, increased age is also associated with impaired wound healing capacities and complete root formation of the third molars, which can result in higher operative and inflammatory complications. [2] Increased incidence of root fracture, alveolitis, and inferior alveolar nerve damage has been reported in previous studies. [10] Completely bony impacted lower third molars that are well below the cervical margin of the second molar crowns should be considered for retention after 30 years of age.   
Removal of lower third molars with dilacerated roots that extend below the inferior alveolar canal or into the cortical bone at the inferior mandibular border predicts inferior alveolar nerve damage and/or jaw fracture. Damaging second molars (fracture of adjacent crowns/roots) or displacement of adjacent teeth is at times avoidable by choosing nonsurgical treatment. Careful patient selection and adherence to indications and contra-indications for third molar removal reduce the more serious complications. [11]   
A positive medical history is associated with an augmented risk of the operative complications. [2] Multiple studies documented an association between compromised medical status and postoperative complications. [12] [13]

**Patients and Methods**

**Patients**

The study was approved by the Ethical Committee of the University Hospitals of the Catholic University of Leuven (mp18376), was registered in the Institutional Clinical Trials database, and was carried out according to the ICH-GCP (International Conference on Harmonization Guidelines on Good Clinical Practice) principles and Helsinki guidelines. The study took place in 2017.  
A total of 1682 patients (818 male and 864 female) who came to the Oral and Maxillofacial Department of the University Hospitals of the Catholic University of Leuven for advice on wisdom teeth removal, between January and December 2016, were recruited for this retrospective cohort study. Medical history, consultation letter, panoramic radiograph and operative report were obtained for every patient. The age and sex of each patient were also recorded.   
The number of wisdom teeth surgically removed per patient was then calculated. In 1134 patients all the remaining wisdom teeth were removed. These patients were excluded from further analysis.  
We found that 548 patients (285 male and 263 female) had one or more wisdom teeth with contra-indications for removal.

**Methods**

Based on the very limited current literature [14] and the experience in the Oral and Maxillofacial Department a list of 8 possible contraindications for wisdom teeth removal was assembled (Table 1). All the remaining wisdom teeth were given a number from 1 to 8 based on the possible contraindications for removal. These contraindications included: 1) possible damage to adjacent structures, 2) compromised health status, 3) adequate space for eruption, 4) abutment tooth, 5) orthodontic reasons, 6) eruption into proper occlusion, 7) symptomless third molars in patients over 30 years of age and 8) unwillingness of the patient.  
When wisdom teeth were given a number 1,2,7 of 8 we added a subcategory (A,B,C,D or E).   
Possible damage to adjacent structures was subdivided into: A) close relationship with the inferior alveolar nerve, B) risk for mandibular fracture, C) risk of damaging adjacent teeth and D) deeply impacted maxillary third molars in close relation with vital structures. Compromised health status was divided into: A) bleeding disorders, B) Bisphosphonates or denosumab therapy, C) Chemotherapy and immunocompromised patients, D) pregnancy and E) other sever health problems. Symptomless third molars in patients over 30 years of ages were contraindicated for removal: A) when erupted and disease-free and B) when unerupted, disease-free and totally covered with bone or soft tissue. Unwillingness of the patient was subdivided into: A) patient refusal of recommended wisdom tooth removal, B) cancellation/ no show for scheduled surgery/ failure to make an appointment for surgery and C) complications after first part of multiple wisdom teeth removal.  
Combinations of multiple contraindications were also possible. The contraindications were determined by comparing the panoramic radiographs and the clinical data from consultation letters and operative reports.

|  |  |  |
| --- | --- | --- |
| **Table I** – Contraindications for wisdom teeth removal | | |
| **Number** |  | **Contraindication** |
| **1** |  | **Possible damage to adjacent structures when the position of the wisdom tooth is such that the removal adversely influences any adjacent structures.** |
| 1A |  | *Close relationship between mandibular third molars and the inferior alveolar nerve* |
| 1B |  | *Deeply impacted mandibular third molars with risk for mandibular fracture* |
| 1C |  | *Risk of damaging adjacent teeth* |
| 1D |  | *Deeply impacted maxillary third molars in relation with vital structures (vessels, maxillary sinus) and/or risk for tuberosity fracture* |
| **2** |  | **Compromised health status** |
| 2A |  | *Coagulopathy* |
| 2B |  | *A history of bisphosphonates or denosumab therapy* |
| 2C |  | *Chemotherapy/radiotherapy/immunocompromised patients* |
| 2D |  | *Pregnancy* |
| 2E |  | *Other severe health problems* |
| **3** |  | **Adequate space for eruption of the wisdom tooth.** |
| **4** |  | **Abutment tooth** |
| **5** |  | **Orthodontic reasons – i.e. when first or second molars/premolars have been extracted.** |
| **6** |  | **Wisdom tooth erupted into proper occlusion** |
| **7** |  | **> 30 years of age and symptomless wisdom tooth** |
| 7A |  | *An erupted, disease-free, symptomless third molar* |
| 7B |  | *An unerupted, disease-free, symptomless third molar totally covered with bone or soft tissue* |
| **8** |  | **An unwilling patient should have his/her wishes respected.** |
| 8A |  | *Patient refusal of recommended wisdom tooth removal* |
| 8B |  | *Cancellation/ no show for scheduled surgery/ failure to make an appointment for surgery* |
| 8C |  | *Complications after first part of multiple wisdom teeth removal* |

**Results**

The mean age of the original patient group of 1682 patients was 30,86 ± 15,57 standard deviation (SD). There were 818 male and 864 female patients with age range 12-87.   
In 1134 patients (67,42%) all the remaining wisdom teeth were removed. In this patient group the mean age was 27,58 ± 14,13 SD (age range 12-87). The group consisted of 533 male and 601 female patients. These patients were excluded from further analysis.  
We found that 548 patients (32,58%) had one or more wisdom teeth with contraindications for removal.The results of this study were based on the data from these 285 male and 263 female patients. The mean age of this patient group was 37,65 ± 16,22 SD. The age range was 13-86.   
There were 209 patients (38,14%) in the group with contraindications younger than 30 years old. The age group of 30-49 years consisted of 212 patients (38,69%) and the age group of 50-70 years consisted of 101 patients (18,43%). We found 26 patients (4,74%) aged more than 70 with contraindications for third molar removal (Figure 1 and Table 2).

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| **Table II** – Age groups of patients with contraindications for removal | | |  |
| **Age group (years)** | **No. of patients (%)** | **No. of third molars** | **No. of contraindications** |
| < 30 | 209 (38,14%) | 500 | 544 |
| 30 – 49 | 211 (38,50%) | 435 | 474 |
| 50 – 70 | 105 (19,16%) | 183 | 216 |
| > 70 | 23 (4,20%) | 31 | 37 |

Figure 1: Age groups of patients with contraindications for wisdom teeth removal.

**Combinations of contraindications**

The results were based on 1149 wisdom teeth from 548 patients with one or more contra-indication for removal. A total of 1271 contraindications was recorded for these third molars. We took contraindications into account individually for each molar. In 1050 third molars one contraindication for removal was recorded, in 76 two, in 21 three and in 2 third molars four (Table 3).   
In patients younger than 30 years old 500 third molars had contraindications and 544 contraindications were recorded. In the age group of 30-49 years there were 435 third molars with contraindications and 474 contraindications were recorded. In the age group of 50-70 years we found 183 wisdom teeth with contraindications and 216 contraindications were noted. We found 31 wisdom teeth with contraindications in patients older than 70 and there were 37 contraindications recorded (Table 2).

Frequent combinations:

* 1A and 7B: close relationship with the inferior alveolar nerve and symptomless, impacted, disease-free third molars in patients over 30 years of age
* 1A and 1B: close relationship with the inferior alveolar nerve and risk for mandibular fracture
* 1B and 7B: risk for mandibular fracture and symptomless, impacted, disease-free third molars in patients over 30 years of age
* 1A, 1B and 7B: close relationship with the inferior alveolar nerve, risk for mandibular fracture and impacted, disease-free third molars in patients over 30 years of age
* 3 and 5: adequate space for eruption and orthodontic reasons - i.e. when first or second molars/premolars have been extracted

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| **Table III** – Number of third molars (n=1149) with one, two, three or four contraindications | |
|  | **No. of third molars** |
| One contraindication | 1050 |
| Two contraindications | 76 |
| Three contraindications | 21 |
| Four contraindications | 2 |

**Frequency of different contraindications in the age groups**

We found different frequencies of contraindications in the age groups (table 4). Overall we found that eruption into proper occlusion was the most frequent contraindication (31,86%), followed by unwillingness of the patient (31,47%) and symptomless third molars in patients over 30 years of age (17,55%) (Figure 2 and 3).  
In the youngest age group we found that the most common contraindications to removal of the wisdom teeth were unwillingness of the patient (51,10%), eruption into proper occlusion (22,24%) and adequate space for eruption (8,64%) (Figure 4 and 5).  
In patients aged 30-49 years, eruption into proper occlusion ( 41,14%), symptomless third molars in patients over 30 years of age (27,64%) and unwillingness of the patient (19,62%) were the most frequent contraindications (Figure 6 and 7).  
In patients aged 50-70 years eruption into proper occlusion (33,33%), symptomless third molars in patients over 30 years of age (33,33%) and unwillingness of the patient (12,50%), were the most prevalent contraindications (Figure 8 and 9).  
Among patients older than 70 years, eruption into proper occlusion was the most common contraindication (Figure 10 and 11).

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| **Table IV** – Frequency of contraindications in different age groups | | | | | | |
|  |  | **Total** | **< 30 years** | **30 - 49 years** | **50 - 70 years** | **> 70 years** |
|  |  | n (%) | n (%) | n (%) | n (%) | n (%) |
| **N°** | **Contraindication** |  |  |  |  |  |
| 1 | Possible damage to adjacent structures | 85 (6,96%) | 28 (5,15%) | 31 (6,54%) | 23 (10,65%) | 3 (8,11%) |
| 2 | Compromised health status | 57 (4,48%) | 17 (3,13%) | 17 (3,59%) | 20 (9,26%) | 3 (8,11%) |
| 3 | Adequate space for eruption | 47 (3,70%) | 47 (8,64%) | 0 (0%) | 0 (0%) | 0 (0%) |
| 4 | Abutment tooth | 6 (0,47%) | 0 (0%) | 4 (0,84%) | 2 (0,93%) | 0 (0%) |
| 5 | Orthodontic reasons | 48 (3,78%) | 45 (8,27%) | 3 (0,63%) | 0 (0%) | 0 (0%) |
| 6 | Eruption into proper occlusion | 405 (31,86%) | 121 (22,24%) | 195 (41,14%) | 72 (33,33%) | 17 (45,95%) |
| 7 | > 30 years of age and symptomless | 223 (17,55%) | 8 (1,47%) | 131 (27,64%) | 72 (33,33%) | 12 (32,42%) |
| 8 | Unwillingness of the patient | 400 (31,47%) | 278 (51,10%) | 93 (19,62%) | 27 (12,50%) | 2 (5,41%) |

Figure 2: Frequency of different contraindications in the total patient group.

Figure 3: Frequency of the main contraindications in the total patient group.

Figure 4: Frequency of different contraindications in patients younger than 30 years old.

Figure 5: Frequency of the main contraindications in patients younger than 30 years old.

Figure 6: Frequency of different contraindications in patients aged 30-49 years.

Figure 7: Frequency of the main contraindications in patients aged 30-49 years.

Figure 8: Frequency of different contraindications in patients aged 50-70 years.

Figure 9: Frequency of the main contraindications in patients aged 50-70 years.

Figure 10: Frequency of different contraindications in patients older than 70 years.

Figure 11: Frequency of the main contraindications in patients older than 70 years**.**

**Difference between contraindications for upper and lower wisdom teeth**

There were 536 maxillary wisdom teeth (277 upper right and 259 upper left) and 613 mandibular wisdom teeth with contraindications (299 lower left and 314 lower right).   
The lower right wisdom teeth was the most frequently contraindicated for removal (Table V).

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| **Table V -** Different wisdom teeth |
| **Wisdom tooth** | **No. of molars (%)** |
| 18 | 277 (24,11%) |
| 28 | 259 (22,54%) |
| 38 | 299 (26,02%) |
| 48 | 314 (27,33%) |

We found different frequencies of contraindications in upper and lower wisdom teeth (Table 4).   
In the maxillary third molars, we found that the most common contraindications for removal were unwillingness of the patient (34,09%), eruption into proper occlusion (25,04%) and symptomless third molars in patients over 30 years of age (21,57%) (Figure 12 and 13).   
Eruption into proper occlusion (37,50%), unwillingness of the patient (29,31%) and symptomless third molars in patients over 30 years of age (14,22%) were the most frequent contraindications for removal of mandibular wisdom teeth. (Figure 14 and 15).

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| **Table VI** – Frequency of contraindications in upper and lower wisdom teeth | | | | | |
|  |  | **Total** | **Maxillary wisdom teeth** | **Mandibular wisdom teeh** |
|  |  | n (%) | n (%) | n (%) |
| **N°** | **Contraindication** |  |  |  |
| 1 | Possible damage to adjacent structures | 85 (6,96%) | 15 (2,61%) | 70 (10,06%) |
| 2 | Compromised health status | 57 (4,48%) | 28 (4,87%) | 29 (4,17%) |
| 3 | Adequate space for eruption | 47 (3,70%) | 32 (5,57%) | 15 (2,16%) |
| 4 | Abutment tooth | 6 (0,47%) | 1 (0,17%) | 5 (0,72%) |
| 5 | Orthodontic reasons | 48 (3,78%) | 35 (6,09%) | 13 (1,87%) |
| 6 | Eruption into proper occlusion | 405 (31,86%) | 144 (25,04%) | 261 (37,50%) |
| 7 | > 30 years of age and symptomless | 223 (17,55%) | 124 (21,57%) | 99 (14,22%) |
| 8 | Unwillingness of the patient | 400 (31,47%) | 196 (34,09%) | 204 (29,31%) |

Figure 12: Frequency of different contraindications in maxillary third molars.

Figure 13: Frequency of the main contraindications in maxillary third molars.

Figure 14: Frequency of different contraindications in mandibular third molars.

Figure 15: Frequency of the main contraindications in mandibular third molars.

**Discussion**

In the absence of clear evidence or consensus statements about what conditions should be included as contraindications for wisdom teeth removal, this project’s primary goal was to identify contraindications associated with adverse outcomes after third molar (M3) surgery. Ventä I. stated that there are only two contraindications for removal of wisdom teeth: 1) an impacted, disease-free, symptomless third molar totally covered with bone and 2) when removal constitutes an unacceptable risk to the local or general health of the patient. [14]   
Other contraindications for extraction of wisdom tooth used by dentists and oral and maxillofacial surgeons include normal eruption and function in dentition, deep impaction with risk of mandibular fracture, potential disruption of the integrity of neighbouring structures (such as important vessels and the inferior alveolar nerve) and the age of the patient.  
Based on the very limited current literature [14] and the experience in the Oral and Maxillofacial Department a list of 8 possible contraindications for wisdom teeth removal was assembled for this study. These contraindications included: possible damage to adjacent structures, compromised health status, adequate space for eruption, abutment tooth, orthodontic reasons, eruption into proper occlusion, symptomless third molars in patients over 30 years of age and unwillingness of the patient.  
Possible damage to adjacent structures was subdivided into: A) close relationship with the inferior alveolar nerve, B) risk for mandibular fracture, C) risk of damaging adjacent teeth and D) deeply impacted maxillary third molars in close relation with vital structures. Compromised health status was divided into: A) bleeding disorders, B) Bisphosphonates or denosumab therapy, C) Chemotherapy and immunocompromised patients, D) pregnancy and E) other sever health problems. Symptomless third molars in patients over 30 years of ages were contraindicated for removal: A) when erupted and disease-free and B) when unerupted, disease-free and totally covered with bone or soft tissue. Unwillingness of the patient was subdivided into: A) patient refusal of recommended wisdom tooth removal, B) cancellation/ no show for scheduled surgery/ failure to make an appointment for surgery and C) complications after first part of multiple wisdom teeth removal.  
Combinations of multiple contraindications were also possible.  
We found different frequencies of contraindications in the age groups. Overall we found that eruption into proper occlusion was the most frequent contraindication, followed by unwillingness of the patient and symptomless third molars in patients over 30 years of age. In the youngest age group we found that the most common contraindications to removal of the wisdom teeth were unwillingness of the patient, eruption into proper occlusion and adequate space for eruption. In patients aged 30-49 years, eruption into proper occlusion, symptomless third molars in patients over 30 years of age and unwillingness of the patient were the most frequent contraindications. In patients aged 50-70 years eruption into proper occlusion, symptomless third molars in patients over 30 years of age and unwillingness of the patient, were the most prevalent contraindications.  
Among patients older than 70 years, eruption into proper occlusion was the most common contraindication.

**Possible damage to adjacent structures when the position of the wisdom tooth is such that the removal adversely influences any adjacent structures**

If the impacted tooth lies in a position in which its removal can seriously damage the inferior alveolar nerve, jeopardize neighbouring molars or cause a mandibular or maxillary tuberosity fracture, it may be wise not to remove the wisdom tooth. When the surgeon makes the decision not to remove a tooth, the contraindications must be weighed against potential future complications. For younger patients who may endure the sequelae of impacted teeth, it may be better to remove the tooth while taking special precautions to prevent damage to adjacent structures. For the older patient, however, for whom the probability of complications is higher, the impacted tooth should be left in place.

**Close relationship between mandibular third molars and the inferior alveolar nerve**Studies have shown that the inferior alveolar nerve can be damaged in anywhere from 0.5% to 5% of lower third molar removals. [15,16] In many cases this can be predicted preoperatively from panoramic radiographs[17] and cone beam computed tomography [18,19] These radiological investigations show the relationship of the inferior alveolar nerve to the roots of the lower third molars. In patients where the risk of damaging the nerve is believed to be very high, nonremoval of the wisdom tooth may be wise. [20] Lingual nerve injury related to wisdom teeth removal occurs less frequently but appears to be more problematic for patients. [21]   
The incidence of nerve lesions is statistically associated with the age of the patient. [22,23] This is to a certain degree related to the chronology of third molar growth. The roots of the wisdom teeth are generally not fully formed until the age of 21. Surgical removal of third molars in the teenage years is associated with a lower incidence of inferior alveolar nerve injury. The greater regenerative capacity of younger patients is associated with a greater likelihood of recovery from nerve injuries. [24]

**Deeply impacted mandibular third molars with risk for mandibular fracture**The mandible is the most commonly fractured facial bone [27] . This is related to its prominent and exposed location[25]. Fracture of the mandible occurs when the strength of the bone and the forces acting on it do not match. Acting forces leading to mandibular fracture may consist of surgical wisdom tooth elevation. It may occur either as an immediate complication during operation, or as a late complication, usually within the first 4 weeks after operation. The mandibular angle region with an impacted third molar is an area of lowered resistance to external forces. The angle of the mandible forms an area of lowered resistance with a thicker superior border, thin basilar bone and the presence of the impacted mandibular third molar. A high percentage of mandibular fractures are located there. Nevertheless, fracture of the mandible after impacted third molar removal is a rare complication [26] .  
The reason for this severe complication is thought to be multifactorial. Patient age is an important factor in fracture risk . Weakening of the mandible as a result of a reduction in bony elasticity during aging may be the cause of the greater incidence of fractures reported at operation among patients in their fifth decade. At the same time, narrowing of the periodontal ligament increases with age. In comparison to young patients, the impacted tooth must be freed more extensively from the surrounding bone, and the jaw is further weakened. The type of impaction seems to be significant. The deeper the tooth was impacted vertically, the more likely that a fracture can occur. Krimmel and Reinert [26] and Perry and Goldberg [28] found a greater incidence of mandibular fracture with full bony impactions, because a greater volume of bone is necessary for removal. The relative portion of the volume of the mandible occupied by the tooth is also an important factor. This can be assessed on a cone beam computed tomogram (CBCT) in cases of impaction near the lower border of the mandible. [26]   
This knowledge should influence the decision to remove impacted third molars in the elderly patient. Other factors that increase the risk of jaw fracture are: dilacerated and flared roots, dense bone, metabolic bone disease, osteomyelitis, small mandible, third molar occupies the height of the jaw and associated odontogenic disorders. [25] The risk seems greater among men, particularly for those who are older than 25 years. Prophylactic third molar removal before 20 years of age should mitigate nearly all risk of fracture. [27]   
The more risk factors present, the more likely a mandibular angle fracture will occur. [28] When the risk of fracture is high, the indications for removal of a lower third molar should be compelling. Third molars with root tips located in the dense cortical inferior mandibular bone or in the inferior alveolar canal may be best left in place. [11]

**Risk of damaging adjacent teeth**Other complications such as damaging adjacent teeth or restorations and displacing neighbouring teeth have been documented. [21] Damaging second molars (fracture of adjacent crowns/roots) or displacement of adjacent teeth is at times avoidable by choosing nonsurgical treatment. Careful patient selection and adherence to indications and contra-indications for third molar removal reduce the risk of more serious complications. [11]   
The prevention of progression of periodontal disease or the elimination of periodontal disease is frequently used as argument for third removal [29]. Longitudinal prospective cohort studies have shown that removal of M3s for these reasons is justified [30,31] . However, there are situations when removal of M3s can either create or worsen periodontal problems on the distal aspect of the lower second molars . Karapataki et al. [32] showed in a prospective study of 20 patients undergoing third molar surgery with no preoperative periodontal disease on the distal aspect of the second molar, that 43% had a worsening of the periodontal condition postoperatively. This was limited to those patients aged over 25 years .

**Deeply impacted maxillary third molars in relation with vital structures (vessels, maxillary sinus)**During surgical removal of upper wisdom teeth, complications are less common. There are no nerves that can be injured near the extraction site. [33] The upper jaw bone is less dense than the lower jaw and this facilitates extraction . An oroantral communication is the most frequent operative complication during extraction of upper wisdom teeth. Other complications include fracture of the maxillary tuberosity, fracture of the root of the third molar, and partial or complete displacement of the tooth into the maxillary sinus.   
The incidence is of sinus communication is uncertain, because often no attempt is made to identify a communication after third molar surgery and most communications close spontaneously. The incidence is higher in older patients, and more complicated extractions. [21] Oro-antral fistulas are the most common dental cause (56–70%) of maxillary sinusitis. Perforation of the sinus is more likely when a tooth is deeply impacted. Rothamel [33] et al. found that acute sinus communication developed in only 5% of all cases around fully erupted teeth, followed by partially erupted teeth (10%) and completely impacted teeth (24%).This is related to the close relation with the maxillary sinus and the increased difficulty of removal. The perforation rate is higher for teeth with less root development, as well as completely developed teeth with closure of the apical foramen. When considering early and late removal of upper wisdom teeth, the risk of perforating the maxillary sinus is quite high. The close relationship between the tip of the root and the maxillary sinus is a prognostic factor. We can conclude that early and late removal of wisdom teeth, deeper impaction and intraoperative root fractures, are associated with a greater risk of oroantral perforation.   
Fracture of the maxillary tuberosity is a less common complication of removal of maxillary wisdom teeth. [34] The incidence of tuberosity fracture has been reported to be at around 0.6% .Generally, a small fragment of bone is able to be separated from its periosteum and extracted with the third molar. In the case of an extensive bony fragment, tearing the fragment from its periosteum and extraction with the wisdom tooth can result in serious complications. [35] Fragile vessels in the area of the posterior maxilla and tuberosity are easily ruptured when bone is fractured and dissected from its periosteum. This can result in excessive bleeding. The risk for haemorrhage can be better understood by studying the anatomy of the vessels in the region. The arterial blood supply is obtained from the maxillary artery which, after crossing the lateral pterygoid, enters the pterygopalatine fossa. Before the maxillary artery enters the fossa, it gives off branches of the posterior superior alveolar artery that wrap around the tuberosity and descend anteriorly and inferiorly. If the tuberosity fracture travels posteriorly and superiorly into the pterygopalatine fossa, other arteries that might be involved include the branches of the maxillary artery that arise from within the pterygopalatine fossa. The venous supply is derived from branches of the pterygoid venous plexus. The veins are wrapped around the maxillary artery. The vasculature is intimately related with the overlying periosteum. When the extraction site of an upper wisdom tooth is bleeding excessively, it is frequently a branch of the posterior superior alveolar artery that is torn along with the tuberosity [36] .

**Compromised health status**

A positive medical history is associated with an augmented risk of operative complications. [2] Multiple studies documented an association between compromised medical status and postoperative complications. [12] [13] Like extremes of age, a compromised health status contraindicates the removal of impacted wisdom teeth. Commonly, compromised medical status and advancing age go hand-in-hand. If the impacted tooth is symptomless and disease-free, its surgical removal must be regarded as elective. If the patient's cardiovascular or respiratory function or host defences are weakened or if the patient has a serious acquired or congenital coagulopathy, the surgeon must consider leaving the tooth in the alveolar process.

**Coagulopathy**  
Life-threatening haemorrhage is a complication that may occur in medically compromised patients with coagulopathy. [34] If the patient has a serious acquired or congenital coagulopathy, the surgeon must consider leaving the wisdom tooth in the alveolar process. Any oral surgical procedure may lead to haemorrhage, if this bleeding reaches the fascial spaces of the neck, it can obstruct the airway. Upper airway obstruction secondary to excessive bleeding in the floor of the mouth is a rare but potentially life threatening complication of wisdom teeth removal. [38] The normal platelet count has a wide range between 100,000 and 500,000/mm3. Mild thrombocytopenia, or 50,000 –100,000/mm3, may produce abnormal postoperative bleeding. Levels below 50,000/mm3 lead to major postvsurgical bleeding. Spontaneous bleeding of mucous membranes occurs below 20,000 cells/mm3. Such patients often require transfusion before surgery. [37]

**A history of bisphosphonates or denosumab therapy**Oral surgery is an important risk factor for developing medication related osteonecrosis of the jaw (MRONJ). A lot of studies have reported that in patients with MRONJ, tooth extraction is a common precipitating event, with 52 to 61% of patients reporting a history of tooth extraction. [39] Estimates for developing MRONJ after tooth extraction in patients treated with intravenous (IV) bisphosphonates range from 1.6 to 14.8%. Bone exposure during surgery or tooth extraction works as a trigger that opens the door for bacterial invasion. This could explain the close relationship between MRONJ and dentoalveolar surgery. [40] Patients receiving monthly IV bisphosphonates or denosumab for treatment of cancer have an increased risk of developing MRONJ after tooth extraction. Dental extractions should be avoided if possible.   
Maintaining perfect oral hygiene and dental care is extremely important in preventing conditions that may require dentoalveolar surgery. Procedures that cause direct osseous injury should be avoided. Nonrestorable teeth may be treated by removal of the crown and endodontic treatment of the remaining roots. [41,42]

**Chemotherapy/radiotherapy/immunocompromised patients**The ability to assemble an adequate immune response is critical for wound healing. Dentoalveolar surgery is usually contraindicated when the total white blood cell count falls below 1500 –3000 cells/mm. The patient becomes vulnerable to infection and compromised wound healing. In spite of a total white blood cell count within normal range (5000 –10,000 cells/mm3), a largely abnormal neutrophil count, makes the patient unable to fight an immediate antigenic challenge. A normal absolute neutrophil count level lies between 3500 and 7000 cells/mm3. A person with levels between 1000 and 2000 cells/mm3 needs antibiotic coverage. Those with less than 1000 cells/mm3 require immediate medical consultation. [14,38]   
Both ionizing radiation and chemotherapy, needed to eradicate malignant cells, interfere with host defence mechanisms and haematopoiesis. Because patients on such therapy cannot mount an appropriate response to injury after surgery, dental extractions are contraindicated.  
Cytotoxic anticancer drugs induce rapid granulocytopenia, followed by thrombocytopenia. Myelosuppression occurs often from a multiple drug treatment. In addition to bone marrow toxicity and immunosuppression, anticancer agents cause mucositis and skin reactions. This may lead to infection and haemorrhage. Active use of such medications is a contraindication for wisdom teeth removal. [37]

**Pregnancy**Oral surgery such as tooth extractions should usually only be done in the second trimester of pregnancy. Organogenesis is completed by the end of the first trimester, and uterine size has not increased to the extent that lying in the same position for a prolonged time is uncomfortable. Furthermore, nausea has usually ended by the end of the first trimester. Extensive elective procedures should be postponed until after delivery. [43] Tooth extraction is a relatively safe procedure during the second trimester of pregnancy.   
However, a pregnant patient with a maxillofacial infection requires special attention due to important changes in physiology including the cardiovascular, respiratory and gastrointestinal systems. The oral cavity changes and the vulnerability to oral infection increases. Oral infections have been associated with adverse pregnancy outcomes such as pre-eclampsia, premature delivery and miscarriage. Extraction of an infected tooth may act as a portal of entry for both bacterial agents and cytokines, leading to fetal distress. This implies that the viability of the fetus is compromised. [44] The mandibular third molar tooth is one of the most common sources of odontogenic infections. These infections can spread into perimandibular spaces. Pregnant patients are usually not immunocompromised, however the maternal immune system does become suppressed in response to the fetus. There is a decrease in cell-mediated immunity and natural killer cell activity. Therefore, bacterial agents can enter the bloodstream and consequently cause intrauterine infection. [44]

**Adequate space for eruption of the wisdom tooth and orthodontic reasons – i.e. when first or second molars/premolars have been extracted.**

Wisdom teeth account for 98% of all impactions and are the most commonly impacted teeth. The mandibular third molar is the most frequently impacted tooth. Morphology of the third molars, mesiodistal width, unsatisfactory uprighting and path of eruption have been associated with third molar impaction. In growing patients undergoing orthodontic treatment, the position of third molars and the retromolar space alter. [45] The most important reason for third molar impaction is believed to be a lack of retromolar space. [46] The retromolar space depends in the maxilla on the development of the maxillary tuberosity, alveolar growth and the mesial drift of the upper first molars. In the mandibula, the retromolar space depends on the resorption at the anterior border of the mandibular ramus and the direction in which the teeth erupt .  
Orthodontic treatment involving extraction therapy makes the chance of third molar eruption higher. Mutiple studies concluded that most lower and upper third molars erupted successfully after the surgical removal of second molars. The less developed the third molar is at the time of second molar removal, the higher the chances are for its eruption. [47] Several authors have shown that orthodontic treatment carried out with premolar extractions has a positive effect on the development, eruption space and vertical position of third molars. The eruption space for the third molar increases due to mesial movement of the first and second molars during space closure.   
In both the maxilla and mandibula, the increase in retromolar space is significantly higher in patients treated with premolar extractions compared to patients treated without premolar extractions. At the end of the orthodontic treatment with premolar extractions, significantly less third molars were situated under the cementoenamel junction of the second molar. [45]

**> 30 years of age and symptomless wisdom tooth**

The most common contraindication for the removal of impacted teeth is advanced age. Generally, the difficulty of removal of third molars increases with age. Several studies indicate that as one becomes older, third molars become more difficult to remove, may take longer to remove and may result in an increased risk for complications. Recovery from complications is more prolonged and is less complete with increasing age. There are different reasons for this, including continued root development and the fact that the periodontal ligament becomes thinner with age and may even lead to ankylosis of the tooth. As a patient ages, the bone becomes densely calcified and therefore less flexible and less likely to bend under the forces of tooth extraction. The result is that more bone must be surgically removed to remove the impacted wisdom tooth. In patients older than 30 with an impacted wisdom tooth that shows no signs of disease and that is fully covered with bone or soft tissue, the tooth should not be removed.   
Chiapasco[48] et al. showed, in a prospective cohort study of 868 patients, that the complication rate was 3 times greater in patients aged over 25 years than in those aged under 25 years. Chuang et al. [49] showed that over the age of 26 years, there may be a 1.5 times likelihood of complications after third molar removal than in patients aged under 25 years.   
Mandibular fracture after removal of lower third molars and tuberosity fracture after removal of upper M3s is a rare but important complication in older patients. The incidence may be higher with increasing age because of factors already mentioned. In the case of the maxillary third molars, it may also be because adjacent teeth have already been removed and the third molar is the only tooth associated with the tuberosity. [50]   
A number of studies have shown that for older patients the periodontal condition on the distal aspect of the second molar may not recover after third molar removal. In some older patients, postoperative periodontal problems can be created after third molar removal when they did not exist preoperatively. [32,51]   
As the age of patients increases, extractions are more likely to be difficult and involve more bone removal, which will lead to an increase in nerve injury. [22] Increasing age was one of the statistically significant factors related to increased risk of damaging the inferior alveolar nerve (along with degree of root development, degree of impaction, and radiographic appearance of the relationship of the roots to the nerve) . [52]   
Sinus complications only occur with maxillary third molars, and Rothamel et al. [33,53] showed that tuberosity fracture is less frequent in younger patients, presumably because the bone is less sclerotic and the third molar is less likely to be an isolated tooth. Additionally, oroantral perforation is more likely to occur and more likely to result in chronic sinus problems in older patients. [49,50]

**Conclusion**

Third molar removal is one of the most common procedures performed in oral and maxillofacial surgery. The overall complication rate is low and most complications are mild, but wisdom teeth removal is so common that the morbidity of complications can be significant. Efforts to limit complications may have a great impact in terms of enhancing patient outcome. In the absence of clear evidence or consensus statements about what conditions should be included as contraindications, this project’s primary goal was to identify contraindications for wisdom teeth removal associated with adverse outcomes. Overall we found that eruption into proper occlusion was the most frequent contraindication, followed by unwillingness of the patient and symptomless third molars in patients over 30 years of age. Due to the retrospective character of the study, these findings should be carefully considered. Further prospective research is necessary for better insights into this topic.

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