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## Indications of the extraction of symptomatic impacted third molars. A systematic review

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### Abstract

**Background:** A literature review was made to determine when third molar (3M) extraction is recommended in symptomatic patients and when it is not recommended.

**Material and Methods:** A Medline (PubMed) and EMBASE search was made for articles related to indications for the extraction of 3Ms, published in the last 10 years and up until September 2018.

**Results:** The electronic search yielded 175 articles. After eliminating duplicates, a total of 173 articles were subjected to review of the title and abstract. Only 19 studies were finally included in the systematic review. There was a well documented increase in morbidity associated to impacted 3Ms (non-restorable caries, fracture, infection, periodontal disease, repeated pericoronitis, cysts and tumors), and in the presence of disease, extraction was considered to be indicated. The extraction of 3Ms with signs and/or symptoms of periodontal disease improved periodontal health at the distal surface of the second molar. Postoperative quality of life of patients with symptomatic 3Ms and with disease improved after surgical extraction.

**Conclusions:** Extraction is indicated in the presence of disease associated to an impacted 3M, whether symptomatic or not. In contrast, extraction is not indicated in the absence of infection or other associated disease conditions.

**Key words:** Third molar, periodontal disease, periodontitis, pericoronitis, dental caries, occlusal caries, mandibular cysts, osteomyelitis, odontogenic tumor.

## Introduction

One of the most important scenarios in dental practice, and particularly in oral surgery, is the presence of diseases and/or complications associated to wisdom teeth or third molars (3Ms), derived from eruption disorders that adversely affect the periodontal health of the neighboring teeth (1,2). Indeed, third molar extraction is the most frequent type of surgery performed by dental surgeons (3). Extraction and the indication of extraction must be based on scientific evidence allowing us to make solid decisions for the benefit of our patients (4). However, there is controversy regarding the prophylactic removal of asymptomatic impacted 3Ms without associated disease (5,6). In this context, it must be taken into account that “asymptomatic” does not discard the possible existence of disease (3,7).

An increasingly relevant concept in prophylaxis is being able to distinguish between patients with no molar symptoms but with associated disease and those with molar symptoms but no associated disease. In the presence of signs or symptoms produced by a 3M (pain, infection, local and/or regional swelling, etc.), patients tend to visit in search of the best possible treatment, which in most cases will consist of surgical or nonsurgical extraction, conditioned to cost-benefit criteria.

However, in many cases there are no such signs or symptoms, despite the presence of disease associated to the position of the third molar (periodontal pockets at the distal surface of the adjacent second molar, impacted molar follicle enlargement, cysts, root reabsorption, etc.) (8-11).

Thus, prophylactic extraction (i.e., removal of the tooth in the absence of symptoms and without disease) must be decided based on a number of prior considerations, of which two are particularly important: (a) What are the chances that the impacted 3M will cause disease at some point in the life of the patient? (b) What morbidity can be expected from removing the molar in a young patient under 25 years of age? This latter issue is clearly pertinent, considering the increasing life expectancy of the population (6).

The present literature review was made to determine those cases in which 3M extraction is recommended in symptomatic patients and in which cases it is not recommended.

In addition, we aimed to establish the indication for the removal of asymptomatic impacted 3Ms with or without associated disease, and to determine which patients with associated disease are likely to have a better outcome in terms of the appearance of complications.

## Material and Methods

The literature review was carried out based on the PRISMA criteria (12), and our search strategy was guided by the following modified PICO (Population, Intervention,

Comparison, Outcome) question (13): What are the indications for extracting third molars that are impacted, produce symptoms or present associated disease?

-Electronic search

A Medline (PubMed) and EMBASE search was made for articles related to indications for the extraction of 3Ms, published in the last 10 years and up until September 2018. We used MeSH (Medical Subject Headings) terms as well as non-MeSH or Free-Text terms, combined with the boolean operators OR / AND as follows:

-MEDLINE (PUBMED):

(((((“Molar, Third”[Mesh] OR wisdom teeth OR wisdom tooth OR third molar OR third molars) AND (“Tooth Extraction”[Mesh] OR removal OR nonextraction OR management))) AND ((symptomatic OR second molar OR periodontal health OR periodontal status OR probing depth OR periodontal pocket OR “Pericoronitis”[-Mesh] OR pericoronitis OR impacted OR included OR occlusal caries OR cervical caries OR odontogenic cyst OR “Jaw Cysts”[Mesh]) OR “Osteomyelitis”[Mesh])) AND (indication OR indications)

-EMBASE:

((('molar tooth'/exp OR 'molar tooth' OR wisdom) AND ('tooth'/exp OR tooth) OR wisdom) AND ('teeth'/exp OR teeth)) AND (((('tooth extraction' OR tooth) AND removal OR tooth) AND (non AND extraction OR management)) AND (((((((impacted AND third AND molar OR symptomatic) AND third AND molar OR second) AND molar OR 'periodontal disease' OR periodontal) AND health OR periodontal) AND status OR 'probing depth' OR 'periodontal pocket' OR periodontal) AND pocket OR 'gingiva disease' OR pericoronitis OR occlusal) AND caries OR cervical) AND caries OR 'odontogenic tumor' OR 'jaw cyst' OR jaw) AND cyst OR 'osteomyelitis')

-Inclusion criteria:

- Randomized clinical trials (RCTs) or non-randomized trials, observational cohort studies, case-control studies and case series (at least 10 cases) involving a cross-sectional design.

- Evaluation of the prophylactic extraction of impacted or non-impacted symptomatic third molars with associated disease.

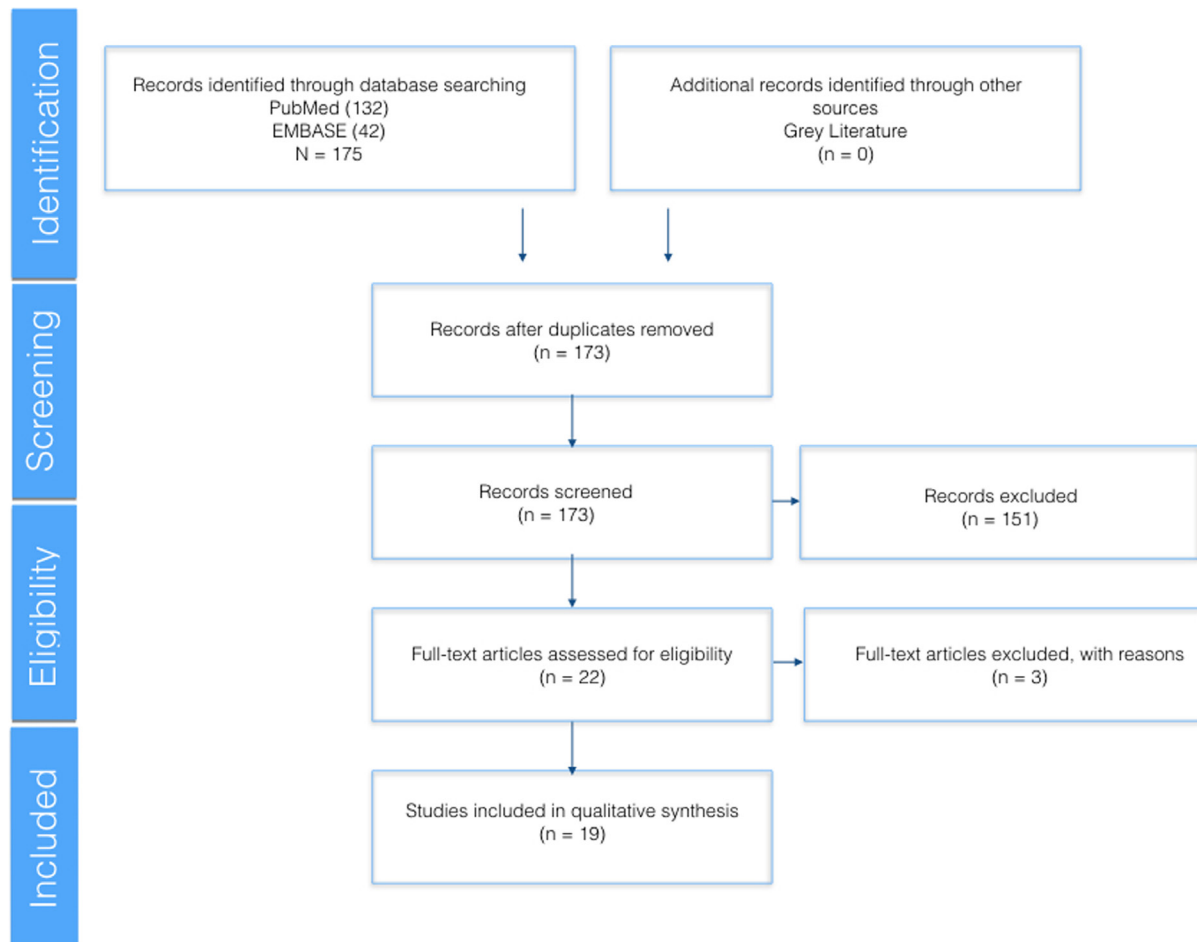
-Exclusion criteria:

- Publications in languages other than English, French or Spanish.

- Preclinical / *in vitro* studies, finite element studies or necropsy studies.

## Results

The Medline (PubMed) and EMBASE search yielded 175 articles. After eliminating duplicates, a total of 173 articles were subjected to review of the title and abstract. Only 19 studies were finally included in the systematic review (Fig. 1).



**Fig. 1:** Flow chart of the selection of articles according to the PRISMA criteria (12).

The main indication for the extraction of the 3Ms was the presence of associated disease (14-17). The existing evidence for extracting or not extracting asymptomatic 3Ms without disease was found to be inconclusive (6); monitoring was thus advised (17), with due assessment of the risk-benefit ratio (18,19).

The scientific evidence therefore suggests that erupted and impacted 3Ms should be removed in the presence of painful symptoms associated to infection, dental caries or altered periodontal health of the adjacent teeth. Likewise, removal is considered to be indicated when the molar may pose problems for planned prosthodontic, orthodontic or surgical treatments.

In view of the well documented increase in morbidity associated to impacted 3Ms (non-restorable caries, fracture, infection, periodontal disease, repeated pericoronitis, cysts and tumors), extraction is considered to be indicated if associated disease is present. In contrast, prophylactic removal is not indicated in the absence of infection or other associated diseases.

-Extraction of third molars with pericoronitis

Pericoronitis is one of the associated disease conditions in which 3M extraction is considered to be indicated. It

is characterized by inflammation of the mucosa surrounding the crown of the molar, with pain and sometimes erythema, edema and localized suppuration. Patients with pericoronitis can also present regional adenopathies, fever, trismus and swallowing pain, which is common in the case of inferior 3Ms and constitutes an indication for removal of the tooth.

Nevertheless, there is some controversy regarding the extraction of 3Ms with pericoronitis. Some authors advise basing the decision on the evidence afforded by the clinical guides, with the recommendation to limit intervention to the monitoring of those patients with one or two episodes of mild pericoronitis, associated to periodontal therapy and the maintenance of low bacterial plaque levels (20,21).

A study published by Tang *et al.* (22), involving 113 patients with symptoms of pericoronitis, considered that patient opinion should be taken into account in deciding treatment, since 79 patients chose extraction mainly because of altered oral function, with a minimum impact upon quality of life (odds ratio [OR] 3.22; 95% confidence interval [95%CI]: 1.08-9.58).

Apart from 3Ms in a favorable position that have cau-

sed one or two episodes of mild transient pericoronitis which can be controlled by periodontal treatment with the maintenance of a low bacterial plaque levels, the rest of 3Ms causing more severe and repeated infection should be removed (17).

Although the surgical management of pericoronitis is subject to controversy, this disorder is currently the most frequent reason for removing impacted 3Ms, particularly because patients with active pericoronal tissue infection stand to benefit from improved quality of life over the long term – this being a factor to be taken into account when considering possible extraction (21).

-Periodontal condition of the second molar

In some cases, as in the study published by Blakey *et al.* (15), the absence of symptoms of impacted 3Ms does not imply the absence of disease. In a sample of 329 patients, 25% of the second molars (2Ms) and 35% of the 3Ms presented a probing depth (PD) of > 5 mm. In this regard, the observation of signs of periodontal disease in asymptomatic 2Ms and 3Ms constitutes an unexpected finding (15).

These observations suggest that patients who wish to preserve their molars should undergo periodic clinical and radiographic evaluations in order to detect disease before it begins to cause symptoms (6,19).

On the other hand, the factors giving rise to postoperative complications comprise patient-related characteristics, anatomical factors, surgical factors and the type of associated disease (16,17). According to Chuang *et al.* (16), the degree of impaction, pre-existing infection and associated disease of 3Ms are associated to an increased risk of postoperative inflammatory complications. Among individuals with preoperative infection, 25% experienced postoperative inflammatory problems (OR 1.25; 95%CI: 1.01-1.6), while those with associated disease were three times more likely to suffer such postoperative complications (OR 3.0; 95%CI 2.2-4.3) (16).

Dicus-Brookes *et al.* (3) performed periodontal probing of 2Ms before and after the extraction of 3Ms, with the observation of significant differences: while 88% of the patients presented a PD of about 4 mm before extraction, this percentage decreased to only 46% after the operation ( $p < 0.001$ ). Furthermore, 61% presented at least one site with PD > 4 mm in other teeth located anterior to 2M before the operation, versus only 29% after surgery ( $p < 0.001$ ). The removal of 3Ms improved the periodontal condition of the 2Ms and of the teeth in a more anterior position, thanks to the decreased presence of oral pathogens (3).

Another similar study documented patients with PD  $\geq$  5 mm around 3M, with an attachment loss of 2 mm, while other molars presented PD < 4 mm with an attachment loss of 1 mm. The presence of 3Ms in young adults was associated with periodontal disease of other teeth. Extraction of the mandibular 3Ms improved the periodontal condition at the distal surface of 2M (19).

The above observations are consistent with those previously published by Dodson and Richardson in 2007 (23). These authors concluded that following 3M extraction, the periodontal health at the distal surface of 2M should remain constant or improve if the patient previously presented periodontal pockets or attachment loss. However, those individuals without associated disease of their 3Ms (i.e., with a healthy periodontal condition) were seen to be at greater risk of developing periodontal pockets distal to 2M after removal of 3M (23). The prescription of chlorhexidine following the extraction of 3Ms in eruption processes with periodontal disease or other preoperative disorders was associated with a shorter time to recovery (less than two days on average) (14).

-Periodontal disease of the third molars

In the presence of periodontal disease of 3M, the clinician can either extract the molar or provide regular periodontal maintenance. It is not advisable to remove asymptomatic 3Ms without disease. However, extraction is indicated when periodontal pockets are detected, particularly if the patient exhibits deficient oral hygiene or periodontal maintenance is not feasible. All these factors should be evaluated in order to make an individualized management decision (17).

The extraction of 3M with signs and/or symptoms of periodontal disease improves periodontal health at the distal surface of 2M. However, in subjects with healthy periodontal tissue surrounding 2M, the extraction of 3M must be evaluated carefully, since probing depth and the clinical attachment level tend to worsen as a result (29).

-Postoperative morbidity following the extraction of symptomatic third molars

Bradshaw *et al.* (24) evaluated the effect of the extraction of 3M upon the quality of life (QoL) of individuals with symptoms of pericoronitis. They found the proportion of patients with severe pain to decrease from 32% before extraction to 3% after removal of the tooth. On the other hand, the proportion of patients with no pain or only very mild pain was seen to increase from 15% before extraction to 96% in the first days after removal of the tooth. The authors concluded that the extraction of 3Ms had a positive impact upon the quality of life of the patients with mild symptoms of pericoronitis.

The extraction of 3Ms with disease before surgery induces a delay in recovery after extraction, since postoperative morbidity is incremented as a result (12,13). According to Philips *et al.* (13), clinical recovery was delayed in those patients who already presented symptoms before removal and who needed to be seen at least once after extraction for the treatment of postoperative complications. This delay in recovery could be related to microbial colonization of the surgical wound (13).

Patient age and gender, and 3M position below the occlusal plane were significantly associated to prolonged

recovery (13). Age and gender, and surgeon perceived difficulty of extraction were identified as statistically significant predictors of delayed healing. Women and patients who had symptomatic 3Ms before surgical extraction showed slower clinical recovery (13).

Colorado-Bonnin *et al.* (25) evaluated the time needed to recover the quality of life of patients subjected to the surgical extraction of the 3Ms. They found men to report less pain than women, though the gender difference failed to reach statistical significance. The surgical removal of lower 3Ms was concluded to have a significant impact upon of the patient during the first three postoperative days. The quality of life of patients with symptomatic 3Ms and disease improved after surgical extraction. In the opinion of Krishnan *et al.* (26), the removal of symptomatic lower 3Ms appears to be the most logical treatment option.

Patients with impacted lower 3Ms are more susceptible to fracture of the mandibular angle as a complication of extraction (27). Older age is associated to an increased risk of mandibular fracture and of other complications secondary to systemic causes that may lead to the contraindication of extraction (28).

Postoperative morbidity associated to prolonged recovery was prospectively evaluated by Phillips *et al.* (30), with the identification of significant predictors such as age, gender, previous symptoms, and surgeon perceived difficulty of extraction (30). In addition, an impacted molar position below the occlusal plane was significantly associated to prolonged recovery, (Table 1, 1 cont., 1 cont.-1).

## Discussion

The present literature review was made to determine when third molar (3M) extraction is recommended in symptomatic patients and when it is not recommended, as well as to establish the indications for the removal of impacted asymptomatic 3Ms with or without disease, and determine which cases of 3Ms with associated disease exhibit a better clinical course in terms of postoperative complications.

A literature search was made to identify those studies most relevant to the objectives of our study. The collected evidence suggests that the main indication of extraction is the presence of associated disease (14-17), though the data are not conclusive in the case of asymptomatic impacted 3Ms without associated disease (6). In such situations monitoring is advised (17), with due assessment of the risk-benefit ratio of surgical removal (18,19).

The extraction of 3Ms with pericoronitis remains subject to controversy, since the decision must be based not only on the existing evidence and surgeon experience but also on the preferences of the patient. In the case of individuals with one or two episodes of mild pericoronitis, the recommendation is to not remove the molar and

to monitor the patient, ensuring good bacterial plaque control (20,21). Impaired oral functions and altered quality of life may be reasons for indicating extraction (22). It should be noted that the absence of associated symptoms in patients with impacted 3Ms does not necessarily imply the absence of disease (15). In this regard, patients who are reluctant to accept the removal of an asymptomatic molar should undergo periodic clinical and radiological controls (6,19). Other local and demographic factors such as the level of impaction, pre-existing disease and the relationship of the molar with the occlusal plane also must be taken into account (16,17). The periodontal health of the 2M adjacent to an impacted 3M may be altered, due to the presence of periodontal pockets (3). The evidence compiled by the present review is not intended to modify the treatment recommendations but to widen our perspective of the management of impacted 3Ms as one of the most frequent situations found in routine clinical practice. The main limitation of our study is that no recommendations were made based on the methodological quality of the studies. It was not our intention to establish such recommendations, since there were many confounding factors that precluded the drawing of firm conclusions, due to the heterogeneity of the studies included in the review.

In many cases no clear and firm evidence could be obtained; indeed, the collected data were largely imprecise – thus underscoring the need for further research in this field, on a more standardized basis and involving models of greater scientific quality.

Additional longitudinal studies are needed, exploring the evolution of periodontal disease in patients with mild pericoronitis subjected to conservative periodontal treatment without 3M extraction, compared with patients in which 3M is removed. This would help to improve our understanding of the general periodontal health impact of either 3M removal or more conservative management in the form of adequate patient monitoring. Lastly, studies are needed to analyze postoperative morbidity according to the different types of disease associated to 3M before surgical removal.

## Conclusions

Since there is a well documented increase in morbidity associated to impacted 3Ms (non-restorable caries, fracture, infection, periodontal disease, repeated pericoronitis, cysts and tumors), extraction is considered indicated in the presence of disease of the impacted molar. However, in the absence of infection or other associated disease conditions, extraction is not indicated. The extraction of 3Ms with preoperative disease results in delayed recovery after removal, since postoperative morbidity is incremented as a result.

**Table 1:** Descriptive summary of the studies included in the review.

Author/year	Type of study	Objectives	Results	Conclusions
Blakey <i>et al.</i> 2002 (15)	Longitudinal clinical trial	Report the prevalence of PD as a clinical measure of the extent of periodontitis associated to asymptomatic 3Ms in the initial examination of a cohort of patients enrolled in a longitudinal clinical trial.	N: 329 * In patients > 25 years, PD was > 5 mm distal to 2Ms or around 3Ms in comparison with patients < 25 years (33% versus 17%; p=0.002). * The distal zones of mandibular 2Ms were more often affected than those of upper 2Ms (25% versus 5%; p=0.0001).	* 25% of the patients with asymptomatic impacted 3Ms present considerable periodontal disease in the region of the molar. The national epidemiological surveys indicate a much lower incidence of periodontitis in the population under 35 years of age.
Phillips <i>et al.</i> 2003 (30)	Prospective clinical trial	Identify the demographic, oral health and surgical risk factors associated to prolonged recovery after 3M extraction using the HRQoL and clinical outcomes.	N: 547 * Age, gender and the position of the occlusal plane of 3Ms was significantly associated with prolonged recovery. * Lifestyle recovery was prolonged only if the lower 3Ms were below the occlusal plane before surgery. * Statistically significant predictors of late clinical recovery: age, gender, previous symptoms and surgeon perceived difficulty.	* Demographic and oral health conditions considered by the surgeon before extraction, and the characteristics of surgery itself, increase the risk of prolonged recovery of HRQoL.
Gutiérrez-Pérez 2004 (21)	Literature review	Pericoronitis, its clinical, histological and microbiological characteristics, and management approach.	* Antimicrobial treatment is indicated as preoperative prophylaxis in the presence of a high risk of infection, and in acute phase suppurative pericoronitis, where surgery is to be postponed. * Amoxicillin – clavulanic acid is the treatment of choice.	The management of pericoronitis can be addressed from three perspectives:  • Symptomatic measures • Antimicrobial measures • Surgical measures
			* The surgical treatment of pericoronitis present in 3Ms is the most common indication for the removal of impacted 3Ms, due to the patient benefits afforded in terms of QoL.	
Richardson <i>et al.</i> 2005 (29)	Literature review	What is the risk of periodontal defects distal to lower 2M after 3M extraction?	<b>Changes in CAL or PD 6 months after 3M extraction:</b> - Clinically insignificant in the distal portion of 2M. * In patients with healthy periodontal conditions before surgery, 48% showed worsening of the periodontal measures after extraction.	* Generally, PD of 2M or CAL remain without change or improve after 3M extraction. * In patients with healthy periodontal tissue of 2M before extraction, the indication of 3M removal must be made with caution, since these subjects are at an increased risk of worsened PD or CAL after extraction.
Colorado-Bonnin <i>et al.</i> 2006 (25)	Survey-based study	Evaluate QoL and degree of satisfaction among adult ambulatory patients after lower 3M extraction.	N: 91 Caucasian patients completed the questionnaire. F: 53/M: 38 <b>Test group:</b> 45 patients <b>Control group:</b> 46 patients <b>Mean age:</b> 25.1 years, SD 7.6 years <b>Most frequent position of 3Ms</b> (according to classifications of Winter and Pell & Gregory): mesioangular and IIB, respectively.	* Males reported less pain than females. * Lower 3M surgery has a significant impact in terms of QoL, particularly in the first 3 days after extraction.
Adeyemo 2006 (27)	Literature review	Relationship between lower impacted 3Ms, cysts, tumor development and mandibular fractures.	*The proportion of impacted 3Ms that are removed without clinically valid justification is 18-50.7%.	* Patients with impacted lower 3Ms are more susceptible to mandibular angle fracture.
			<b>*The justifications for prophylactic surgery include:</b>	* The presence of 3Ms helps prevent condylar fractures, which are more serious, difficult to treat and have a greater risk of complications.
			- Minimize risk of disease development (cysts and tumors)	* The prophylactic removal of impacted lower 3Ms should be suspended in the absence of specific complications.
			- Reduction of mandibular angle fracture risk - Greater surgical difficulty with advancing age - 3Ms play no defined role in mouth	* The removal of impacted 3Ms should be limited to those teeth with a well defined diagnosis and clear surgical or pathological indications.
Marciani <i>et al.</i> 2007 (28)	Literature review	Indications and evaluation of risk in 3M extraction.	<b>Considerations in deciding treatment:</b> * Inform the patient of the consequences of treatment versus no treatment. * Consider the problems referred to HRQoL, the clinical problems and economical cost.	* The extraction of 3Ms is considered when there is clinical and radiographic evidence of acute or chronic periodontitis, caries, pericoronitis and deleterious effects upon 2Ms. * Those 3Ms that interfere with orthognathic surgery or orthodontic treatment should be removed.
				* Advanced age, an increased mandibular fracture risk, deficient surgical access, systemic disease and an increased risk of intra- or postoperative complications may be contraindications for the removal of 3Ms.
Bagheri <i>et al.</i> 2007 (18)	Literature review	Indications and contraindications of the prophylactic removal of impacted 3Ms. Do the cumulative risks and costs of 3M extraction exceed the lifelong benefits?	<b>Considerations in deciding 3M extraction:</b>	* The relationship between asymptomatic 3Ms and multiple health risks warrant their removal in early adulthood.

**Table 1 cont.:** Descriptive summary of the studies included in the review.

			<p>* Presence of ongoing symptoms or disease</p> <p>* Anticipation of future complications</p> <p>* Morbidity associated to 3M retention</p> <p>* Possible risks of extraction at an older age</p>	<p>* The surgical risk and the complications are justified when 3Ms are associated to disease processes (e.g., caries, resorption, pathological conditions related to cysts and tumors, periapical abscesses, odontogenic infections, etc.).</p>
Dodson <i>et al.</i> 2007 (23)	Literature review	Determine the risk of periodontal defects of 2M after 3M removal. <b>Specific objective:</b> Among patients subjected to lower 3M extraction, what is the risk of periodontal defects distal to 2M?	<p>* PD or CAL (in 2 cohort studies and 5 RCTs): clinically insignificant changes at end of follow-up (&lt; 2 mm).</p> <p>* To determine therapeutic efficacy in extraction of 3M to improve periodontal condition of 2M (in 8 RCTs):</p> <ul style="list-style-type: none"> <li>- Between 52-100% either showed no changes or improved the disease condition at the site where 3M was located.</li> </ul>	<p>* In the case of pre-existing periodontal disease, it is suggested that periodontal health distal to 2M should improve after 3M removal.</p> <p>* The periodontal health of 2M generally remains unaltered or improves after 3M removal.</p>
Chuang <i>et al.</i> 2008 (16)	Prospective cohort study	Estimate the frequency of inflammatory complications (surgical bed infection and alveolar osteitis) after 3M extraction and identify the risk factors for such complications.	<p>N: 4004 (8748 3Ms) Age: mean 39.8 ± 13.6</p> <p><b>Variables analyzed in relation to postoperative inflammation:</b></p> <ul style="list-style-type: none"> <li>- Impaction level, periodontal disease related to 3Ms, pre-existing infection around 3Ms, disease of 3M (osteitis).</li> </ul>	<p>* Impaction level, pre-existing infection and disease were associated to an increased risk of postoperative inflammatory complications after 3M extraction.</p>
Kandasamy <i>et al.</i> 2009 (20)	Literature review	Indications of 3M extraction.	<p>* Gender, oral contraceptive use, surgeon experience, presence of disease and degree of impaction are key parameters in molar extraction.</p>	<p>* There are clear indications for the removal of 3Ms associated to disease processes.</p> <p>* Monitoring is advised in the case of asymptomatic 3Ms. Surgery should only be decided following due evaluation of the risks and benefits for the patient.</p>
Krishnan <i>et al.</i> 2009 (26)	Retrospective study	Indications of 3M extraction in a dental school in Libya.	<p>N: 439 M: 183/ F: 256 Age: 15-24 years (61%)</p> <p><b>Indications for 3M extraction:</b></p> <ul style="list-style-type: none"> <li>- Recurrent pericoronitis (54%)</li> <li>- Pulpitis/caries of 3M / 2M (31%)</li> <li>- Orthodontics (2%)</li> <li>- Cysts/tumors (5%)</li> </ul> <p>* The most common symptoms were pain and sensitivity (tenderness).</p> <p>* The relative absence of prophylactic removal as an indication could be due to socioeconomic and logistic factors.</p>	<p>* Knowledge of the indications for the extraction of a lower 3M will help the management of these patients.</p> <p>* Patients generally do not like the idea of prophylactic removal of 3Ms.</p> <p>* The removal only of symptomatic lower 3Ms appears to be the most logical option, in view of the economic and human resource limitations of the developing countries.</p>
Bienstock <i>et al.</i> 2011 (14)	Prospective cohort study	Identify the factors associated to the duration of postoperative disability after 3M extraction. <b>Specific objectives.</b> Identify factors associated to late recovery.	<p>N: 4004, 8748 3M removed</p> <p><b>Mean duration of postoperative disability:</b> 1.4 ± 1.8 days (range 0-26, median 1 day).</p> <p><b>Earlier return to daily life activities</b> (p &lt;0.05) was associated to erupting 3Ms, periodontal disease or other preoperative disease, and chlorhexidine use.</p>	<p>* 3M removal is associated with a delay in return to normal daily life activities of at least 2 days on average.</p> <p>* A series of factors are significantly associated with delays in returning to normal activities (e.g., age, gender and anatomical position of the 3Ms).</p> <p>* One factor – chlorhexidine use – was associated to briefer disability, possibly because it reduces the risk of alveolar osteitis.</p>
Kandasamy <i>et al.</i> 2011 (17)	Literature review	Individually analyze the 3 key criteria for the extraction of asymptomatic 3Ms: periodontal disease, age and informed consent.	<p>* <b>Periodontal disease:</b> carefully evaluate the recommendation of the AAOMS on the indications of the early removal of asymptomatic 3Ms, based on the assumption that the latter will probably give rise to periodontal disease in future and could contribute to systemic disease.</p>	<p>* There are clear indications for the removal of 3Ms associated to symptoms and disease, as well as protocols for the removal of asymptomatic 3Ms.</p> <p>* The systematic removal of asymptomatic 3Ms is becoming a practice of the past, in contrast to the currently viewed primary obligation to “not cause harm”. There are increasingly fewer excuses for such practice, which is no longer justified in contemporaneous dental and medical practice.</p>
			<p>* <b>Age:</b> deciding early 3M removal based simply on the notion that future extraction will involve more complications and morbidity is unfounded.</p>	
			<p>* <b>Informed consent:</b> inform the patients not only of the risks of disease if 3Ms are not removed, but also of the complications resulting from such extraction.</p>	
Marciani <i>et al.</i> 2012 (19)	Literature review	Estimate the proportion of patients with asymptomatic 3Ms and evidence of disease at the start of the study, and assess the risk health posed by impacted 3M over the long term.	<p>N: 329</p> <p><b>PD in patients with asymptomatic 3Ms:</b> PD = 5 mm: 82 (25%) at 3M and 2M level</p> <p><b>CAL associated to PD:</b></p> <p>PD &lt; 5 mm was associated to CAL = 1 mm</p> <p>PD &gt; 5 mm was associated to CAL = 2 mm in 80 of 82 subjects</p> <p>*The increase in PD and loss of CAL, together with periodontal pathogens, were consistent with the clinical and microbial changes associated with the start of periodontitis, manifesting first in the region of 3M in young patients.</p>	<p>* The data suggest that the absence of symptoms associated to impacted 3Ms is not synonymous of the absence of disease.</p> <p>* Those patients that want to retain their 3Ms should undergo periodic clinical and radiographic controls to detect possible disease before it causes symptoms.</p>

**Table 1 cont.-1:** Descriptive summary of the studies included in the review.

Bradshaw <i>et al.</i> 2012 (24)	Prospective, exploratory clinical study	Evaluate the effect of 3M extraction upon QoL in patients with symptoms of pericoronitis.	N: 60 Age: 21.9 years <b>Median postoperative follow-up:</b> 7.7 months. <b>Patients reported:</b> Intense pain decreased after surgery (32% to 3%). A total of 15% experienced pain intensity as "none", "weak" or "very weak", after extraction. A total of 22% and 18% reported "quite a lot" or "a lot" of eating and chewing difficulties during the follow-up period.	* Removal of 3M had a positive impact upon the QoL outcomes in patients with mild pericoronitis symptoms.
Dicus-Brookes <i>et al.</i> 2013 (3)	Prospective, longitudinal clinical study	Evaluate the impact of 3M extraction upon the periodontal condition of adjacent 2M and more anterior teeth, in patients with mild pericoronitis symptoms.	N: 69 M: 45%. Caucasians 57% Age: 21.8 years (20.2-25.2 years) <b>Periodontal condition of 2M after 3M extraction:</b> <b>Initial condition:</b> PD > 4 mm distal to 2M: in 88% of the cases. <b>After surgery:</b> PD > 4 mm distal to 2M: in 46% of the cases; p<0.01.	* The extraction of 3Ms in patients with mild symptoms of pericoronitis improved the periodontal condition of D2M and the more anterior teeth in the mouth.
Steed <i>et al.</i> 2014 (6)	Literature review	Indications for 3M extraction.	<b>Patient symptoms described as:</b> Present and attributable to 3M Absent <b>Clinical or radiographic evidence of disease:</b> Present / Absent	* An asymptomatic 3M does not necessarily imply the absence of disease. * The current evidence is not enough to discard or support prophylactic removal versus monitoring of asymptomatic 3Ms without associated disease. * The evidence warranting extraction versus monitoring of asymptomatic 3Ms without associated disease is insufficient.
Tang <i>et al.</i> 2014 (22)	Prospective clinical study	Evaluate how the QoL measures affect the decision to remove 3Ms in patients with mild pericoronitis symptoms.	N: 113 Mean age: 23.2 ± 3.8 years <b>Extraction group:</b> 79 patients subjected to removal of 3Ms <b>Non-extraction group:</b> 34 patients	* The presence of mild pericoronitis and oral functional and lifestyle problems – factors which dental professionals do not usually consider – was significantly associated to the patient decision to seek early 3M removal.

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#### **Conflicts of interest**

The authors declare that they have no conflicts of interest in relation to this study.