

Timely extraction of the first permanent molars severely affected in mixed dentition.

Extracción oportuna de los primeros molares permanentes severamente afectados en dentición mixta.

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Abstract: The aim of this study was to establish a guide for general dentists that allow identifying the ideal moment to extract the first permanent molars with poor prognosis, in the hope of obtaining a spontaneous closure of space, regarding that the first permanent molar is more susceptible to develop dental caries in children due to its early eruption in the oral cavity and molar incisor hypomineralization affects them the most. **Methods:** we proceed to search for the articles in databases PUBMED and SciELO, selected articles published from 1998 a 2018 were analyzed based on inclusion and exclusion criteria. **Conclusion:** Our review suggests that a full evaluation of the compromised first permanent molar should be performed before planning an extraction. It can be concluded that the ideal stage to extract a first permanent molar with bad prognosis is in the Demirjian stage E or D evaluated with radiographs, which is generated at a chronological age of 8 to 10.5 years, ideally in the presence of third molars.

Keywords: *Tooth extraction; molar; dentists; radiography, dental; prognosis.*

Resumen: El objetivo de este estudio fue establecer una guía para odontólogos que permita identificar el momento ideal para extraer los primeros molares permanentes con mal pronóstico, con el objetivo de obtener un cierre espontáneo del espacio, teniendo en cuenta que el primer molar permanente es más susceptible a desarrollar caries en niños debido a su erupción temprana en la cavidad oral y es el más afectado por la hipomineralización. **Material y Métodos:** Se procedió a buscar y analizar artículos científicos de las bases de datos PUBMED y SciELO, publicados entre 1998 y 2018 en base a criterios de inclusión y exclusión. **Conclusión:** Nuestra revisión sugiere que se debe realizar una evaluación completa del primer molar permanente comprometido antes de planificar una extracción. Se puede concluir que la etapa ideal para extraer un primer molar permanente con mal pronóstico son los estadios E o D de Demirjian, evaluados con radiografías, que se genera a una edad cronológica de 8 a 10,5 años, idealmente en presencia de terceros molares.

Palabras Clave: *Extracción dental; diente molar; odontólogos; radiografía dental; pronóstico.*

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INTRODUCTION.

Between 60 and 90% of school students around the world have caries.¹ The first permanent molar (FPM) erupts early in the oral cavity, thus becoming prematurely exposed to noxae, making it more prone to caries before 15 years of age.² In addition, it is the tooth most susceptible to developmental defects such as molar-incisor hypomineralization (MIH).³

The prevalence of MIH in children 6 to 12 years old in the Metropolitan Region of Santiago de Chile was 12.7%, mostly at 8 and 9 years of age.⁴ The molars affected by MIH commonly show enamel disintegration in the occlusal area, which favors the development of caries and has a poor restorative prognosis, without even considering that they may need extensive restorations shortly after eruption.⁵

Treatment of the molars affected by MIH can be painful due to the difficulty of achieving adequate anesthesia, and the alterations in enamel makes the success of the restoration unpredictable, with repeated restorations often needed.

As a result of these repeated treatment, the behavior of children worsens, as they are more afraid and anxious about dental treatment.⁵ In cases where molars with severe MIH cannot be maintained in good condition, extraction should be considered as an alternative treatment.

A successful eruption of the second permanent molar (SPM) can be achieved when performing the extraction of the FPM under appropriate circumstances, which may take the place of the PMP and appropriately replace it.

When the third molar erupts there is the possibility of completing the molar area, preventing the development of a possible malocclusion. Therefore, when extracting the severely affected PMP, a cycle of restorations is avoided.⁶⁻⁸ The management of children with compromised FPMs presents several challenges including

high rates of restoration failures, which entail high dental costs. If one considers that this restoration should last 50 years, that in many instances the enamel is of poor quality, having to perform restorations repeatedly or even endodontic treatments, it is often better option to replace this FPM with the SPM.⁹

In patients in which a FPM presents a poor prognosis, the management of pain, infection, or both is essential, limiting the number of general anesthesia and determining the best cost/benefit balance for the patient.⁸

The objective of this study is to establish a guide for general dentists to identify the ideal time to extract the first permanent molars with a poor prognosis, in the hope of obtaining a spontaneous closure of the resulting space.

MATERIALS AND METHODS.

Articles were searched in the PUBMED and SciELO databases and subsequently selected, according to a series of previously established inclusion criteria.

Boolean combinations (and, or) of the following terms were used in the search strategy: first permanent molar, extraction, ortodontics, panoramic radiography, spontaneous closure of space.

The inclusion criteria were the following: extraction of at least one permanent first molar, radiographic record prior to extraction; bibliographic reviews, systematic reviews or clinical trials.

The exclusion criteria were: extraction of teeth other than permanent first molars, extractions for orthodontic treatment, prior orthodontic treatment.

The search limits used were: period of publication of the articles between 1998 and 2018; children aged 5 - 16 years; and Spanish and English language.

The selection of articles was made at first through the reading the abstracts, discarding redundant ones (Figure 1).

Figure 1. Flow diagram of the articles reviewed..

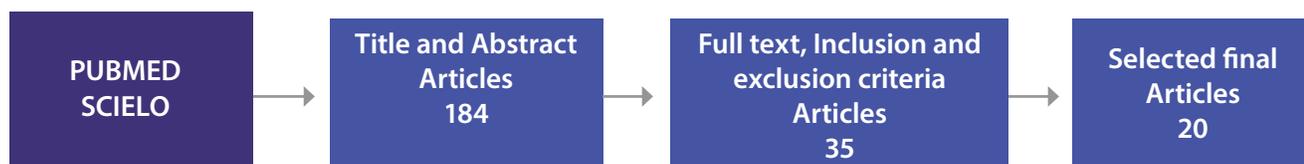


Table 1 . Summary of information gathered from each of the selected studies.

Study design	Study	Year	Conclusions
Systematic review	Eichenberger <i>et al.</i> ⁷	2015	The overall success rate of the clinical outcome for maxillary extraction of FPMs was higher than mandibular extraction. Extractions of the mandibular FPMs should be performed between 8 and 11.5 years of age to achieve a good clinical outcome.
Systematic review	Alkhadra <i>et al.</i> ¹⁵	2017	Treatment with active devices is important after extraction of FPM with poor prognosis. If such therapy is not necessary, extraction at the ideal age of development should be considered to achieve spontaneous closure of the space.
Systematic review	Afnan <i>et al.</i> ²	2018	The ideal time for FPM extraction is at Demirjian stage E.
Bibliographic review	Sandler <i>et al.</i> ¹⁴	2000	Careful case evaluation must be considered before treatment to ensure that the benefits will outweigh any disadvantages.
Bibliographic review	Gill <i>et al.</i> ¹³	2001	In order to plan the extraction of FPM it is necessary to evaluate the need for subsequent orthodontic treatment, if this is not necessary, the extraction must be considered at the ideal time.
Bibliographic review	Ong <i>et al.</i> ²⁰	2010	Depending on each individual case, the ideal time for the extraction of lower FPMs may be early-on, between 8 and 9 years of age, but generally it is about 10 years.
Bibliographic review	Cobourne <i>et al.</i> ⁶	2014	Treatment planning for forced FPM extraction can present a complex problem, particularly in the presence of underlying malocclusion.
Bibliographic review	Wu <i>et al.</i> ⁸	2017	There is no good quality scientific evidence to support the "optimal time" for extraction of FPMs with a poor prognosis.
Case Control	Yavuz <i>et al.</i> ¹⁶	2006	The early loss of the first permanent molars could have an accelerating effect on the development of the third molar on the side of the extraction compared to the contralateral teeth.
Case Control	Rahhal <i>et al.</i> ¹¹	2014	Clinically it is recommended to extract highly destroyed upper FPM at the age of 10.5 years to ensure complete closure of the extraction space by the passive mesial drift of the upper SPM.
Longitudinal study	Jälevik <i>et al.</i> ⁵	2007	The extraction of FPMs severely affected by MIH is a good treatment alternative.
Retrospective Study	Teo <i>et al.</i> ¹²	2013	Although only more than half of the patients had FPMs removed at the "ideal time," this did not seem to influence the successful positioning of the upper or lower SPMs.
Retrospective Study	Teo <i>et al.</i> ¹⁷	2016	In addition to FPM extraction time, the presence of the permanent third molar and the SPM angulation should also be considered in order to ensure a reliable degree of spontaneous closure of the lower SPM space.
Retrospective Study	Patel <i>et al.</i> (18)	2017	It is suggested that the presence of the third molar and mesially angled SPM are favorable for the closure of the space.

CFPM: First permanent molar. SPM: Second permanent molar. MIH: molar-incisor hypomineralisation.

RESULTS.

The full text of the articles was read and based on inclusion and exclusion criteria, the final articles were selected, as summarized in Table 1.

DISCUSSION.

The optimal extraction time is based on the data published by Thilander and Skagius in 1970, where they describe that it is when there is radiographic evidence

of early calcification in the dentin of the SPM root bifurcation,⁶ which normally occurs at the chronological age between 8 and 10 years,¹⁰ and is equivalent to the Demirjian stage of development E.

Another parameter used as a reference for FPM extraction is when the SPM is at the cement-enamel junction of the FPM's disto-buccal root, which generally occurs at the age of 10.5 years and it accelerates the eruption of the SPM.¹¹

Extractions of the upper FPMs have a more predictable closure of the space compared to the lower extractions,¹² therefore, the determination of the timing of when to extract the FPM is more critical in the mandible than in the maxilla.^{6,12,13}

The extraction of an FPM when fulfilling the conditions described above should allow the SPM to advance to the PMP area, achieving good proximal contact with the second premolars. Before proceeding to FPM extraction, it is necessary to evaluate clinical and radiographic conditions in order to increase the probability of spontaneously closing the space.

Malocclusion, arc length discrepancy (crowding or excess space), molar ratio, permanent tooth loss, dental development stage, teeth size, state of eruption of the second premolar at the time of FPM extraction, presence of third molars reasonably well formed and in good position, divergent skeletal malocclusions with dolichofacial pattern, anterior open bite, and state of the other teeth (dental anomalies).^{5,8,14,15}

The extraction of the mandibular FPM has been noted to facilitate the eruption of the third molar as it increases the available space.¹⁶

According to Teo *et al.*,¹⁷ the development of the second premolar within the bifurcation of the second temporal molar should be identified in order to achieve a favorable eruptive guidance and prevent distal displacement, rotation and inclination of the second premolar towards the extraction site; mesial angulation of the SPM in relation to the FPM increases the closure of the space. Regarding the presence of the third molar, the extraction of the FPM favors the eruption of the third molar, increasing the space for its eruption and decreasing possible impaction. According to these authors, the presence of one or more radiographic

factors is significantly associated with greater closure of the space.

Furthermore Patel *et al.*,¹⁸ took the FPM as reference and defined that the mesial or straight angulation of the developing SPM and the presence of the third molars are significantly related to the closure of the space when inferior FPMs are extracted. Chronological age is used as a determinant of dental maturation in relation to the patient's age; most studies take one into account more than the other.

In the study by Jalevik *et al.*,⁵ FPMs were extracted between the ages of 5.6 and 12.7 years, on average at 8.2 years. They defined as an ideal result the spontaneous and complete closure of the space, obtaining a point of contact between the second premolar and SPM without angulation or rotation of either of the two teeth, without distal displacement of the second premolar and without individual dental malocclusions.

This follow-up study showed a favorable closure of space in 85.2% of cases after the extraction of upper and lower PMP only taking into account the chronological age of the patients.

On the other hand, among the methods used to evaluate dental maturation on radiographs are those of Nolla, Demirjian and Moorrees. Nolla's method divides dental development into 11 stages that range from 0 which denotes absence of crypt and 11, which denotes apical closure in unirradicular and multiracial teeth. The Moorrees method proposes the allocation of maturation stages for the crown and root, and these vary in number for single-rooted or multi-rooted teeth.

Regarding the Demirjian method we highlight the following states: D crown developed, E early or initial bifurcation, F late bifurcation, G almost complete root development.¹²

In the study conducted by Martínez *et al.*,¹⁹ the Demirjian method presented greater precision in the estimation of dental age of the three methods applied, because it provided more precision between the evaluation of dental age and chronological age.

In the study by Teo *et al.*,¹² despite the majority of cases being in stage D, E, F or G of Demirjian, a favorable result was obtained, without dental age being as relevant. In mandibular extractions a good result was

obtained in most cases where the SPM were in stage E and F compared to the molars that were in stage than D or G.

According to Patel *et al.*,¹⁸ the stage of dental development is significant only for the maxillary arch, not for the mandibular arch where the angulation of the developing SPM and the presence of the third molars is more relevant in order to obtain spontaneous closure of the space when FPMs are extracted.

The fundamental belief of those who measure only chronological age is that early extraction before 8 years of age could produce distal inclination and rotation of non-erupted second premolars, and conversely a late extraction after 11 years of age, that is, during or after the eruption of the SPM, will result in an incomplete closure of the space, mesial rotation of the SPM, distal migration of the second premolar, atrophy of the alveolar ridge and overeruption of the opposite FPM.^{6,12,13}

However, this is not entirely true, since as mentioned above, the chronological age must be complemented with the stage of dental development of the SPM taking into account the clinical characteristics on a case-by-case basis. Indication *versus* contraindication according to type of malocclusion:

Class I: With minimal crowding, it is necessary to extract at the ideal moment, not to perform tooth extractions of balance neither in the mandible nor the maxilla. If the mandibular FPM will be removed, consider extractions of compensation in the maxilla. If the maxillary FPM will be extracted, do not consider mandible compensation extractions.

With moderate crowding in the anterior area, extraction at the ideal time can result in spontaneous resolution of crowding and good space closure. Consider extractions of FPM for contralateral balance in bilateral crowding.²⁰

Class II: With slight crowding, the mandibular extractions should be performed at the ideal time and

the maxillary extractions should be postponed until the eruption of the SPM. Balance and compensation extractions are not recommended.

Subdivision I: Maxillary FPMs are better retained until the eruption of the SPM and employ restriction of a mesial movement of the SPM with a palatine arch.

Subdivision II: In the case of overbite, lower extractions should be avoided.²⁰

Class III: it is best to refer to an orthodontist.

The extraction of PMPs is contraindicated in the following cases: brachyfacial type, patients with overbite, in absence of permanent teeth, diastema or excess interdental space and class III malocclusion.⁸

CONCLUSION.

It can be concluded that the ideal stage to extract a FPM with a doubtful prognosis is at Demirjian stage E (early or initial bifurcation) or stage D (developed crown), which is around chronological age of 8 to 10.5 years.

As the spontaneous closure in the lower arch is less predictable than in the upper arch, it is very important to determine the ideal extraction time of the mandibular FMP, in addition in the mandible the mesial angulation of the developing SPM and the presence of the third molars is more relevant for achieving an optimal result. Because FPM extraction is not a successful treatment by itself in all cases, all patients should be referred to follow-up by an orthodontist.¹³ This review is especially useful for general dentists who are often faced with children with extensive caries in FPMs, particularly in instances when it is not easy to consult an orthodontist.

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