ORIGINAL ARTICLE

Eruption disturbances of the first and second permanent molars: Results of treatment in 43 cases

Eduard Valmaseda-Castellón, DDS,[a] Cristina De-la-Rosa-Gay, DDS,[b] and Cosme Gay-Escoda, MD, DDS, PhD[c]
Barcelona, Spain

Impaction or retention of first and second permanent molars is an uncommon condition with diverse therapeutic approaches. To ascertain the success rate of different treatment possibilities, a retrospective study was made of 25 patients with a total of 43 permanent molars with eruption disturbances. In most cases, the nonerupted teeth were mandibular second molars (65%), followed by maxillary second molars (21%). Their position, degree of impaction (inclusion), clinical features, repercussion on the neighboring teeth, type of treatment, and outcome were evaluated. Infraocclusion was often associated with malposition of neighboring teeth, as well as extrusion and infraocclusion of opposing teeth. Due mostly to a delay in the diagnosis of the condition, an acceptable final position of the nonerupted molar was obtained in only 8 of 13 conservatively treated second molars. In order to prevent this situation, radiographic examination (ideally during the early mixed dentition period) and early diagnosis of eruption disturbances of permanent first and second molars are recommended, particularly when considering that these anomalies are associated with a high rate of occlusal disturbances that may require orthodontic correction. (Am J Orthod Dentofacial Orthop 1999;116:651-8)

Eruption, a multifactorial process primarily dependent on the tooth germ, is defined as the axial or occlusal movement of a tooth from its developmental position within the jaw toward its functional position within the occlusal plane.[1-6] A tooth is impacted when it has arrested its eruption due to the presence of a barrier (detectable clinically or radiographically) or an abnormal eruption path.[7,8] If eruption has been arrested but neither a physical barrier nor an abnormal eruption path is present, then the tooth is said to be primarily retained. *Secondary retention* refers to the cessation of tooth eruption after emergence where the cause is neither a physical barrier in the path of eruption nor abnormal positioning.[8] The term *inclusion* is in turn used to describe a tooth that remains inside the bone.[9]

The inclusion of permanent first and second molars is uncommon, with prevalence rates of 0.08% for the second maxillary molar and less than 0.01% for the first mandibular molar.[10] Several systemic and local factors have been related to the cause of these anomalies. Impaction may result from several local causes, such as malocclusion disturbances of the primary dentition, the position of neighboring teeth, supernumerary teeth, cysts, or odontomata.[10-13] Primary retention has been attributed to an alteration of the dental follicle, which is unable to initiate the metabolic processes leading to bone resorption and eruption.[14] Roots develop completely even when the tooth cannot erupt because root formation seems to be unrelated to the eruption process.

Secondary retention is related to ankylosis,[7,8] which is probably due to a localized alteration of the periodontal ligament, but it has not yet been determined whether impairment of the eruptive mechanism occurs before or after ankylosis. Some authors[8,15] have suggested that root resorption is a physiologic process also in permanent teeth, though repair with cementum usually occurs. However, if cementum apposition is impaired, and the resorption area is repaired by osteoblasts, then ankylosis occurs.

Treatment of impaction or primary retention of a permanent molar consists of its surgical exposure and, in the case of impaction, removal of any possible barrier.[7,16,17] Orthodontic treatment should follow in the event of abnormal positioning of the tooth, malocclusion, lack of space in the dental arch, or if spontaneous eruption is not expected. If a second permanent molar is secondarily retained (ankylosed) and the third molar has not yet formed its roots, then the recommended treatment is extraction of the nonerupted molar, to avoid occlusal disturbances related to the localized growth deficit associated with the ankylosed molar. In

From the Faculty of Dentistry, University of Barcelona, Barcelona, Spain.
[a]Master of Oral Surgery and Implantology.
[b]Master of Orthodontics and Orthopedics in Children and Adults.
[c]Department of Oral and Maxillofacial Surgery.
Reprint requests to: Dr Cosme Gay-Escoda, Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, University of Barcelona, Campus de Bellvitge, Feixa Llarga s/n, E-08907 L'Hospitalet de Llobregat, Barcelona, Spain; e-mail: cgay@bell.ub.es)

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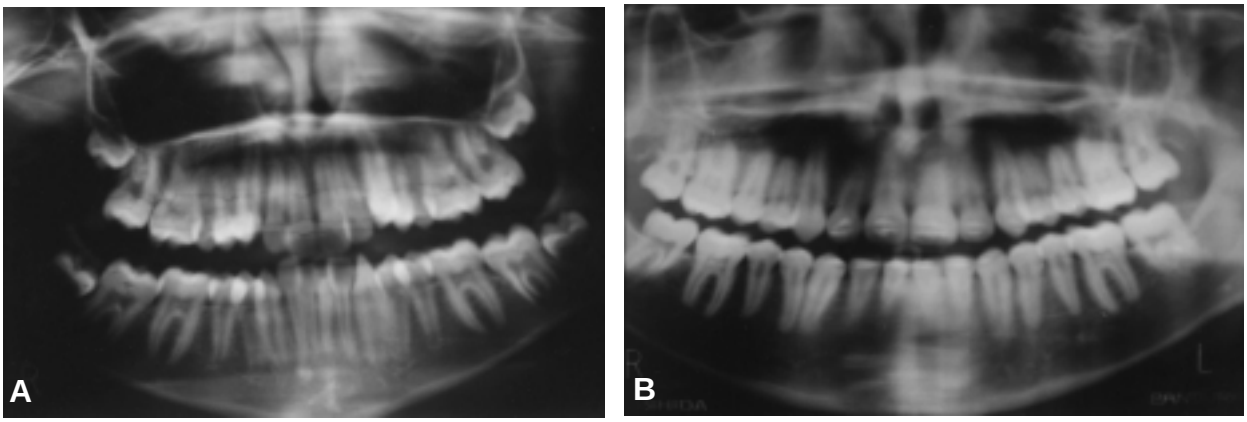

Fig 1. A, Panoramic radiograph of a 12-year-old boy immediately before extracting the four second molars for orthodontic purposes because of lack of space in both arches. **B**, Final panoramic radiograph of the same patient at the age of 17 after completion of orthodontic treatment and eruption of the third molars. Note the spontaneous "replacement" of the extracted teeth by the third molars.

Table I. Permanent molars found to be retained or impacted

Nonerupted molars	*Number*	*Percentage (%)*
First upper molar	4	9
Second upper molar	9	21
First lower molar	2	5
Second lower molar	28	65

this case, and particularly if the third molar has a low Nolla stage (between 5 and 8), it can erupt in such a position as to "replace" the lost second permanent molar (Fig 1). If the second molar is extracted in such an early stage of development of the third molar, the latter will take years to erupt, and control of extrusion of the opposing teeth must be considered. On the other hand, when the extracted tooth is a first molar, mesial drifting of the second permanent molar is associated with mesioversion in the lower jaw and mesioversion and rotation in the upper jaw. Orthodontic correction or prosthetic replacement of the missing tooth are often required. In the case of secondary retention, prosthetic rebuilding is only recommended if infraocclusion is slight and growth is fully completed. Unfortunately, the low prevalence of impaction of the first and second permanent molars, and the difficulty of distinguishing between primary and secondary retention and impaction have been major factors underlying the lack of uniformity in the management of these eruption disturbances.

The purpose of the present study was to examine the results of treatment in a retrospective series of 25 patients with a total of 43 first or second permanent molars presenting eruption disturbances.

MATERIAL AND METHODS

Patients referred to the Department of Oral Surgery and Implantology of the Faculty of Dentistry of Barcelona between 1992 and 1996 for any reason and who presented with impacted or retained permanent molars (except the third molar) were included in the study. The study population consisted of 25 patients (14 males and 11 females). One patient was only 8 years old, 2 patients were over 30 years old, and another 5 patients were between 21 and 30 years old. The mean age (±SD) of the other 17 patients, whose age ranged between 14 and 20 years, was 17.3 ± 2.2 years.

All patients underwent complete clinical and radiographic examinations. In addition to age and gender, the following factors were recorded: frequency, distribution, location, and number of nonerupted molars; position of neighboring and opposing teeth; and degree of infraocclusion and associated pathologic conditions. The degree of infraocclusion was considered mild, moderate, or severe as defined by Brearly and McKibben.[18] The distribution of the nonerupted molars is shown in Table I.

An individualized treatment plan was established according to the patient characteristics (age, degree of infraocclusion, associated pathologic conditions, etc). Treatment included careful observation and watchful waiting, extraction of the nonerupted molars or of the third molar, surgical luxation, surgical exposure, orthodontics, restoration, and transplantation of the third molar.

In patients over the age of 20 years, no attempts were made to bring the affected molar into the dental arch, in as much as the prognosis of such treatment

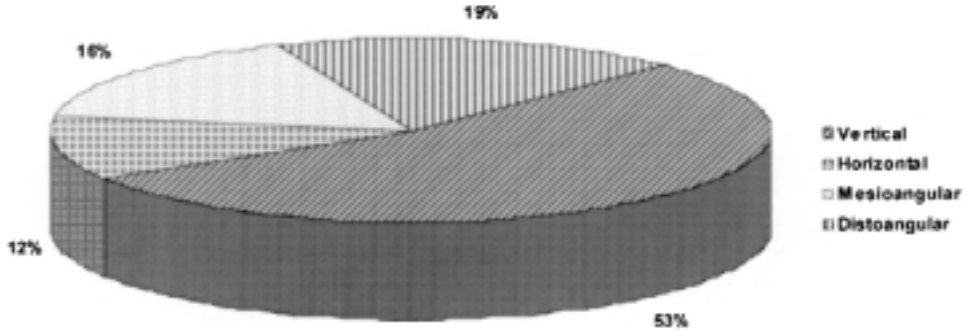

Fig 2. Position of impacted or retained permanent molars.

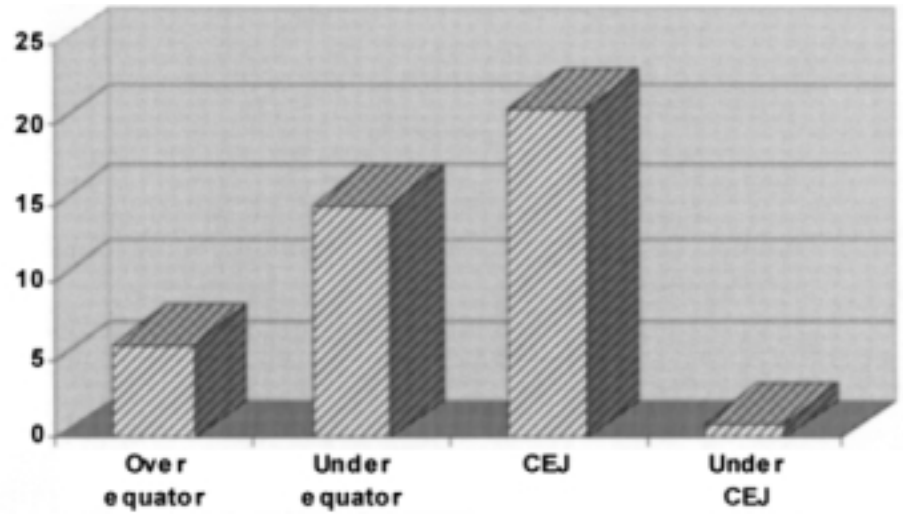

Fig 3. Degree of infraocclusion of the unerupted permanent molars.

was poor. Moreover, these patients were referred to the Oral Surgery Department not to treat their nonerupted second molars, but to surgically extract the third molars.

In patients younger than 20 years of age, treatment depended on whether the first or second permanent molar was considered to be impacted or retained. If a visible obstacle or a deviation in the eruption path was detected, treatment choices were surgical uprighting and orthodontic traction, orthodontic traction using elastics and eventually segmented springs, and transplantation. Extraction of third molars was considered if they were found to interfere with the chosen treatment. If the first or second molars were retained, surgical exposure was considered. Restoration of the crown of a second molar was only carried out in one case as an interim solution to avoid antagonist tooth extrusion.

After treatment, a molar was considered to be functional only if it had an acceptable position in the dental arch, occluded with the antagonist, and was asymptomatic.

RESULTS

There were a total of 43 retained or impacted permanent molars. The most frequently nonerupted teeth were second molars, with 28 lower second molars (65%) and 9 upper second molars (21%) (Table I). Only 6 first molars (4 upper and 2 lower) were nonerupted. Noneruption of more than 1 permanent molar (excluding third molars) was present in 11 patients, which accounts for 44% of the cases. In 26 second molars (70% of all second molars), the neighboring third molar was considered to be an obstacle for normal eruption. Nevertheless, the third molar cannot be considered to be the primary cause of the impaction of a first or second permanent molar, inasmuch as it is not an eruption path obstacle at the time of eruption of these teeth.

Table II. Different treatments used with second permanent molars included in the study

	Number of teeth		
Treatment	*Third molar extracted*	*Third molar not extracted*	*Functional second molars*
Surgical exposure			
Upper	1	—	1/1
Lower	4	1	3/5
Orthodontic traction			
Upper	—	—	—
Lower	0	1	1/1
Surgical luxation and orthodontic traction			
Upper	—	—	—
Lower	3	—	2/3
Restoration			
Upper	—	—	—
Lower	1	—	0/1
Transplantation			
Upper	—	—	—
Lower	1	—	0/1
No treatment			
Upper	3	3	—
Lower	4	2	—
Total treated			
Upper	1	—	1/1
Lower	9	2	6/11

Thirty-nine (91%) of the 43 molars were asymptomatic. In 3 molars, a history of pericoronitis was present, and 1 retained molar had extensive caries. In 8 cases (19%), a clinical diagnosis of follicular cyst associated with the impacted molar was established. Nonerupted or partially erupted permanent molars were all associated with several occlusal disturbances, such as version of neighboring teeth (16%) and extrusion (19%) or noneruption of opposing teeth (44%). Twenty-three nonerupted molars were infraoccluded in a vertical position, 5 were horizontal, 8 had a distoangular inclination, and 7 presented a mesioangular inclination (Fig 2).

The degree of tooth infraocclusion was considered mild in 6 cases (14%) and moderate in 14 (33%). In most cases (n = 23; 53%), the infraocclusion was severe, ie, the occlusal plane of the nonerupted tooth was located between the cementoenamel junction and the apexes of the neighboring mesial tooth or below the apexes (Fig 3).

Two first molars in 2 separate patients were not treated because they were symptomless and their prognosis was considered poor (both individuals were past their twenties). The other 4 first molars were in the same 8-year-old patient. The upper first molars were left untreated, because the orthodontist preferred to wait for spontaneous eruption to occur. The lower first molars were surgically exposed, and one of them erupted but with some buccal tipping, followed by a buccal periodontal abscess that resolved after surgical debridement.

Second molars had a broader range of treatment. Extraction of the nonerupted second permanent molar was carried out in 12 cases, either because the prognosis of the molar was considered to be poor, or because the patient refused a more conservative approach. Twelve second molars were left untreated because the patient refused treatment.

Conservative treatment procedures of second permanent molars are recorded in Table II. Only patients between 14 and 20 years old with intact second molars received conservative treatment.

Six permanent second molars were surgically exposed, and in all cases but one, the third molar was extracted in the same surgical operation. Four of them erupted and attained an acceptable position.

One patient (a 14-year-old girl) who had a mesially impacted right second lower molar, was successfully treated by orthodontic traction alone, using an appliance similar to that described by Majourau and Norton[19] and separating elastics (Fig 4). Another case was a 14-year-old boy with a vertically impacted right second lower molar that was surgically luxated and brought to a correct occlusion with traction elastics. The left second lower molar, however, failed to respond to treatment, developed a follicular cyst, and had to be extracted (Fig 5). The third patient to be treated with orthodontics was

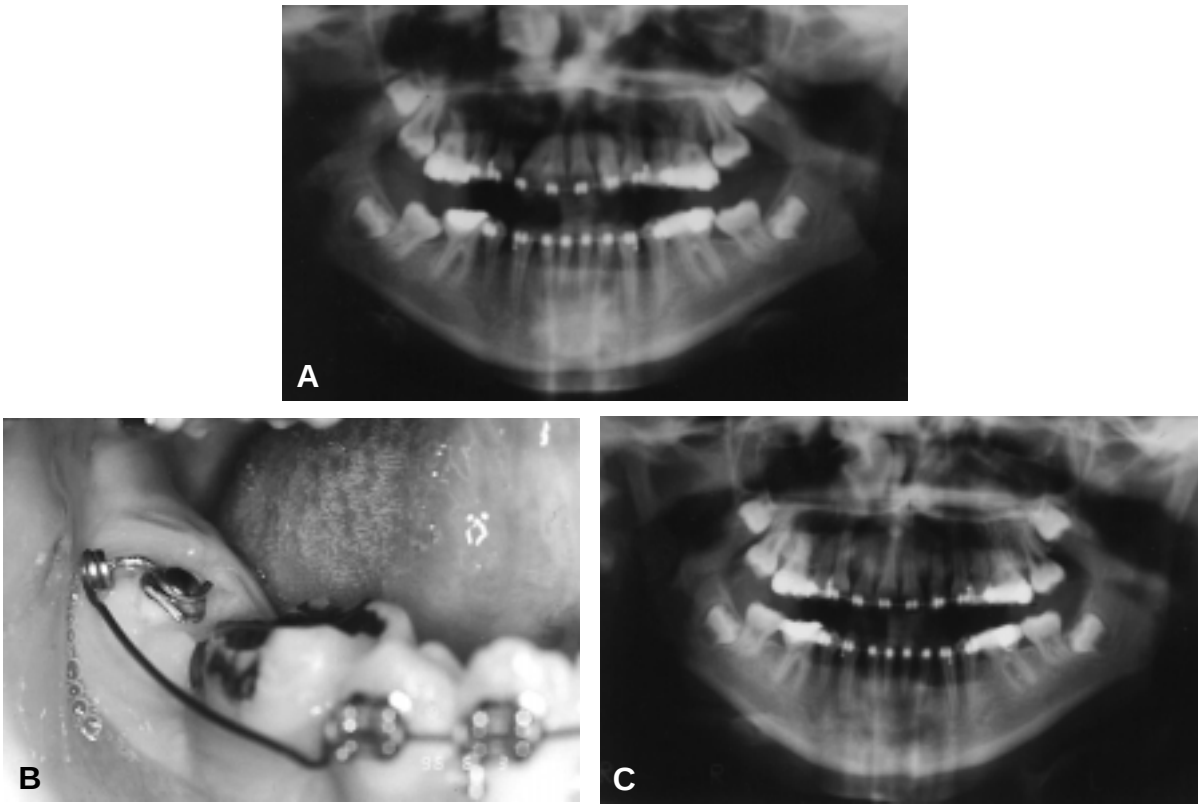

Fig 4. A, Panoramic radiograph of a 14-year-old girl, whose lower second molar was mesially impacted. **B**, Tooth was uprighted with a spring and separation elastics. **C**, Panoramic radiograph shows the uprighted lower second molar after 5.5 months.

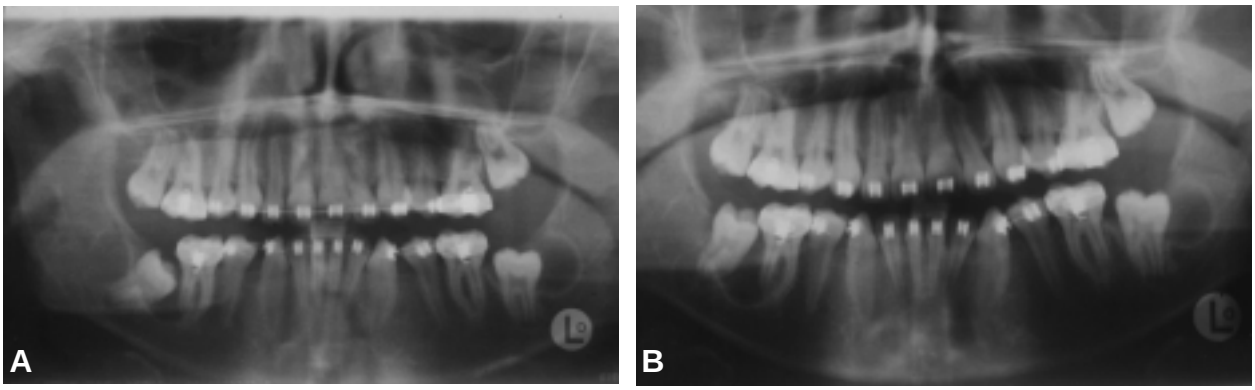

Fig 5. A, Panoramic radiograph of a 14-year-old boy before luxation and orthodontic traction of both lower second molars. **B**, Panoramic radiograph 15 months after luxation and traction of both lower molars. Left lower second molar failed to respond to treatment and shows a follicular cyst.

a 15-year-old boy who had 2 mesially impacted lower second molars. The left one was treated by surgical luxation, but the right lower second molar could not be surgically uprighted and was extracted. As an alternative, the right lower third molar was transplanted in its site but has not erupted to date (Fig 6).

DISCUSSION

In the present study, excluding third molars, the most commonly nonerupted permanent molars were lower second molars followed by upper second molars. In a prevalence study of uneruption or impaction of

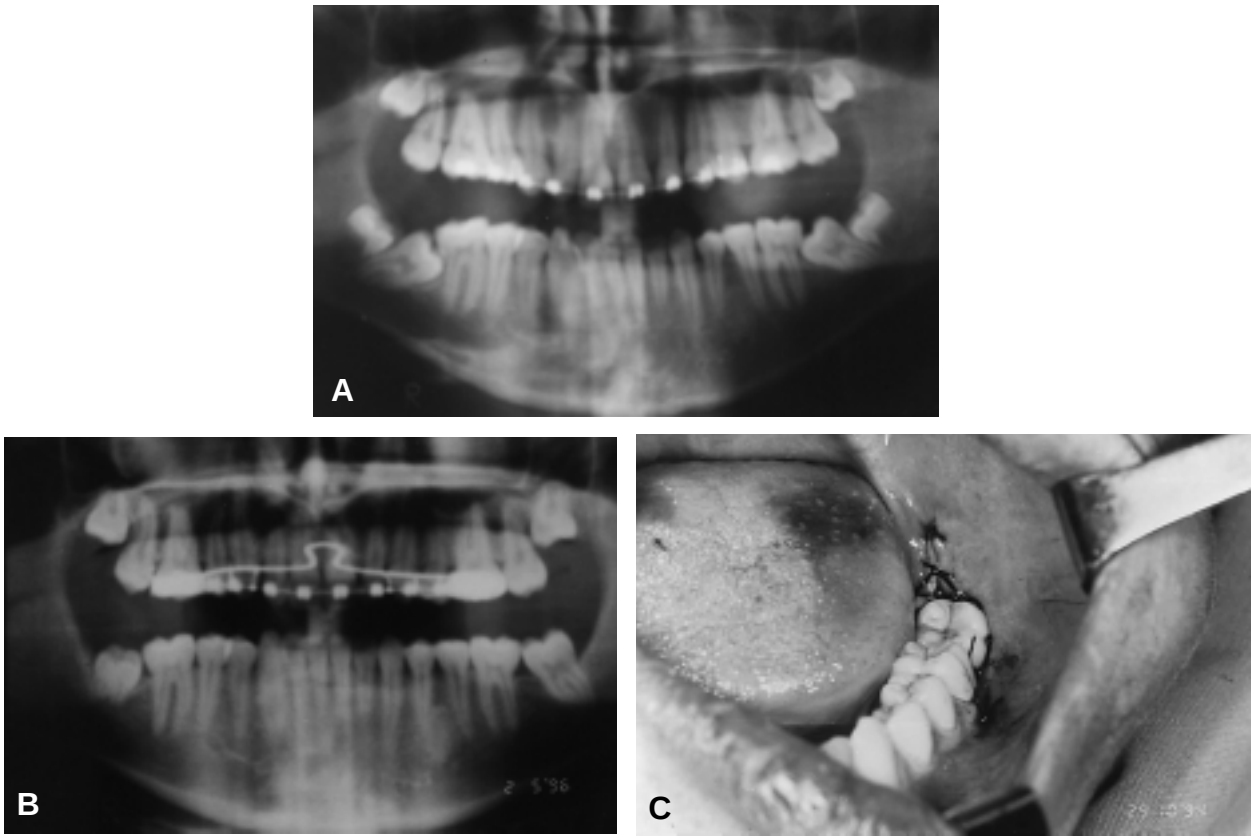

Fig 6. A, Panoramic radiograph of a 15-year-old boy with lower second molars that were mesially impacted. **B**, Panoramic radiograph after extraction of the left lower third molar and surgical luxation and orthodontic traction of the left lower second molar. The right lower second molar was extracted and the right lower third molar was transplanted into its extraction site, although development was arrested and the tooth failed to erupt. **C**, Immediate postoperative view of the left lower second molar after surgical luxation.

permanent molars in soldiers, Grover and Lorton[10] found that, excluding third molars, the most frequently nonerupted permanent molars were the second molars (0.08% of the population for upper second molars and 0.06% for lower second molars). Impacted maxillary first molars were found in 0.02% of the population, but no mandibular first molar was found to be nonerupted. These results are consistent with our study, as second molars were the most commonly nonerupted teeth and lower first molars were very rarely altered. However, in our sample, the rate of retained or impacted lower second molars was 3 times higher than for maxillary second molars; this was not the case in the study of Grover and Lorton,[10] probably because of racial and age differences between the 2 series.

Usually, noneruption of anterior teeth is easily noticed by the patient because the primary tooth is not replaced by its corresponding permanent tooth, a fact that causes the patient to seek dental help. Conversely, inclusion of permanent molars generally occurs in asymptomatic patients. Of 43 studied molars, only 3 had experienced pain because of pericoronitis. Thus, the discovery of an inclusion (impaction) usually occurs during a routine visit.[20] This implies a late diagnosis of the abnormality. In effect, in our study, 7 patients were over the age of 20 years, and the prognosis of their unerupted permanent molars was poor.

Patients included in the study were referred to the Oral and Maxillofacial Service, which was the reason for both the late diagnosis and the severity of cases, as well as the poor prognosis of unerupted molars. Extraction of the impacted or retained molar is indicated when surgical exposure and orthodontic treatment cannot lead to eruption[7] or if a pathologic process is present. In 8 cases, a follicular cyst associated with the impacted molar was diagnosed. When roots of the impacted tooth are completely developed, the chances

for success of conservative treatment decrease dramatically.[21,22] The best timing for surgical treatment of impacted second molars is in adolescence, from 10 to 17 years of age,[21-23] when the third molar root is not yet completely formed and the apexes are still open.[21] Treatment consists of extraction of third molars and surgical repositioning of second molars when the latter exhibit mesial tilting. A common finding after this technique is the loss of pulp responsiveness of second molars,[23] though this seems to be due to pulp calcification, rather than to pulp necrosis. Late diagnosis also causes occlusal disturbances to be more severe and prevalent, eg, the version of neighboring teeth (16%) and extrusion (19%) or absence of complete eruption of opposing teeth (44%).

Raghoebar et al[24] recommended the regular follow-up of patients who have had retained teeth because it is relatively likely that new akylosis will develop. In our study, 11 of 25 patients had more than 1 impacted or retained permanent molar (excluding third molars), and these molars were generally on the same side of the patient's mouth. Moreover, in 26 second molars, the neighboring third molar had an altered position; however, it is not always possible to ascertain whether this alteration was the cause of the inclusion because mesioangular positioning of third molars is very common,[25] and the noneruption of second molars is very rare. Moreover, at the usual age of eruption of the second molar, the third molar cannot constitute a barrier in the eruption path. In any case, the treatment approach indicated for inclusion is not heavily dependent on whether it is a primary retention or a bony impaction.[7] In both cases, surgical exposure, orthodontic treatment, or both, might bring the molar into the dental arch. But there is an important difference if the disturbance is a secondary retention (ie, retention after emergence), which has been attributed to ankylosis. Secondarily retained permanent molars usually cannot be treated by surgical exposure or orthodontics, and a prosthetic build-up is thus required if infraocclusion is slight and growth has been completed or extraction otherwise is the alternative.[7]

Early removal of molars, before the growth spurt occurs, has been recommended to treat secondary retention.[7] This disturbance is associated with ankylosis; the presence in the dental arch of ankylosed teeth during the growth period can cause severe tilting and extrusion of neighboring and opposing teeth.

The prognosis seems to be better for maxillary second permanent molars than for mandibular second permanent molars, for inasmuch as the eruption of upper third molars has a distal direction, they drift mesially and upright at the same time, resulting in an acceptable closure of the space. Conversely, mandibular third molars erupt in a vertical or mesial direction, and their mesial drift is often associated with mesial tilting[7] and poor occlusion.[26] However, if second molar extraction is performed in an early stage of development of the third molar, this tooth can also spontaneously replace the lost second molar. Very likely, the scenario is the same when considering first molar extraction, and an early extraction before second molar eruption would facilitate the "replacement" of the lost molar, but information in the dental literature is lacking.

The results of the treatments do not seem very promising. Only in about half of the conservatively treated cases could the nonerupted tooth reach an acceptable position, and in 28% of all cases, the molar had to be extracted. The advanced age at diagnosis, the severity of the cases, and the difficulty and uncertainty of conservative treatment can contribute to this poor result. Table II shows that orthodontic treatment of the impacted second molar had a 75% success rate (3 of 4 erupted molars), though it must be taken into account that these treatments were performed only in 3 young patients (two 14-year-olds and one 15-year-old patient).

In some cases, it is not enough to extract the third molars to allow for correct eruption of the second molars in teenagers.[22,27] However, in cases of surgical exposure with or without surgical luxation of second mandibular molars, lower third molar extraction in the same operation is recommended when there is posterior crowding in the dental arch,[22,23] because the lower third molar could prevent lower second molar eruption even if it is not the direct cause of the noneruption of these molars. Nevertheless, if second molar eruption is questionable, it could be wiser to perform early extraction of second molars and allow the third molars to replace them.[7]

CONCLUSIONS

1. In patients with absence of eruption of permanent first or second molars, the most commonly nonerupted teeth were the second molars, especially the second mandibular molars.
2. In this group of patients, most of the first and second molars showed a normal direction of eruption, which speaks against impaction.
3. In almost half of the patients, there was more than 1 retained or impacted first or second molar. In addition, 44% of the unerupted molars had unerupted opposing teeth. Thus, there are reasons to suspect that these eruption disturbances are not an isolated case in patients and that there might be factors that predispose to this disorder.

4. The success rate of conservative treatment was approximately 50%, which shows that management is difficult and unpredictable. If neither an early diagnosis is established nor early treatment is provided, loss of the molar or absence of function are the most common final result.

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