TREATMENT OPTIONS FOR IMPACTED TEETH
CHARLES A. FRANK
J Am Dent Assoc 2000;131;623-632

The following resources related to this article are available online at jada.ada.org (this information is current as of May 10, 2009):

Updated information and services including high-resolution figures, can be found in the online version of this article at:
http://jada.ada.org/cgi/content/full/131/5/623

This article appears in the following subject collections:
Endodontics http://jada.ada.org/cgi/collection/endodontics

Information about obtaining reprints of this article or about permission to reproduce this article in whole or in part can be found at:
http://www.ada.org/prof/resources/pubs/jada/permissions.asp

© 2009 American Dental Association. The sponsor and its products are not endorsed by the ADA.
The intent of this article is to consolidate and organize available information regarding treatment for impacted teeth and the associated complications.

Studies have reported that the incidence of tooth impaction varies from 5.6 to 18.8 percent of the population. Any permanent tooth may become impacted; however, the maxillary canine, with the exception of the third molars, has been the most frequently impacted tooth. Although impacted teeth (other than third molars) affect a small percentage of the population, they accounted for 22.4 percent of patients referred for orthodontic evaluation in a Swedish study.

TREATMENT OPTIONS

There are four treatment options for impacted teeth: observation, intervention, relocation and extraction. Some interaction among treatment options is likely. Observation implies no treatment for a specific period, which is subdivided into preimpaction and postimpaction periods.

Intervention consists of a brief period of orthodontic therapy or the removal of teeth (deciduous and/or permanent), with the attempt to eliminate tooth impaction. Relocation refers to the repositioning of an impacted tooth surgically or orthodontically. Extraction in this report refers only to the removal of an impacted permanent tooth.

OBSERVATION

Observation of the dentition normally begins with the completion of the deciduous eruption and ends with the removal or eruption of an impacted tooth. To be a viable treatment option, a dental professional using clinical and radiographic evaluation can, in most cases, predict tooth impaction (that is, the preimpaction observation period) or anticipate pathological sequelae associated with impacted teeth (that is, the postimpaction observation period). If the deciduous dentition has erupted without incident and findings on the oral examination are unremarkable, the preimpaction observation period begins with the
eruption of first permanent molars at approximately 6 years of age.

**Preimpaction observation.** I present this period chronologically to allow the dentist to assess the development of the dentition at significant times.

Ectopic eruption of molars. The most common ectopically erupting permanent teeth are the maxillary first molars, the maxillary canines and the mandibular lateral incisors. Before patients reach age 7 years, researchers and clinicians recommend that ectopically erupting maxillary first molars be observed, because their eruption is still deemed possible.5-10 After age 7 years, molar eruption is considered impossible. Figure 1 shows maxillary and mandibular arch-length discrepancies in an 8-year-old boy, as evidenced by the premature loss of the deciduous mandibular right canine and atypical resorption of the deciduous maxillary left canine root by the erupting maxillary left lateral incisor.

My literature search revealed that maxillary first-molar ectopic eruption is highly correlated with large permanent maxillary teeth, abnormal permanent maxillary first molar angle of eruption, short maxillary, large deciduous maxillary teeth, posterior positioning of the maxilla and delayed calcification of affected maxillary first molars.10-12 The mesial inclination of the developing maxillary first molar and its location (apical to the distobuccal root of the deciduous second molar) are radiographic prognosticators for ectopic eruption.8 Untreated irreversible ectopic eruption of the maxillary first molar results in loss of arch length.

Ectopic eruption of incisors. Ectopic eruption of the mandibular lateral incisor may delay its emergence into the mouth or result in the premature loss of the adjacent deciduous canine. Pronounced mandibular incisor crowding or premature loss of one or both deciduous canines is commonly associated with mandibular arch-length discrepancy. Therefore, analysis of arch length should be done.

**Supernumerary teeth.** About 1 to 3 percent of the population have supernumerary teeth.13,14 More than 90 percent of supernumerary teeth are found in the maxilla, with the vast majority located in the premaxilla.11-13 Primosch13 recommended routine radiographic examination of the maxillary occlusal surface in children aged 6 through 9 years. Because supernumerary teeth frequently appear in the premaxilla, their presence must be ruled out when maxillary incisor eruption is delayed or the eruption sequence is atypical. Complications associated with the presence of supernumerary teeth are cystic degeneration, nasal eruption, interference with the eruption of adjacent permanent teeth (delayed or displaced), resorption of adjacent permanent teeth, permanent tooth rotation, diastema, local infection and periodontitis.11,13

In an attempt to establish treatment options, authors11,12,14 have categorized supernumerary teeth by their shape: conical (peglike) and tuberculate (tooth width and length are similar).11,12,14 The conical form is the most common, is usually located between the maxillary incisors and frequently erupts. The conical form can displace or rotate adjacent maxillary incisors; however, incisor eruption is rarely delayed.14 Therefore, conical supernumerary teeth are permitted to erupt, which simplifies their removal. The inverted conical form is frequently associated with cystic lesions and can erupt into the nasal floor, becoming more difficult to remove with time.11 The removal of these supernumer-
ary teeth is recommended.\textsuperscript{13,14} The tuberculate form rarely erupts, is frequently bilateral and interferes with permanent tooth eruption.\textsuperscript{11,12} Immediate removal of the tuberculate supernumerary tooth is also recommended.\textsuperscript{13,14}

Tissue obstructions. If permanent tooth eruption is delayed and if findings of clinical and radiographic examinations are unremarkable, then the dental professional should consider soft-tissue or osseous interferences to eruption. Non-pathological soft-tissue interferences arise from thickened gingival tissue or thickened follicular tissue.\textsuperscript{9,16} If the stage of root development is not consistent with the extent of eruption, I recommend that the clinician compare clinical and radiographic findings with those obtained more than six months earlier to assess tooth eruption.

Ectopic eruption of canines. Researchers recommend early detection of impacted maxillary canines because of their unpredictable and rapid resorption of the maxillary incisor roots.\textsuperscript{17-19} Ericson and Kurlo\textsuperscript{17} reported that buccally and palatally impacted canines were proportionally associated with incisor resorption. Resorption has not been associated with canine impaction before age 10 years.\textsuperscript{18} Ericson and Kurlo\textsuperscript{18,19} found that incisor root resorption was three times more prevalent in girls than in boys. This may be because of more advanced stages of dental development in girls.\textsuperscript{20-23}

The eruption path of the maxillary canine is not radiographically predictable before 10 years of age.\textsuperscript{19,22,24} However, after 10 years of age, alveolar contour was a good predictor of unerupted canine position (especially when compared with the contralateral canine).\textsuperscript{21,22,24} According to Ericson and Kurlo,\textsuperscript{21,22} 5 percent of 10- to 11-year-old children have unerupted nonpalpable canines. These authors\textsuperscript{21} recommended radiographic evaluation in these cases. Palatal maxillary canine impaction in Class I uncrowded malocclusions was predicted on the basis of the absence of a permanent canine alveolar bulge superior to the deciduous canine, and on the frontal radiograph revealing a medially tipped permanent canine at the lateral border of the nasal cavity.\textsuperscript{23}

Becker and colleagues\textsuperscript{25} reported that maxillary canine palatal impaction resulted from two events during canine eruption. The maxillary lateral incisor root was instrumental in both. Initially, the lateral incisor root failed to provide buccal guidance to the erupting canine, permitting its palatal movement. Once the maxillary canine was palatally positioned, the lateral incisor root impeded further canine eruption into the narrowing alveolus. Becker and colleagues\textsuperscript{25} demonstrated that people with absent or smaller-than-normal maxillary lateral incisors accounted for less than 1.1 percent of the population; however, 47.7 percent of people with palatally impacted maxillary canines had absent (5.5 percent) or small (42.2 percent) lateral incisors.

Small maxillary lateral incisors tend to possess shorter roots and develop later than normal.\textsuperscript{25} Therefore, they frequently fail to provide buccal guidance for erupting canines and then prevent further canine eruption into the narrowing alveolar process. Although there is no buccal guidance for an erupting maxillary canine when the lateral incisor is missing, canine eruption into the narrowing alveolar process is not
prevented. Figure 2 shows an 11-year-old girl with a haplodont (maxillary left lateral incisor), overretained deciduous maxillary left and right lateral incisors (both teeth firm to palpation), congenitally missing or unerupted maxillary right lateral incisor (no alveolar bulge noted) and the absence of maxillary canine buccal alveolar bulges. Neither the deciduous lateral incisor roots nor the undersized maxillary left lateral incisor provided sufficient buccal guidance for the erupting maxillary canines. In addition, the deciduous maxillary canines and maxillary lateral incisor prevented canine eruption into the narrowing alveolar process.

Genetic factors have been reported to be the primary cause of palatally impacted maxillary canines.° An increased probability of palatally impacted canines is associated with other genetic dental anomalies (that is, tooth agenesis, smaller tooth size and delayed tooth development), bilateral occurrence (17 to 45 percent of cases), sex differences (as much as a 1:3.2 male-to-female ratio), familial history of palatally impacted canines and ethnic differences (5:1 European-to-Asian ratio).° Therefore, anomalous or missing permanent maxillary lateral incisors and palatally impacted maxillary canines are considered covariables.° Regardless of whether a missing or anomalous maxillary lateral incisor is a primary etiologic factor of, or a covariable with, palatally impacted maxillary canines, the clinician should be aware that these conditions have a greater probability of appearing together.

Ankylosis. Researchers have reported that from 1.3 to 14 percent of the population have experienced ankylosis of a primary molar. Maxillary deciduous molars tend to ankylose at the time of, or before the eruption of, the first permanent molars, while the mandibular deciduous molars ankylose at about age 7 to 8 years. Most deciduous molars with infraocclusion show progression with time.° Figure 3 is a panoramic radiograph of a 9-year-old girl with ankylosed deciduous maxillary molars and deciduous mandibular second molars. The deciduous mandibular first molars exfoliated normally at a time consistent with the development of the dentition, the mandibular second molars are about to exfoliate and the deciduous maxillary molars are resorbing normally.

Figure 3. A. Panoramic radiograph of a 9-year-old girl reveals ankylosed deciduous first molars (apparently farther from the occlusal plane) and deciduous mandibular second molars. B. Panoramic radiograph of the same patient three years later. Note the ankylosis of the deciduous maxillary second molars and the greater infraocclusion of the deciduous first molars and deciduous mandibular second molars. The deciduous mandibular first molars exfoliated normally at a time consistent with the development of the dentition, the mandibular second molars are about to exfoliate and the deciduous maxillary molars are resorbing normally.
mandibular second molars.

Reported consequences of deciduous molar ankylosis are loss of arch length, impaction of succedaneous teeth, ectopic eruption path of succedaneous teeth, supraeruption of opposing dentition, periodontal compromise to adjacent permanent teeth, surgical complication of deciduous tooth removal (trauma), introduction of epithelial tissue into the bony alveolus and attenuated alveolar growth. However, numerous longitudinal studies have revealed that infraoccluded molars that exfoliated naturally within a normal period did not affect the eruption time or path of succedaneous teeth, did not permanently affect alveolar bone development and did not adversely affect the root development of succedaneous teeth. In addition, Kurol and Thilander noted spontaneous uprighting of all permanent molars with the eruption of the premolars, which resolved the arch-length discrepancy resulting from the mesial tipping of the first molar. The removal of ankylosed deciduous molars is unwarranted unless the succedaneous tooth is erupting abnormally or the occlusal surface of the ankylosed deciduous molar is level with the gingival height of the adjacent teeth.32,35,37

Abnormal tooth bud position. Poorly rotated or angulated premolars often are associated with atypical root resorption of the deciduous molars. Figure 4 is a panoramic radiograph of a 10-year-old patient, which reveals absence of third molars and the mandibular right second premolar, an atypically positioned mandibular left second premolar crown and insufficient maxillary and mandibular arch lengths. Radiography should be repeated about nine months later to determine if the position of the developing mandibular left second premolar has improved and if the mandibular right second premolar is beginning to develop.

Interceptive treatment (that is, eruption guidance) also should be considered for arch-length discrepancies. According to Silling and colleagues, minor positional differences in a developing permanent premolar associated with a retained deciduous tooth correct themselves after the deciduous tooth is removed.

Postimpaction observation. Attempting to reposition an impacted tooth into the alveolar process is not always warranted. Complications associated with treatment must be weighed against possible pathological concerns associated with observation. Dentists must consider each patient’s medical status, dental status, age, periodontal condition, hygiene, motivation, adverse habits and functional and occlusal relationships. Complications resulting from treatment include osseous defects, root fracture, root resorption, short root development, fractured roots, the need for endodontic therapy and periodontitis. Only treatment that minimizes injury to the dentition and periodontium should be considered. Treatment can be delayed until the patient is mentally and physically ready.

After tooth impaction is diagnosed and a decision not to treat is made, I recommend periodic observation to rule out possible pathological sequelae. During this postimpaction observation period, clinicians must perform clinical and radiologic examinations about every 18 to 24 months. The following pathological sequelae associated with tooth impaction have been noted: dentigerous cyst, odontogenic keratocyst, adenomatoid odontogenic tumor, calcifying...
epithelial odontogenic (Pindborg) tumor, odontogenic myxoma, ameloblastoma, ameloblastic fibroma, ameloblastic fibrous odontoma, ameloblastic fibrosarcoma (ameloblastic sarcoma), external/internal resorption of the impacted tooth, external root resorption of adjacent teeth, transmigration, referred pain and periodontitis.39-49

INTERVENTION
If a decision to treat is made, treatment should be as minimal as needed to facilitate natural eruption (the most physiologic type of tooth movement), permitting normal septal development and favoring the establishment of adequate bands of keratinized gingivae.7

Attempting to regain space lost from an ectopically erupting first molar is not always warranted.7 Efforts to regain space may be contraindicated in cases in which there is a congenitally missing tooth, a moderate-to-severe arch-length deficiency or a Class I molar relationship on the side of an ectopically erupting molar.

Space-regaining efforts require the maxillary first molar to move distally and buccally, rotate distally and become upright.51 Space can be regained through the placement of separators (brass, spring or elastic) between the maxillary deciduous second molar and the maxillary permanent first molar, with entrapment of 1 millimeter or less.6,7,51 With entrapment of 2 mm or more, the use of fixed or removable appliances is advised.7 Removal of the maxillary deciduous second molar is recommended only when it is not otherwise possible to regain arch length.7 If the deciduous molar has to be removed to regain space, then this space must be maintained after treatment.

Severe crowding, atypical resorption of the mandibular deciduous canine root by the mandibular permanent lateral incisor, or premature loss of one or both mandibular deciduous
canines are symptoms of pronounced anterior arch-length discrepancies. After the mandibular incisors erupt, the mandibular arch-length discrepancy is predicted to determine the need for serial extraction. Serial extraction calls for the timed removal of primary teeth and, ultimately, permanent teeth. If necessary, serial extraction starts with the removal of primary incisors. Serial extraction simplifies and/or shortens orthodontic treatment by facilitating the eruption of the permanent teeth. However, when these patients are not properly observed or treated, serial extraction can cause tooth impaction.

Although overretained or atypically resorbed deciduous teeth are considered to be a consequence, rather than a cause, of impaction, their removal is associated with improvement in, or correction of, permanent tooth position. The removal of a deciduous tooth is advised when there is radiographic evidence of atypical root resorption and the succedaneous tooth is unfavorably inclined or positioned. Fernandez and colleagues recommended removal of the deciduous maxillary canine to prevent impaction when a panoramic radiograph revealed that the complete development of the maxillary lateral incisor and the overlapping of the canine with relation to the lateral incisor were associated with the absence of the canine bulge, lateral incisor agenesis, ankylosis, malformations or ectopic eruption.

The majority of impacted teeth erupt if hard- or soft-tissue obstructions are removed from their eruption paths. Figure 5 shows complete eruption of the mandibular incisors and delayed eruption of the maxillary incisors in a 10-year-old girl. During the course of a year, no change was noted in the position of the maxillary incisors, which were partially embedded in bone and covered by mucosa. The surgical procedure consisted of reflecting and apically repositioning a labial soft-tissue flap with keratinized tissue from the palate. Di Biase conducted a survey, which found that after the removal of supernumerary teeth, 75 percent of the impacted maxillary incisors spontaneously erupted. Many authors have reported that impacted teeth maintain the potential for eruption even after their root apices form.

**RELOCATION**

When interceptive treatment fails to improve the position or inclination of the developing tooth or when teeth are impacted, efforts to reposition them should be considered. Impacted teeth may be repositioned surgically or orthodontically. Surgical relocation. Surgical repositioning (autotransplantation) is deemed a reasonable solution for treating impacted permanent teeth. Indications for surgical repositioning include the patient's age, the need to minimize or eliminate orthodontic treatment and patient compliance. The adult patient may not wish or be able to endure the rigors of extended orthodontic care. Minimizing or eliminating orthodontic treatment for patients with periodontally compromised teeth or marginal dental hygiene practices is recommended. Patients who are medically compromised or who have physical or mental disabilities may benefit from limited or no orthodontic treatment. Also, the cost of surgically assisted orthodontic treatment may be a limiting factor. Other factors to consider are presence or absence of adequate space, shape and status of the impacted tooth, and shape and status of adjacent teeth.

Complications associated with autotransplanted teeth are devitalization, pulpal obliteration, decreased root length, periodontal compromises and root resorption. These complications are affected by the extent of the transplanted tooth's root development, the patient's age, the tooth that is being transplanted, the ectopia of the impacted tooth, the length of extraoral storage during transplantation (that is, the time the tooth is out of the mouth) and the skill of the operator.

**Orthodontic relocation.** Kokich and Mathews recommend surgical exposure and orthodontic eruption of an impacted tooth when its apex is completely formed. Frequently, space must be orthodontically created before the clinician can surgically expose and orthodontically erupt an impacted tooth. This requires only one phase of
orthodontic treatment and hastens the eruption of an impacted tooth.

The prognosis for orthodontically erupting and repositioning an impacted tooth within the alveolar process depends on the position and angulation of the impacted tooth, the length of treatment time, the patient's age, the degree of patient cooperation, the available space and the presence of keratinized gingival tissue. The differential diagnosis for tooth impaction can be made only after the clinician surgically exposes the tooth and attempts orthodontic eruption. If tooth movement is not detectable with reasonable digital force, and orthodontic eruptive forces are unsuccessful, then the tooth is ankylosed. If tooth movement is perceived with reasonable digital force, but there is no response to orthodontic eruptive forces, then primary failure of eruption must be ruled out.

Complications associated with orthodontic repositioning of impacted teeth include absence of or inadequate keratinized gingivae, reduced sulcular depth, gingival recession, increased gingivitis, ankylosis, multiple exposures, devitalization, pulpal obliteration, external root resorption, injury to adjacent periodontium, marginal bone loss and extraction of the impacted tooth and/or an adjacent tooth. Many of these complications can be reduced through judicious surgical exposure and appropriate orthodontic preparation of the dentition.

The orthodontic appliance (including cements, bands, brackets, auxiliaries, arch wires and ligature ties) and poor access to the crown of the impacted tooth compromise local hygiene practices. Results of studies showing compromises to the periodontium of impacted and/or adjacent teeth are inconsistent. Generally, periodontal concerns in regard to impacted teeth have centered on the presence of adequate keratinized gingivae. Surgical techniques and eruption paths were designed to maintain or ensure the presence of adequate amounts of keratinized gingivae. Clinicians must weigh the possibility of creating periodontal problems involving an impacted tooth and/or adjacent teeth as a result of extensive osseous reduction against possible pulpal problems and mechanical challenges encountered while attempting to erupt an impacted tooth with limited osseous reduction.

Because of possible contamination by oral fluids, bonding an attachment or bracket to an impacted tooth is challenging. However, new bonding materials with an affinity for water can improve the placement of attachments on impacted teeth. These materials simplify bonding procedures, minimize the removal of bone from around the crown of the impacted tooth and have clinically acceptable bond strengths.

Clinicians should consider only those treatment goals for impacted teeth that minimize injury to the dentition and periodontium.

**EXTRACTION**

Clinicians should consider only those treatment goals for impacted teeth that minimize injury to the dentition and periodontium. Because it is not possible to reposition all impacted teeth within the alveolus, their removal may be indicated. The following factors need to be evaluated before an impacted tooth is extracted: patient's age, dental status of adjacent teeth (including periodontal, endodontic and operative status, shape, resorption), dental status of the impacted tooth, occlusal relationship and arch length. Complications that are associated with the surgical removal of impacted teeth include periodontally compromised adjacent teeth, damage to adjacent teeth, root fracture, neuropathy, sinus involvement and osseous defect.

**SUMMARY**

To make a differential diagnosis for an impacted tooth, clinicians must perform a clinical assessment of the patient's condition. Informed consent should address treatment options for impacted teeth and associated treatment complications. I have presented four treatment options for the management of impacted teeth: observation, intervention, relocation and extraction. Some interaction exists among the treatment options, and some options are viable only for a specific period. Before the dentist can recommend an appropriate treatment plan to a patient, he or she must perform a clear clinical and radiographic assessment of the patient's mouth, review the pathological ramifications...
resulting from impacted teeth, discuss the complications of treatment with the patient and consider the patient’s expressed concerns.

Dr. Frank is a board-certified orthodontist in private practice. He also teaches part-time at the University of Florida, Jacksonville, and the Jacksonville Naval Air Station. Address reprint requests to Dr. Frank, 8657 Autumn Green Dr, Jacksonville, FL 32256.


