# Principles of Management of Impacted teeth

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CHAPTER

## CHAPTER OUTLINE

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An impacted tooth is one that fails to erupt into the dental arch within the expected time. The tooth becomes impacted because adjacent teeth, dense overlying bone, or excessive soft tissue prevents eruption. Because impacted teeth do not erupt, they are retained for the patient's lifetime unless surgically removed. The term *unerupted* includes both impacted teeth and teeth that are in the process of erupting. The term *embedded* is occasionally used interchangeably with the term *impacted*.

Teeth most often become impacted because of inadequate dental arch length and space in which to erupt; that is, the total length of the alveolar bone arch is smaller than the total length of the tooth arch. The most common impacted teeth are the maxillary and mandibular third molars, followed by the maxillary canines and mandibular premolars. The third molars are the most frequently impacted, because they are the last teeth to erupt; therefore they are the most likely to have inadequate space for eruption.

In the anterior maxilla, the canine tooth is also commonly prevented from erupting by crowding from other teeth. The canine tooth usually erupts after the maxillary lateral incisor and maxillary first premolar. If space is inadequate to allow eruption, the canine tooth becomes impacted. In the anterior mandible a similar situation affects the mandibular premolars, because they erupt after the mandibular first molar and mandibular canine. Therefore if room for eruption is inadequate, one of the premolars, usually the second premolar, remains un-erupted and becomes impacted.

As a general rule, all impacted teeth should be removed unless removal is contraindicated. Extraction should be performed as soon as the dentist determines that the tooth is impacted. Removal of impacted teeth becomes more difficult with advancing age. The dentist should *not* recommend that impacted teeth be left in place until they cause difficulty. If the tooth is left in place until problems arise, the patient may experience an increased incidence of local tissue morbidity, loss of adjacent teeth and bone, and potential injury to adjacent vital structures. Additionally, if removal of impacted teeth is deferred until they cause problems later in life, surgery is more likely to be complicated and hazardous, because the patient may have compromising systemic diseases. A fundamental precept of the philosophy of dentistry is that problems should be prevented. Preventive dentistry dictates that impacted teeth are to be removed before complications arise.

This chapter discusses the management of impacted teeth, It is not a thorough or in-depth discussion of the technical aspects of surgical impaction removal. Instead its goal is to provide both the information necessary for proper management and a basis for determining the difficulty of surgery.

## INDICATIONS FOR REMOVAL OF IMPACTED TEETH

All impacted teeth should be considered for removal as soon as the diagnosis is made. The average age for completion of the eruption of the third molar is age 20, although eruption may continue in some patients until age 25. During normal development the lower third molar begins its development in a horizontal angulation, and as the tooth develops and the jaw grows, the angulation changes from horizontal to mesioangular to vertical. Failure of rotation from the mesioangular to the vertical direction is the most common cause of the tooth remaining impacted. The second major factor is that the mesiodistal dimension of the teeth versus the length of the jaw is such that inadequate room exists in the alveolar process anterior to the anterior border of the ramus to allow the tooth to erupt into position.

As noted earlier, some third molars will continue to erupt after age 20, coming into final position by age 25. Multiple factors are associated with continued eruption. When late eruption occurs, the unerupted tooth is usually covered only with soft tissue or very slightly with bone. These teeth are almost always in a vertical position and are relatively superficially positioned with respect to the occlusal plane of the adjacent second molar.

Finally and perhaps most importantly, sufficient space exists between the anterior border of the ramus and the second molar tooth to allow eruption.[1-2] Likewise, if the tooth does not erupt after age 20, it is most likely covered with bone. In addition, the tooth is likely a mesioangular impaction and located lower in the alveolar process near the cervical level of the adjacent second molar. Finally, inadequate space exists to allow eruption. Therefore the dentist and surgeon can use these parameters to predict whether or not a tooth will erupt into the arch or remain impacted.

Early removal reduces the postoperative morbidity and allows for the best healing.[3-6] Younger patients tolerate the procedure better and recover more quickly and with less interference to their daily lives. Periodontal healing is better in the younger patient, because of better and more complete regeneration of the periodontal tissues. Moreover, the procedure is easier to perform in younger patients. The ideal time for removal of impacted third molars is when the roots of the teeth are one-third formed and before they are two-thirds formed, usually during the late teenage years, between ages 17 and 20.

If impacted teeth are left in the alveolar process, it is highly probable that one or more of several problems will result.[7-8] To prevent this, impacted teeth should be removed.

### Prevention of Periodontal Disease

Erupted teeth adjacent to impacted teeth are predisposed to periodontal disease (Figs. 9-1 and 9-2). The mere presence of an impacted mandibular third molar decreases the amount of bone on the distal aspect of an adjacent second molar (see Fig. 9-1). Because the most difficult tooth surface to keep clean is the distal aspect of the last tooth in the arch, the patient may have gingival inflammation with apical migration of the gingival attachment on the distal aspect of the second molar. With even minor gingivitis the causative bacteria have access to a large portion of the root surface, which results in the early formation of severe periodontitis (see Fig. 9-2). Patients with impacted mandibular third molars often have deep periodontal pockets on the distal aspect of the second molars but have normal sulcular depth in the remainder of the mouth.

The accelerated periodontal problem resulting from an impacted third molar is especially serious in the maxilla. As a periodontal pocket expands apically, it becomes involved with the distal furcation of the maxillary second molar relatively early, which makes advancement of the periodontal disease more rapid and severe. In addition, treatment of the localized periodontal disease around the maxillary second molar is more difficult because of the distal furcation involvement.

By removing the impacted third molars early, periodontal disease can be prevented and the likelihood of bony healing and bone fill into the area previously occupied by the crown of the third molar is increased.[4-6]

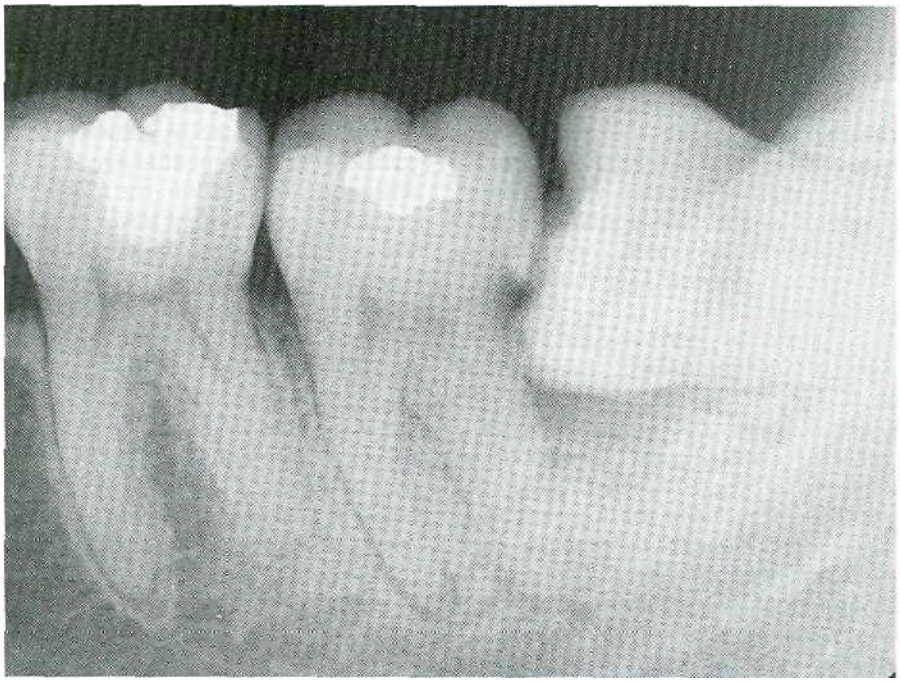


FIG. 9-1 Radiograph of mandibular third molar impacted against second molar, with bone loss resulting from presence of third molar.

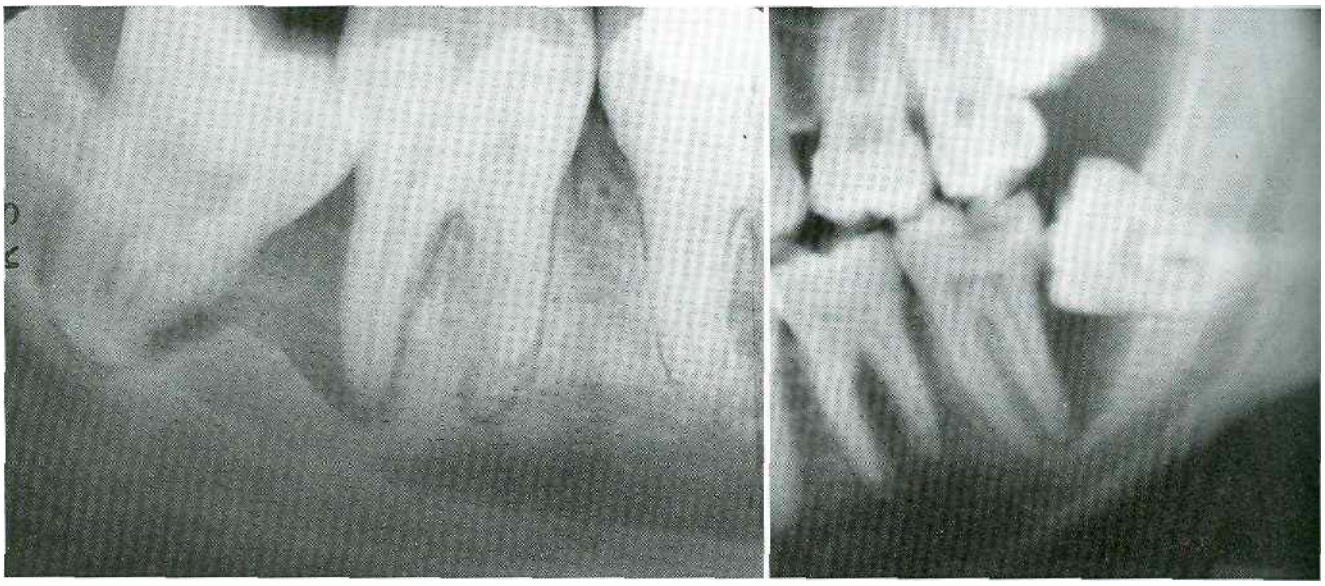


FIG. 9-2 Radiographs show variations of mandibular third molar impacted against second molar, with severe bone loss secondary to periodontal disease and third molar.

### Prevention of Dental Caries

When a third molar is impacted or partially impacted, the bacteria that cause dental caries can be exposed to the distal aspect of the second molar, as well as to the third molar. Even in situations in which no obvious communication between the mouth and the impacted third molar exists, there may be enough communication to allow for caries production (Figs. 9-3 through 9-5).

### Prevention of Pericoronitis

When a tooth is partially impacted with a large amount of soft tissue over the axial and occlusal surfaces, the patient frequently has one or more episodes of pericoro-nitis.[9] Pericoronitis is an infection of the soft tissue around the crown of a partially impacted tooth and is caused by the normal oral flora. For most patients the bacteria and host defenses maintain a delicate balance, but host defenses cannot eliminate the bacteria.

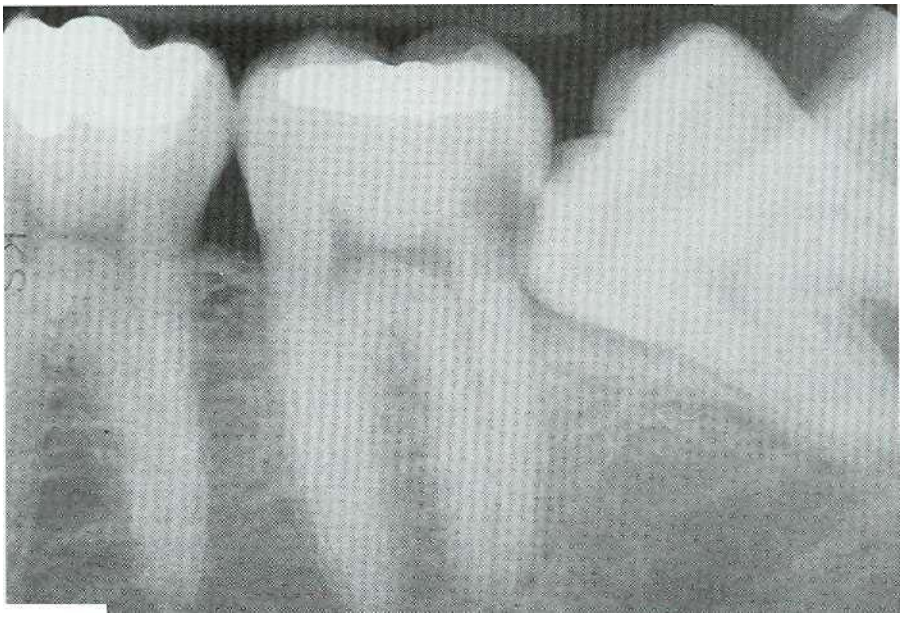


FIG. 9-3 Radiograph of caries in mandibuiar second molar secondary to presence of impacted third molar.

If the host defenses are compromised (e.g., during minor illnesses, such as influenza or an upper respiratory infection, or from severe fatigue), infection can occur. Thus although the impacted tooth has been present for some time without infection, if the patient experiences a mild, transient decrease in host defenses, pericoronitis may result.

Pericoronitis can also arise secondary to minor trauma from a maxillary third molar. The soft tissue that covers the occlusal surface of the partially erupted mandibular third molar (known as the *operculum)* can be traumatized and become swollen. Often the maxillary third molar further traumatizes the already swollen operculum, which causes increased swelling that again can be traumatized more easily. This spiraling cycle of trauma and swelling is often interrupted only by removal of the maxillary third molar.

Another common cause of pericoronitis is entrapment of food under the operculum. During eating, a small amount of food may be packed into the pocket between the operculum and the impacted tooth. Because this pocket cannot be cleaned, bacteria invade it and pericoronitis begins.

Streptococci and a large variety of anaerobic bacteria (the usual bacteria that inhabit the gingival sulcus) cause pericoronitis. It can be treated initially by mechanically debriding the large periodontal pocket that exists under the operculum by using hydrogen peroxide as an irrigating solution. Hydrogen peroxide not only mechanically removes bacteria with its foaming action, it also reduces the number of anaerobic bacteria by releasing oxygen into the usually anaerobic environment of the oral cavity. Other irrigates, such as chlorhexidine or iodophors, can reduce the bacterial population of the pocket.

Pericoronitis can present as a very mild infection or as a severe infection that requires hospitalization of the patient. Just as the severity of the infection varies, the treatment and management of this problem vary from very mild to aggressive.

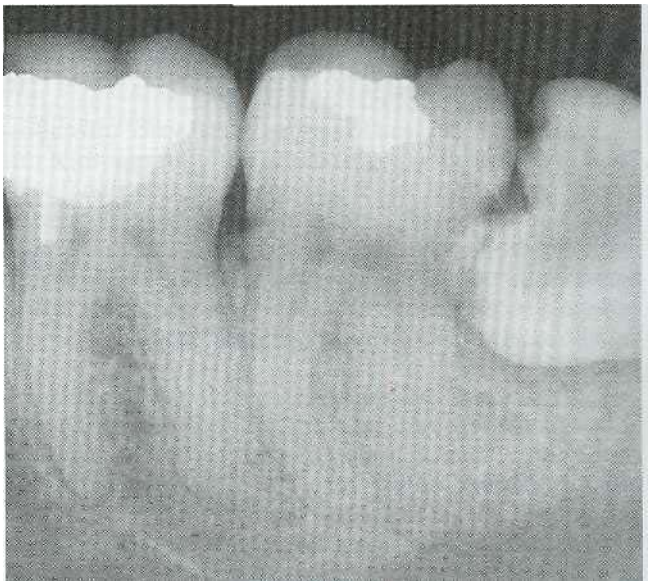


FIG. 9-4 Radiograph of caries in mandibular impacted molar.

In its mildest form, pericoronitis is a localized tissue swelling and soreness. For patients with a mild infection, irrigation and curettage by the dentist and home irrigations by the patient usually suffice.

If the infection is slightly more severe with a large amount of local soft tissue swelling that is traumatized by a maxillary third molar, the dentist should consider extracting the maxillary third molar in addition to local irrigation.

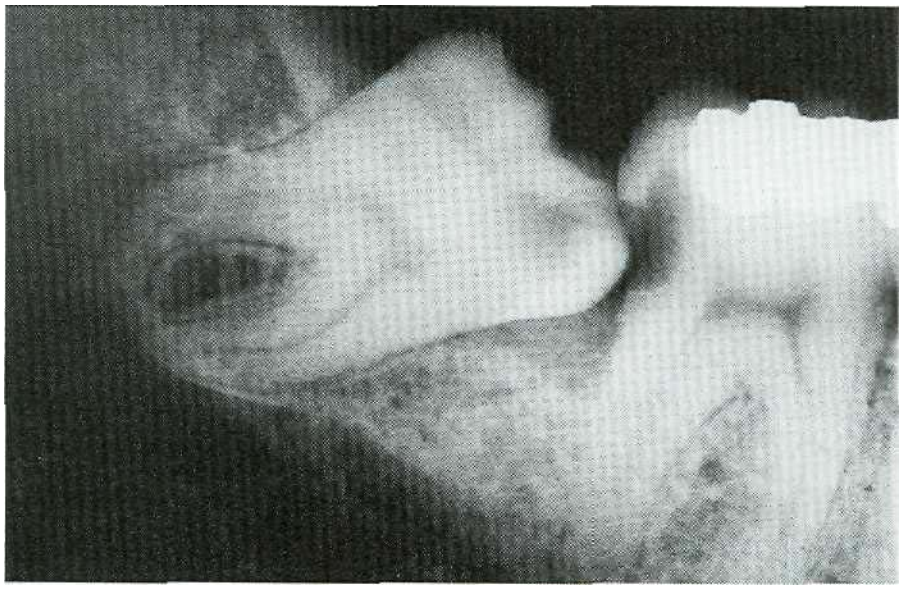


FIG. 9-5 Radiograph of caries in both impacted third molar and second molar.

For patients who have (in addition to local swelling and pain) mild facial swelling, mild trismus secondary to inflammation extending into the muscles of mastication, and a low-grade fever, the dentist should consider administering an antibiotic along with irrigation and extraction. The antibiotic of choice is penicillin.

Pericoronitis can lead to serious fascial space infections. Because the infection begins in the posterior mouth, it can spread rapidly into the fascial spaces of the mandibular ramus and the lateral neck. If a patient develops trismus (with an inability to open the mouth more than 20 mm), a temperature of greater than 101° F, facial swelling, pain, and malaise, the patient should be referred to an oral and maxillofacial surgeon, who may admit the patient to the hospital.

Patients who have had one episode of pericoronitis, although managed successfully by these methods, will continue to have episodes of pericoronitis, unless the offending mandibular third molar is removed. The patient should be informed that the tooth should be removed at the earliest possible time to prevent recurrent infections. The mandibular third molar should not be removed until the signs and symptoms of pericoronitis have been completely resolved. The incidence of postoperative complications, specifically dry socket and postoperative infection, increases if the tooth is removed during the time of active infection.

Prevention of pericoronitis can be achieved by removing the impacted third molars before they penetrate the oral mucosa and are visible. Although excision of the surrounding soft tissue, or operculectomy, has been advocated as a method for preventing pericoronitis without removal of the impacted tooth, it is very painful and usually does not work. The soft tissue excess tends to recur, because it drapes over the impacted tooth and causes regrowth of the operculum. The overwhelming majority of cases of pericoronitis can be prevented only by extraction of the tooth.

**Prevention of Root Resorption**

Occasionally, an impacted tooth causes sufficient pressure on the root of an adjacent tooth to cause root resorp-tion (Figs. 9-6 and 9-7). Although the process by which root resorption occurs is not well defined, it appears to be similar to the resorption process primary teeth undergo in the presence of the succedaneous teeth. Removal of the impacted tooth may result in salvage of the adjacent tooth by cemental repair. Endodontic therapy may be required to save these teeth.

**Impacted Teeth under a Dental Prosthesis**

When a patient has an edentulous area restored, there are several reasons that impacted teeth in the area should be removed before the prosthetic appliance is constructed. After teeth are extracted, the alveolar process slowly undergoes resorption. Thus the impacted tooth becomes closer to the surface of the bone, giving the appearance of erupting. The denture may compress the soft tissue on the impacted tooth, which is no longer covered with bone; the result is ulceration of the overlying soft tissue and initiation of an odontogenic infection (Fig. 9-8).

Impacted teeth should be removed before prosthesis is constructed because, if the impacted tooth must be removed after construction, the alveolar ridge may be so altered by the extraction that the prosthesis becomes unattractive and less functional (Fig. 9-9). In addition, if removal of impacted teeth in edentulous areas is achieved before the prosthesis is made, the patient is probably in good physical condition. Waiting until the overlying bone has resorbed and ulceration with infection occurs does not produce a favorable situation for extraction. If extraction is postponed, the patient will be older and more likely to be in poorer health. Furthermore, the mandible may have become atrophic, which increases the likelihood of fracture during tooth removal (Fig. 9-10).

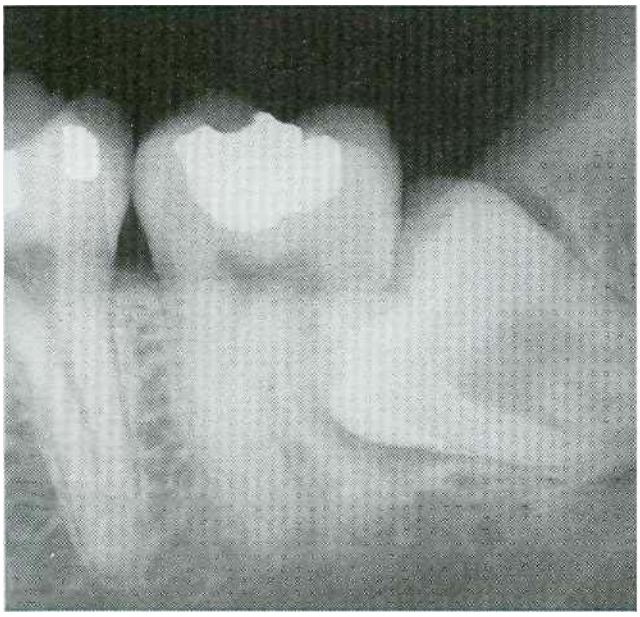


FIG. 9-6 Root resorption of second molar as result of impacted third molar.

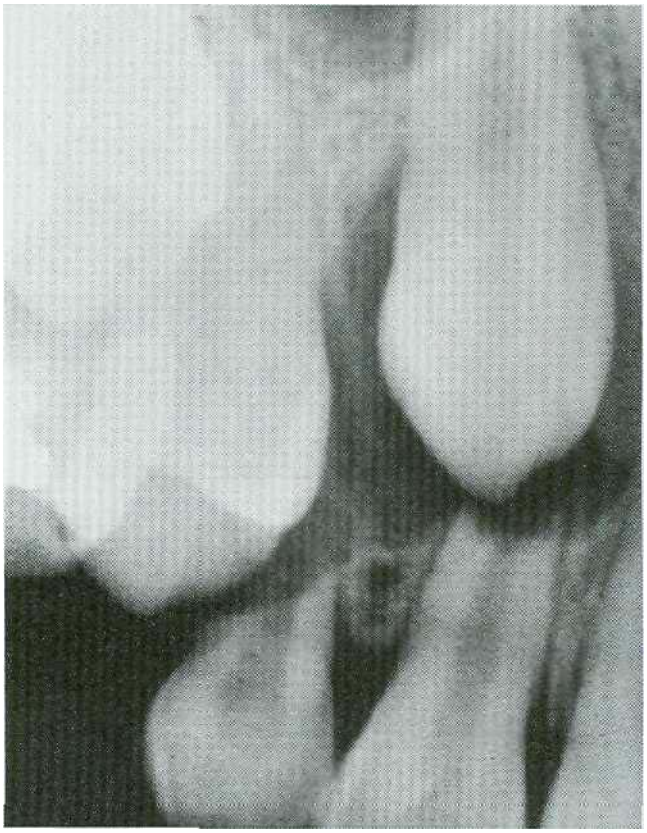


FIG. 9-7 Root resorption of maxillary lateral incisors as result of impacted canine.

### Prevention of Odontogenic Cysts and Tumors

When impacted teeth are retained within the alveolar process, the associated follicular sac is also retained. Although in most patients the dental follicle maintains its original size, it may undergo cystic degeneration and become a dentigerous cyst or keratocyst. If the patient is closely followed, the dentist can diagnose the cyst before it reaches large proportions (Fig. 9-11). However, unmon-itored cysts can reach enormous sizes (Fig. 9-12). As a general guideline, if the follicular space around the crown of the tooth is greater than 3 mm, the diagnosis of a dentigerous cyst is a reasonable one.

In the same way that odontogenic cysts can occur around impacted teeth, odontogenic tumors can arise from the epithelium contained within the dental follicle. The most common odontogenic tumor to occur in this region is the ameloblastoma. Usually, ameloblastomas in this area must be treated aggressively by excision of the overlying soft tissue and of at least a portion of the mandible. Occasionally, other odontogenic tumors may occur in conjunction with impacted teeth (Fig. 9-13).

Although the overall incidence of odontogenic cysts and tumors around impacted teeth is not high,[10] the overwhelming majority of pathologic conditions of the mandibular third molar are associated with unerupted teeth. It is therefore recommended that impacted teeth be removed to prevent the occurrence of cysts and tumors.

### Treatment of Pain of Unexplained Origin

Occasionally, patients come to the dentist complaining of pain in the retromolar region of the mandible for no obvious reasons. If conditions such as myofascial pain dysfunction syndrome and temporomandibular joint (TMJ) disorder are excluded and if the patient has an unerupted tooth, removal of the tooth sometimes results in resolution of the pain.

### Prevention of Fracture of the Jaw

An impacted third molar in the mandible occupies space that is usually filled with bone. This may weaken the mandible and render the jaw more susceptible to fracture (Fig. 9-14). If the jaw fractures through the area of an impacted third molar, the impacted third molar is frequently removed before the fracture is reduced and intermaxillary fixation is applied.

### Facilitation of Orthodontic Treatment

In patients who require retraction of first and second molars by orthodontic techniques, the presence of impacted third molars may interfere with the treatment. It is therefore recommended that impacted third molars be removed before orthodontic therapy is begun.

Another consideration is that, after orthodontic treatment has been concluded, there may be crowding of the mandibular incisor teeth. This has been attributed to the mesial force transmitted to the molar and premolar teeth by impacted third molars, especially mesially inclined impactions.[11]-[12] Several other factors influence crowding. Growth of the maxilla stops before growth of the mandible. If the upper and lower incisors are in a proper overbite and overjet relationship, and if the mandible continues to grow after the maxilla stops growing, the mandibular incisors then become crowded to accommodate the constriction imposed on them by the maxillary incisors. This explanation appears sound, because crowd-

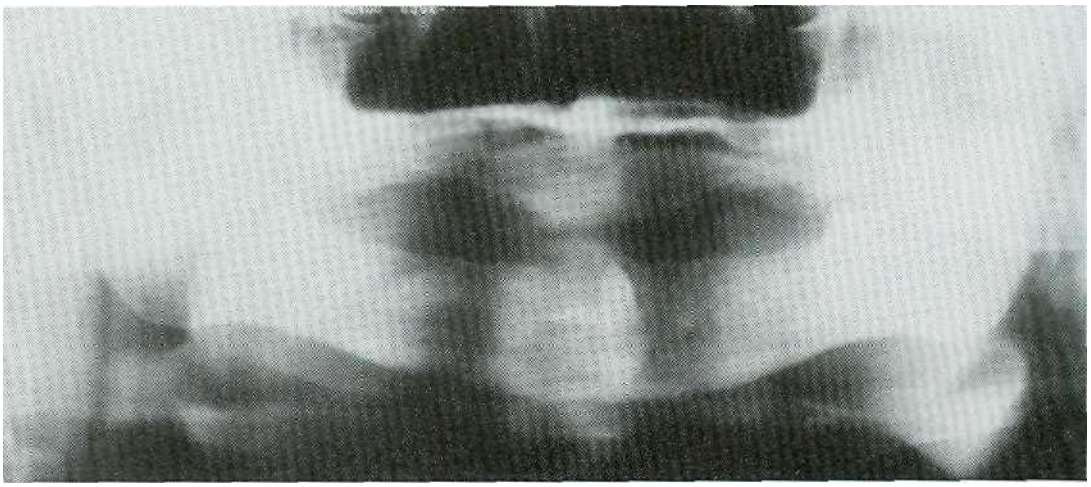


FIG. 9-8 Impacted tooth retained under denture. Tooth is now at surface and is causing infection.

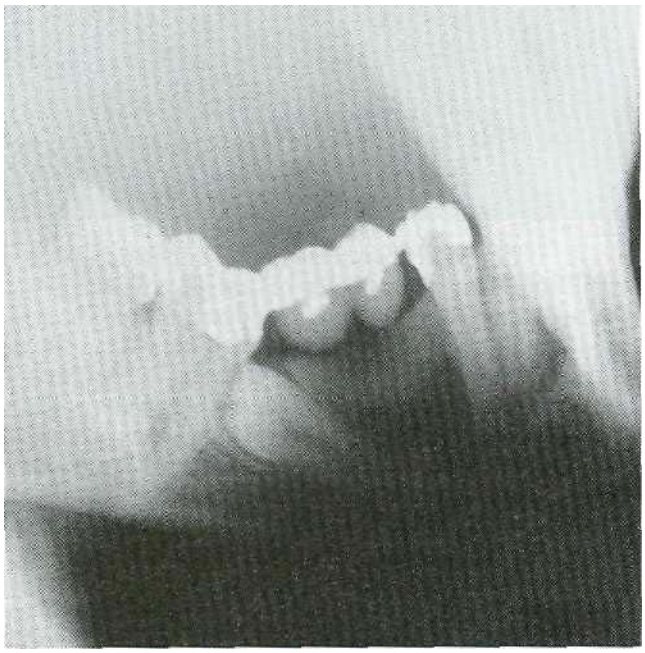


FIG. 9-9 Impacted tooth under fixed bridge. Tooth must be removed and therefore may jeopardize bridge.

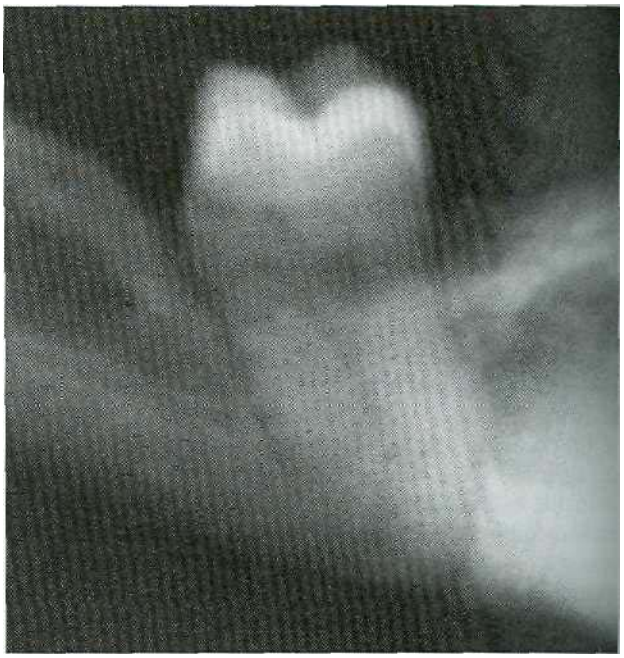


FIG. 9-10 Impaction in atrophic mandible, which may result in jaw fracture during extraction.

ing occurs after the age at which the maxilla stops growing and the mandible continues forward growth.

Many orthodontists still refer their patients to surgeons for removal of impacted third molars after orthodontic treatment is complete. Although the surgeon should explain the other reasons for surgery, the decision to remove impacted teeth to help prevent crowding should be supported.

### Optimal Periodontal Healing

As noted earlier, one of the most important indications for removal of impacted third molars is to preserve the periodontal health. A great deal of attention has been given to the two primary parameters of periodontal health after third molar surgery; that is, bone height on the distal aspect of the second molar and attachment level on the distal aspect of the second molar.

Recent studies have provided information on which to base the likelihood of optimum periodontal tissue healing.[13–15] The two most important factors have been shown to be the extent of the preoperative infrabony defect on the distal aspect of the second molar and the patient's age at the time of surgery. If a large amount of distal bone is missing because of the presence of the impacted tooth and the associated follicle, it is less likely that the infrabony pocket can be decreased. Likewise, if the patient is older, then the likelihood of optimum bony healing is decreased. Patients whose third molars are removed before age 25 are more likely to have better bone

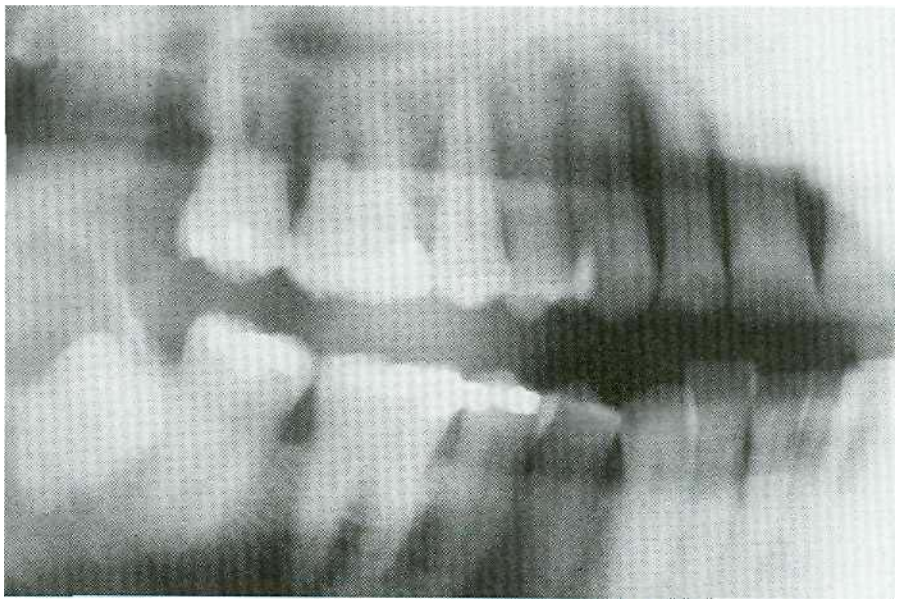


FIG. 9-11 Small dentigerous cyst arising around impacted tooth.

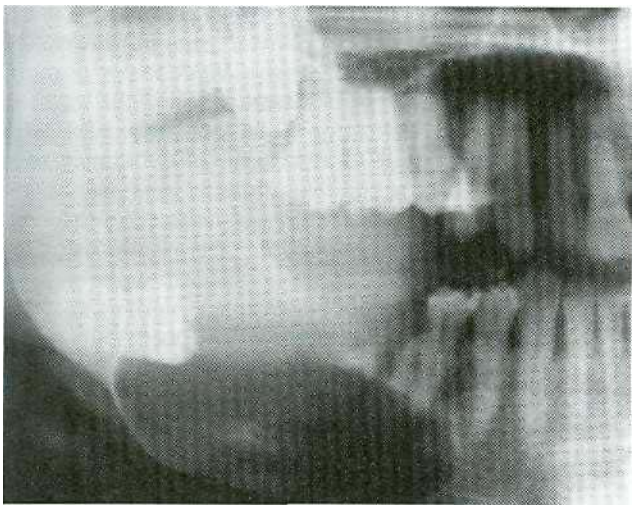


FIG. 9-12 Large dentigerous cyst that extends from coronoid process to mental foramen. Cyst has displaced impacted third molar to inferior border of mandible.

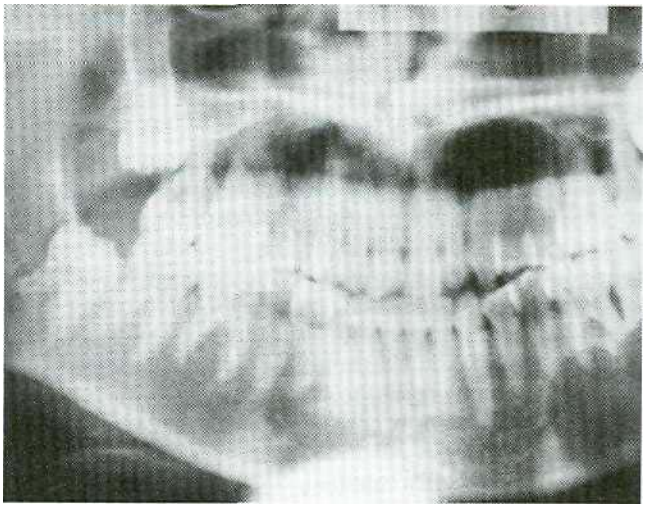


FIG. 9-13 Large ameloblastoma in mandible as result of impacted third molar.

healing than those whose impacted teeth are removed after age 25.[14] In the younger patient, not only is the initial periodontal healing better but the long-term continued regeneration of the periodontium is clearly better.[14] As mentioned previously, unerupted teeth may continue to erupt until age 25. Because the terminal portion of the eruption process occurs relatively slowly, the chances of developing pericoronitis increase, as do the amount of contact between the third molar and second molar. Both of these factors decrease the possibility for optimum periodontal healing. However, it should be noted that the completely bony impacted third molar in a patient older than age 30 should probably be left in place unless some specific pathology develops. Removal of such asymptomatic completely impacted third molars in older patients will clearly result in pocket depths and alveolar bone loss, which will be greater than if the tooth were left in place.

## CONTRAINDICATIONS FOR REMOVAL OF IMPACTED TEETH

All impacted teeth should be removed unless specific contraindications justify leaving them in position. When the potential benefits outweigh the potential complications and risks, the procedure should be performed. Similarly, when the risks are greater than the potential benefits, the procedure should be deferred.

Contraindications for the removal of impacted teeth primarily involve the patient's physical status.

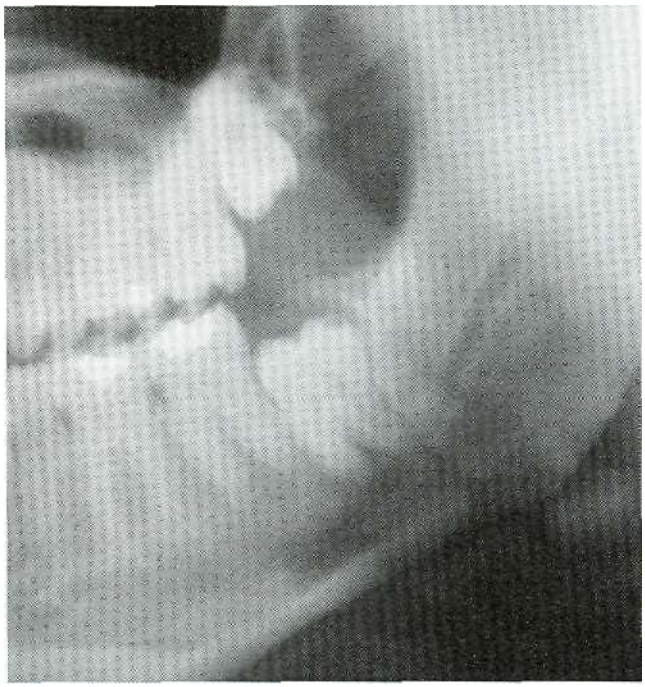


FIG. 9-14 Fracture of mandible that occurred through location of impacted third molar.

### Extremes of Age

The third molar tooth bud can be radiographically visualized by age 6. Some surgeons think that removal of the tooth bud at age 7 to 9 can be accomplished with minimal surgical morbidity and therefore should be performed at this age. However, most surgeons believe that it is not possible to predict accurately if the forming third molar will be impacted. The consensus is that very early removal of third molars should be deferred until an accurate diagnosis of impaction can be made.

The most common contraindication for the removal of impacted teeth is advanced age. As a patient ages the bone becomes highly calcified, therefore less flexible and less likely to bend under the forces of tooth extraction. The result is that more bone must be surgically removed to displace the tooth from its socket.

Similarly, as patients age, they respond less favorably and with more postoperative sequelae. An 18-year-old patient may have 1 or 2 days of discomfort and swelling after the removal of an impacted tooth, whereas a similar procedure may result in a 4- or 5-day recovery period for a 50-year-old patient.

Finally, if a tooth has been retained in the alveolar process for many years without periodontal disease, caries, or cystic degeneration, it is unlikely that these unfavorable sequelae will occur. Therefore in an older patient (usually over age 35) with an impacted tooth that shows no signs of disease and that has a radiographically detectable layer of overlying bone, the tooth should not be removed (Fig. 9-15). The dentist caring for the patient should check the impacted tooth radiographically every 1 or 2 years to ensure that no adverse sequela occurs.

If the impacted tooth shows signs of cystic formation or periodontal disease involving either the adjacent tooth or the impacted tooth, if it is a single impacted tooth underneath a prosthesis with thin overlying bone, or if it becomes symptomatic as the result of infection, the tooth must be removed.

### Compromised Medical Status

Similar to extremes of age, compromised medical status may contraindicate the removal of an impacted tooth. Frequently, compromised medical status and advancing age go hand-in-hand. If the impacted tooth is asymptomatic, its surgical removal must be viewed as elective. If the patient's cardiovascular or respiratory function or host defenses for combating infection are compromised or the patient has a serious acquired or congenital coagu-lopathy, the surgeon must consider leaving the tooth in the alveolar process. On the other hand, if the tooth becomes symptomatic, the surgeon must work carefully with the patient's physician to remove the tooth with the least operative and postoperative medical sequelae.

### Probable Excessive Damage to Adjacent Structures

If the impacted tooth lies in an area in which its removal may seriously jeopardize adjacent nerves, teeth, or previously constructed bridges, it may be prudent to leave the tooth in place. When the dentist makes the decision not to remove a tooth, the reasons must be weighed against potential future complications. For younger patients who may suffer the sequelae of impacted teeth, it may be wise to remove the tooth while taking special measures to prevent damage to adjacent structures. However, for the older patient with no signs of impending complications and for whom the probability of such complications is low, the impacted tooth should not be removed. A classic example of such a case is the older patient with a potentially severe periodontal defect on the distal aspect of the second molar but in whom removal of the third molar would almost surely result in the loss of the second molar. In this situation the impacted tooth should not be removed.

### Summary

The preceding discussion of indications and contraindications for the removal of impacted third molars has been designed *to* point out that there are various risks and benefits for removing impacted teeth in patients. Patients who have one or more pathologic symptoms or problems should have their impacted teeth removed. Most of the symptomatic, pathologic problems that result from impacted third molars occur because of partially erupted teeth and occur less commonly with a complete bony impaction.

It is less clear what should be done with impacted teeth before they cause symptoms or problems. In making a decision as to whether or not an impacted third molar should be removed, a variety of factors must be considered. First, the available room in the arch into which the tooth can erupt must be considered. If adequate room exists, then the clinician may choose to defer removal of the tooth until eruption is complete. A second consideration is the status of the impacted tooth and the

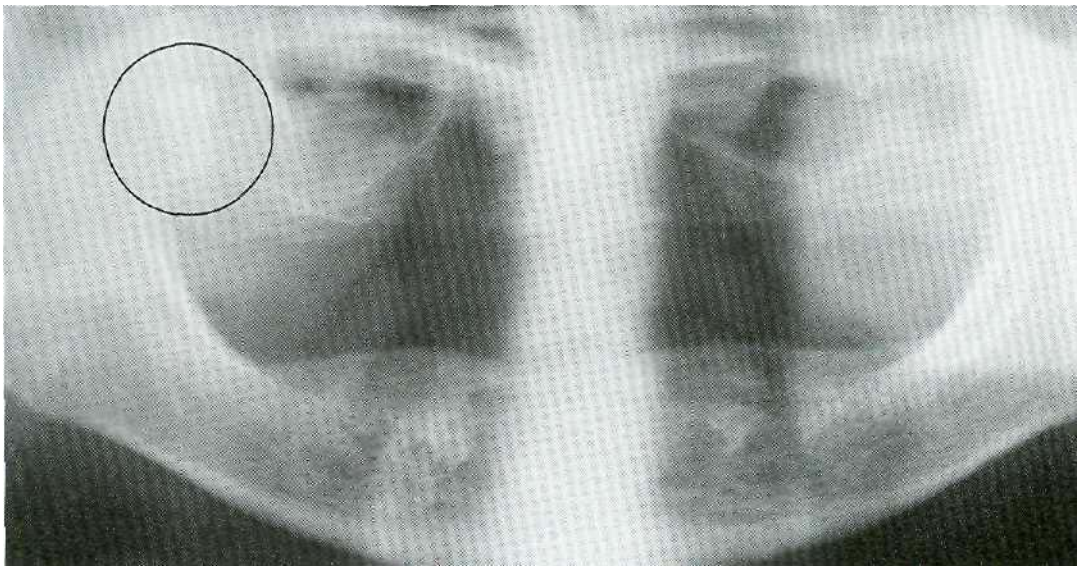


FIG. 9-15 Impacted maxillary right third molar in 63-year-old patient. This molar should not be extracted because it is deeply embedded and no signs of disease are present.

age of the patient. It is critical to remember that the average age of complete eruption is 20, but that eruption may continue to occur up to age 25. A tooth that appears to be a mesioangular impaction at age 17 may eventually become more vertical and erupt into the mouth. If insufficient room exists to accommodate the tooth and a soft tissue operculum exists over the posterior aspect, then pathologic sequelae are likely to occur.

Although there have been some attempts at making very early predictions of whether or not a tooth was going to be impacted, these efforts have not yet resulted in a reliable predictive model. However, by the time the patient reaches age 18, the dentist and surgeon can reasonably predict whether there will be adequate room into which the tooth can erupt with sufficient clearance of the anterior ramus to prevent soft tissue operculum formation. At this time, if surgical removal is chosen, soft tissue and bone tissue healing will occur at its maximal level. At age 18 or 19, if the diagnosis for inadequate room for functional eruption can be made, then the asymptomatic third molar can be removed and the long-term periodontal health of the second molar will be maximized.

## CLASSIFICATION SYSTEMS OF IMPACTED TEETH

Removal of impacted teeth can be either extremely difficult or relatively straightforward and easy. To determine the degree of difficulty preoperatively, the surgeon should examine the patient methodically. The primary factor determining the difficulty of the removal is accessibility. Accessibility is determined by the ease of exposing the tooth, of preparing a pathway for its delivery, and of preparing a purchase point (or taking advantage of a natural purchase point). With careful classification of the impacted teeth using a variety of systems, the surgeon can approach the proposed surgery in an orderly fashion and predict whether any extraordinary surgical approaches will be necessary or if the patient will encounter any postoperative problems.

The majority of the classifying results from analysis of the radiograph. For most situations the periapical radiograph provides adequate detail and should be the radiograph most commonly used. The panoramic radiograph shows a more accurate picture of the total anatomy of the region and can be used as an adequate substitute.

For each patient the dentist should carefully analyze the factors discussed in this section. By combining these factors, the dentist can assess the difficulty of the surgery and elect to extract the impacted teeth that are within his skill level. However, for the patient's sake the dentist should refer the patient to a specialist if a tooth presents a difficult surgical problem.

### Angulation

The first classification system employs a description of the angulation of the long axis of the impacted third molar with respect to the long axis of the second molar. Because teeth at certain inclinations have ready-made pathways for withdrawal, whereas pathways for teeth of other inclinations require the removal of substantial amounts of bone, this classification system provides an initial evaluation of the difficulty of extractions.

The mesioangular impaction is generally acknowledged as the least difficult impaction to remove (Fig. 9-16). The mesioangular-impacted tooth is tilted toward the second molar in a mesial direction. This type of impaction is also the most commonly seen and comprises approximately 43% of all impacted teeth.

In a severe mesial inclination the impacted tooth is horizontal (Fig. 9-17). This type of impaction is usually considered more difficult to remove than the mesioangular impaction. Horizontal impactions occur less frequently and are only seen in approximately 3% of all mandibular impactions.

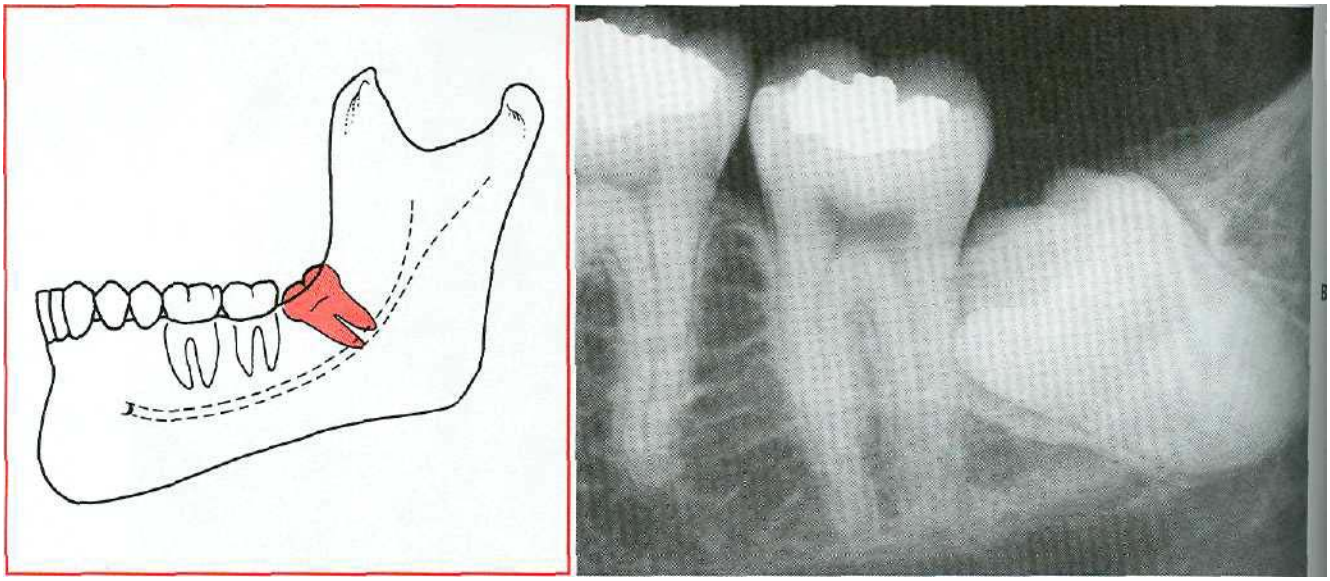


FIG. 9-16 **A**, Mesioangular impaction—most common and easiest impaction to remove. **B**, Mesioangular impaction is usually in close proximity to second molar.

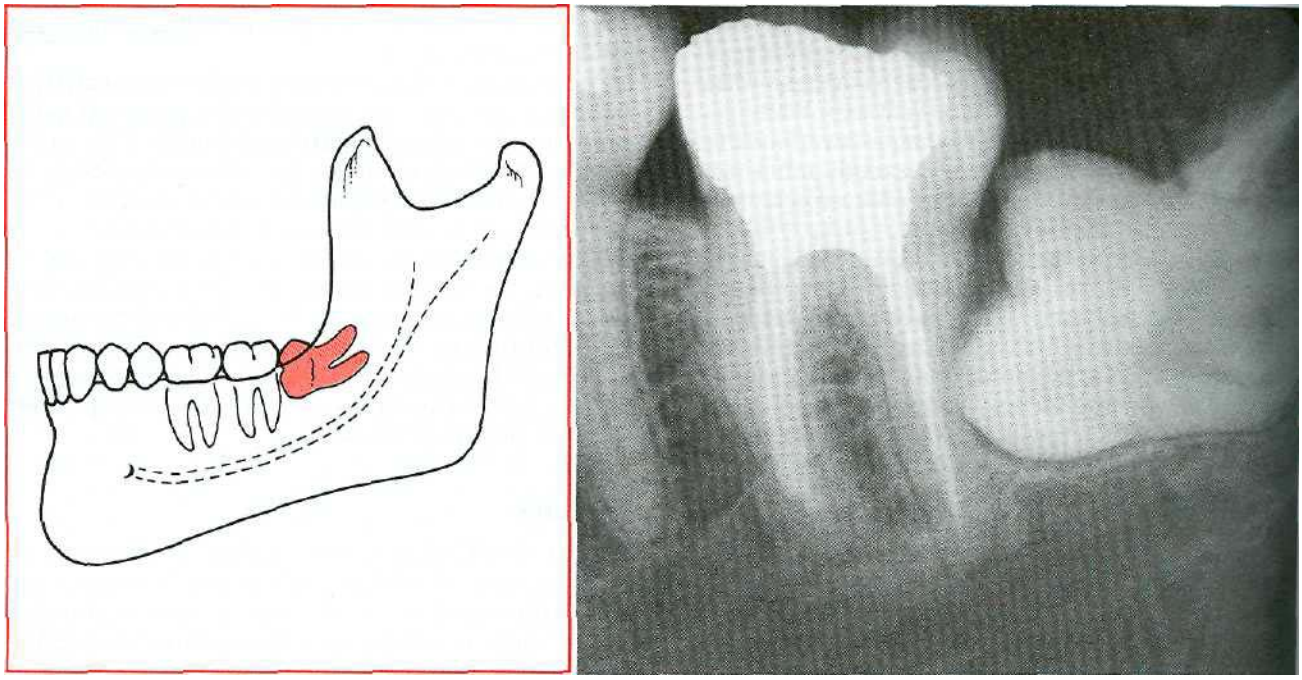
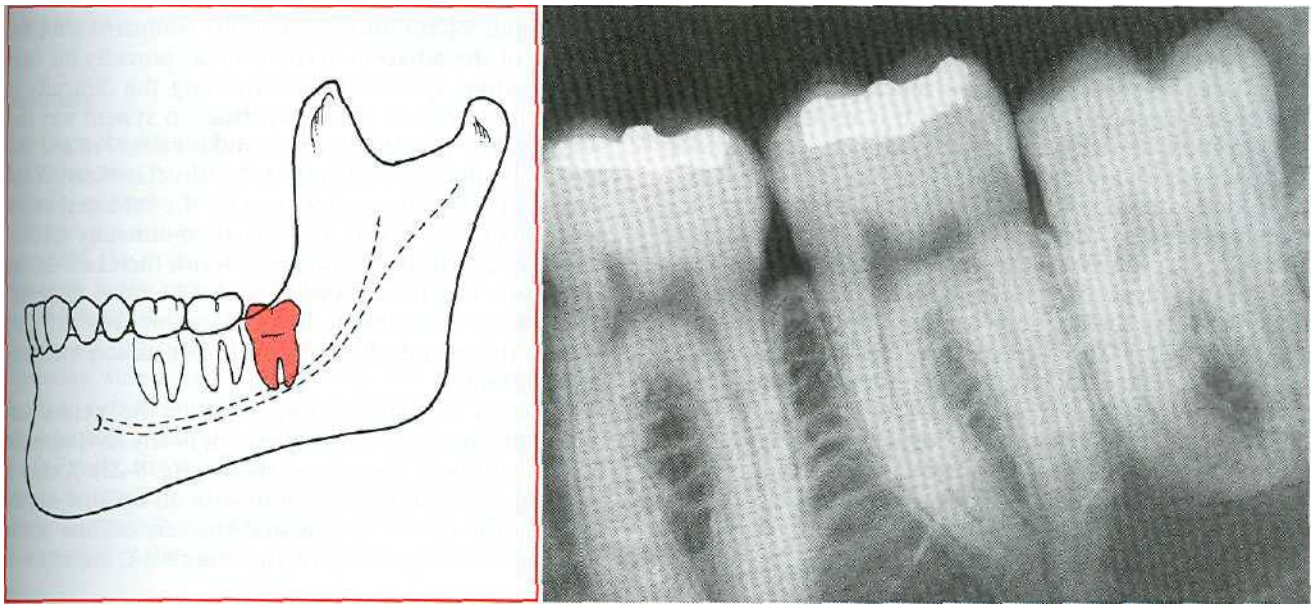


FIG. 9-17 **A**, Horizontal impaction—uncommon and more difficult to remove than mesioangular impaction. **B**, Occlusal surface of horizontal impacted third molar is usually immediately adjacent to root of second molar, which often produces early severe periodontal disease.

In the vertical impaction the long axis of the impacted tooth runs in the same direction as the long axis of the second molar. This impaction occurs with the second greatest frequency, accounts for approximately 38% of all impactions, and is third in difficulty of removal (Fig. 9-18).

Finally, the distoangular impaction is the tooth with the most difficult angulation for removal (Fig. 9-19). In the distoangular impaction the long axis of the third molar is distally or posteriorly angled away from the second molar. This impaction is the most difficult remove because the tooth has a withdrawal pathway that runs into the mandibular ramus, and its removal requires greater surgical intervention. Distoangular impactions occur uncommonly and account for approximately 6% of all impacted third molars. Erupted third molars may be in a distoangular position. this occurs, they are extremely difficult to remove tinely, compared with the removal of other teeth.



B

FIG. 9-18 **A**, Vertical impaction—second most common impaction and second most difficult to remove. **B**, Vertical impaction is frequently covered on its posterior aspect with bone of anterior ramus of mandible.

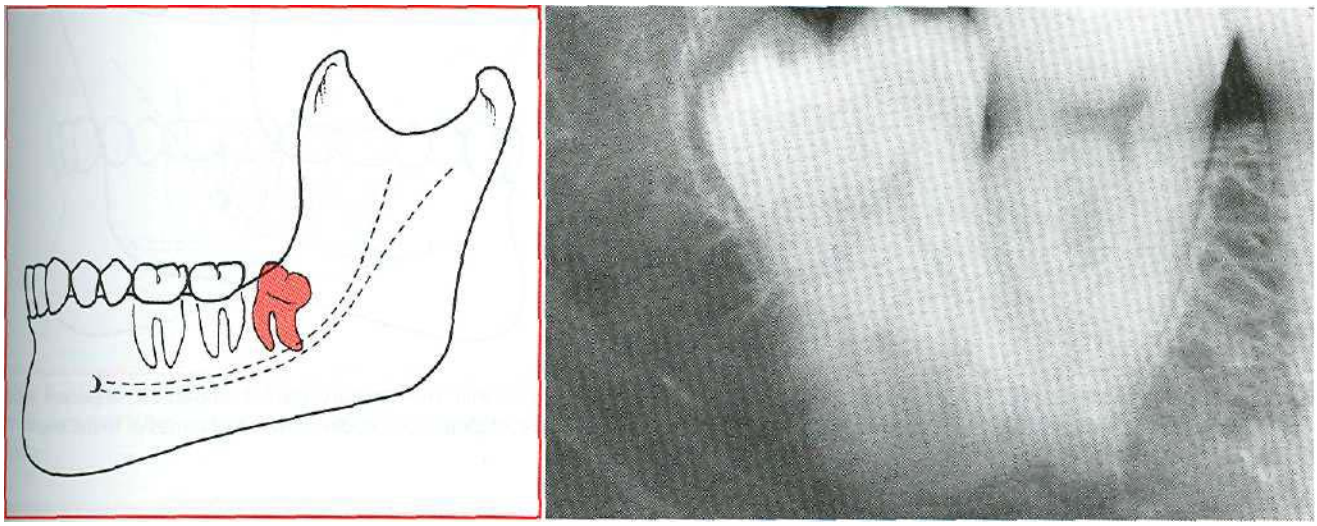


FIG. 9-19 **A**, Distoangular impaction—uncommon and most difficult of the four types to remove. **B**, Occlusal surface of distoangular impaction is usually embedded in ramus of mandible and requires significant bone removal for extraction.

In addition to the relationship between the angulation of the long axes of the second and third molars, the teeth can also be angled in a buccal or lingual direction. As is noted earlier, the linguocortical plate of the mandible becomes thinner as it progresses posteriorly. Therefore most mandibular third molars are angled toward the lingual direction or in lingual version. Occasionally, a tooth is angled toward the buccal aspect of the mandible or in buccal version.

Rarely a tooth is a transverse impaction, that is, in an absolutely horizontal position in a buccolingual direction. The occlusal surface of the tooth can face either the buccal or lingual direction. To determine buccal or lingual version accurately, the dentist must take a perpendicular occlusal film. However, this determination is usually not necessary, because the surgeon can make this identification early in the operation, and the buccal or lingual position of the tooth does not greatly influence the difficulty of the surgery.

### Relationship to Anterior Border of Ramus

Another method for classifying impacted mandibular third molars is based on the amount of impacted tooth that is covered with the bone of the mandibular ramus. This classification is known as the *Pell and Gregory classification* and is sometimes referred to as the *Pelt and Gregory classes 1, 2, and 3*. For this classification it is important

that the surgeon carefully examine the relationship between the tooth and the anterior part of the ramus. If the mesiodistal diameter of the crown is completely anterior to the anterior border of the mandibular ramus, it is in a class 1 relationship. If the tooth is angled in a vertical direction, the chances for the tooth to erupt into a normal position are good (Fig. 9-20).

If the tooth is positioned posteriorly so that approximately one half is covered by the ramus, the tooth's relationship with the ramus is class 2. In the class 2 situation the tooth cannot become completely free from bone, because a small shelf of bone overlies the distal portion of the tooth (Fig. 9-21). A class 3 relationship between the tooth and ramus occurs when the tooth is located completely within the mandibular ramus (Fig. 9-22). It should be obvious that the class 1 relationship will provide the greatest accessibility to the impacted tooth and therefore will be easiest to remove. The class 3 relationship provides the least accessibility and therefore presents the greatest difficulty.

### Relationship to Occlusal Plane

The depth of the impacted tooth compared with the height of the adjacent second molar provides the next classification system for determining the difficulty of impaction removal. This classification system was also suggested by Pell and Gregory and is called *Pell and Gregory A, B, and C* classification. In this classification the degree of difficulty is measured by the thickness of the overlying bone; that is, the degree of difficulty increases as the depth of the impacted tooth increases. As the tooth becomes less accessible and it becomes more difficult to section the tooth and to prepare purchase points, the overall difficulty of the operation increases substantially.

A class A impaction is one in which the occlusal surface of the impacted tooth is level or nearly level with the occlusal plane of the second molar (Fig. 9-23). A class B impaction is an impacted tooth with an occlusal surface between the occlusal plane and the cervical line of the second molar (Fig. 9-24). Finally, the class C impaction is

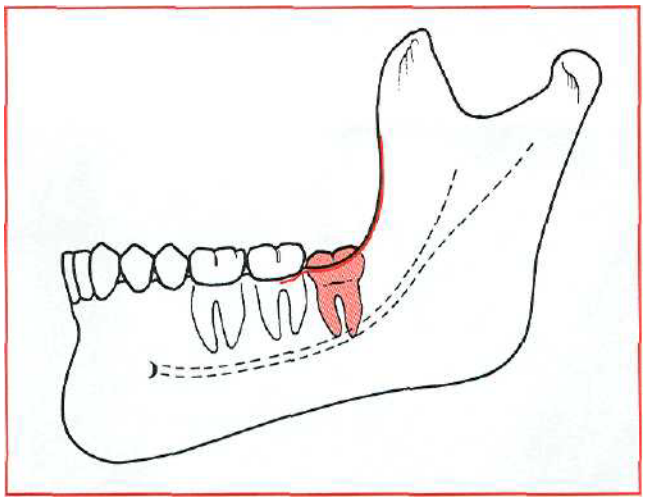


**FIG. 9-20** Pell and Gregory class 1 impaction. Mandibular third molar has sufficient anteroposterior room (i.e., anterior-to-anterior border of ramus) to erupt.

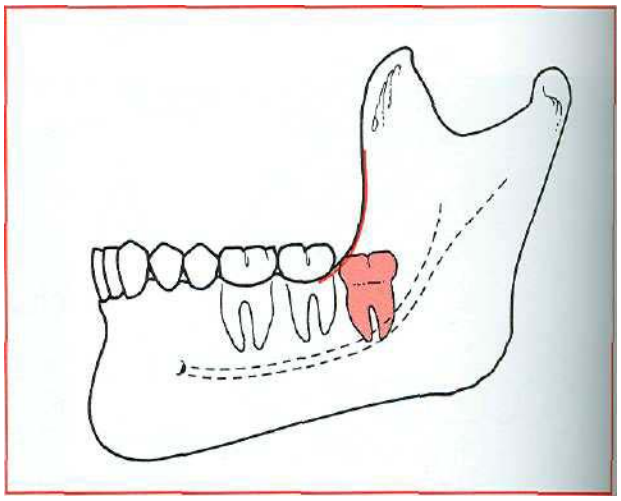


**FIG. 9-22** Pell and Gregory class 3 impaction. Impacted third molar is completely embedded in bone of ramus of mandible.

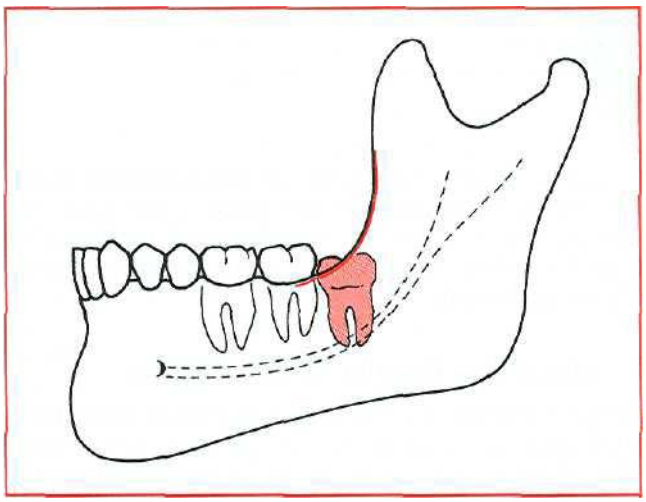


**FIG. 9-21** Pell and Gregory class 2 impaction. Approximately half is covered by anterior portion of ramus of mandible.

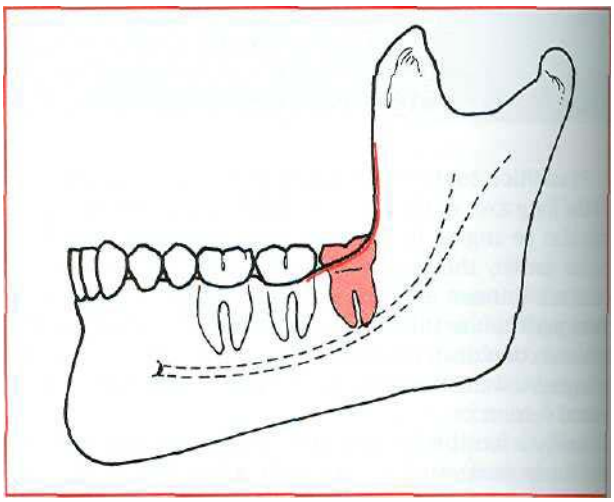


**FIG. 9-23** Pell and Gregory class A impaction. Occlusal plane of impacted tooth is at same level as occlusal plane of second molar.

one in which the occlusal surface of the impacted tooth is below the cervical line of the second molar (Fig. 9-25).

### Summary

The three classification systems discussed so far are used in conjunction to determine the difficulty of an extraction. For example, a mesioangular impaction with a class 1 ramus and a class A depth is easy to remove and is essentially the extraction of an erupted tooth (Fig. 9-26). However, as the ramus relationship changes to a class 2 and the depth of the impaction increases to a class B, the degree of difficulty becomes greater. A horizontal impaction with a class 2 ramus relationship and a class B depth is a moderately difficult extraction and one that most general practitioners do not want to attempt (Fig. 9-27). Finally, the most difficult of all impactions is a distoangular impaction with a class 3 ramus relationship at a class C depth. Even specialists view removing this tooth as a surgical challenge (Fig. 9-28).

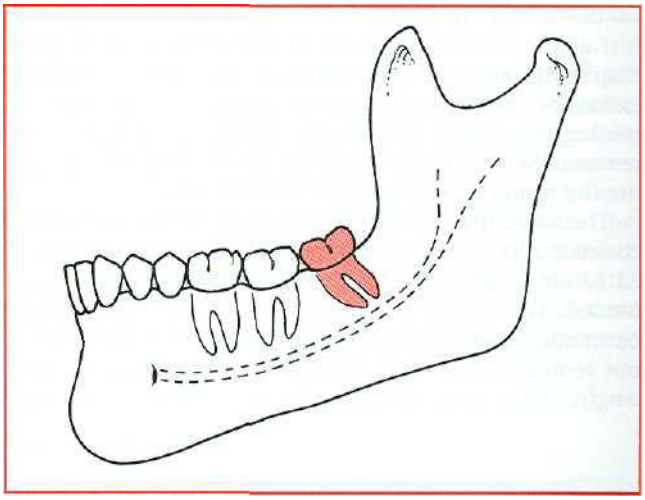


**FIG. 9-26** Mesioangular impaction with class 1 ramus relationship and class A depth. All three classifications make it easiest type of impaction to remove.

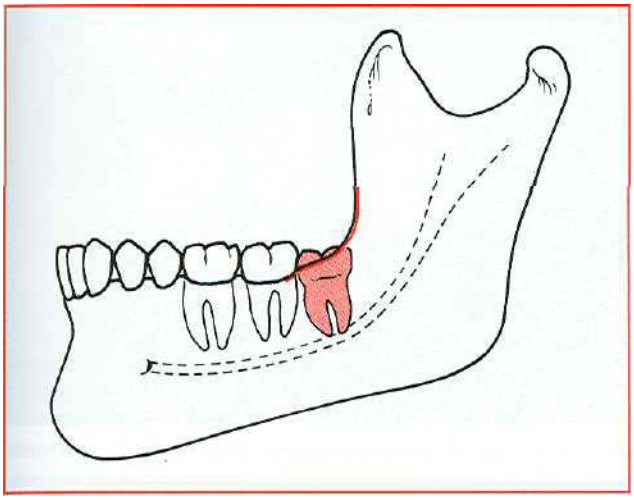


**FIG. 9-24** Pell and Gregory class B impaction. Occlusal plane of impacted tooth is between occlusal plane and cervical line of second molar.

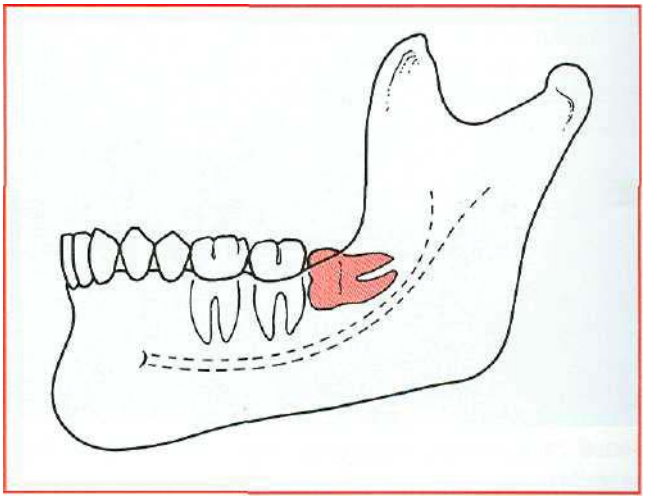


**FIG. 9-27** Horizontal impaction with class 2 ramus relationship and class B depth makes it moderately difficult to extract.

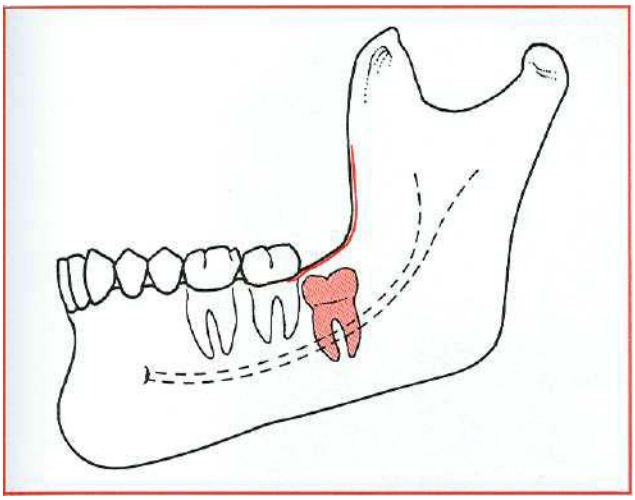


**FIG. 9-25** Pell and Gregory class C impaction. Impacted tooth is below cervical line of second molar.

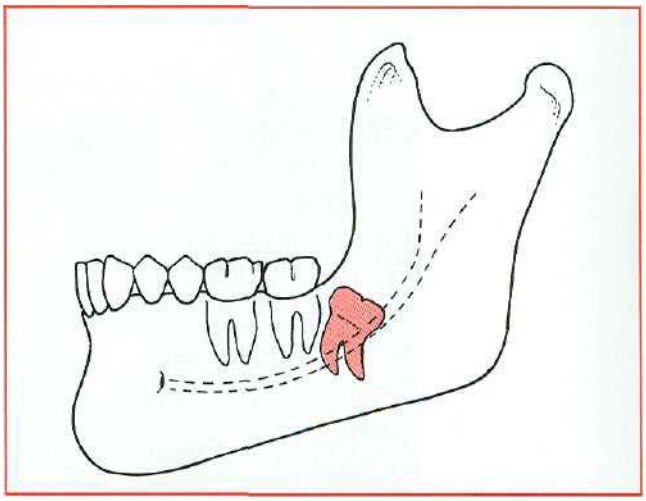


**FIG. 9-28** Impaction with distoangular, class 3 ramus relationship and class C depth makes it extremely difficult to remove.

## ROOT MORPHOLOGY

Just as the root morphology of the erupted tooth has a major influence on the degree of difficulty of a closed extraction, root morphology plays a major role in determining the degree of difficulty of the impacted tooth's removal. Several factors must be considered when assessing the morphologic structure of the root.

The first consideration is the length of the root. As discussed earlier, the optimal time for removal of an impacted tooth is when the root is one third to two thirds formed. When this is the case, the ends of the roots are blunt and almost never fracture (Fig. 9-29). If the tooth is not removed during the formative stage and the entire length of the root develops, the possibility increases for abnormal root morphology and for fracture of the root tips during extraction. If the root development is insufficient (i.e., less than one third complete), the tooth is more difficult to remove, because it tends to roll in its crypt like a ball in a socket, which prevents easy elevation (Fig. 9-30). The next factor to be assessed is whether the roots are fused into a single, conic root (Fig. 9-31), or if they are separate and distinct roots. The fused, conic roots are easier to remove than widely separate roots (Fig. 9-32).

The curvature of the tooth roots also plays a role in the difficulty of the extraction. Severely curved or dilacerated roots are more difficult to remove than straight or slightly curved roots (see Fig. 9-32). The surgeon should carefully examine the apex area of the radiograph to assess

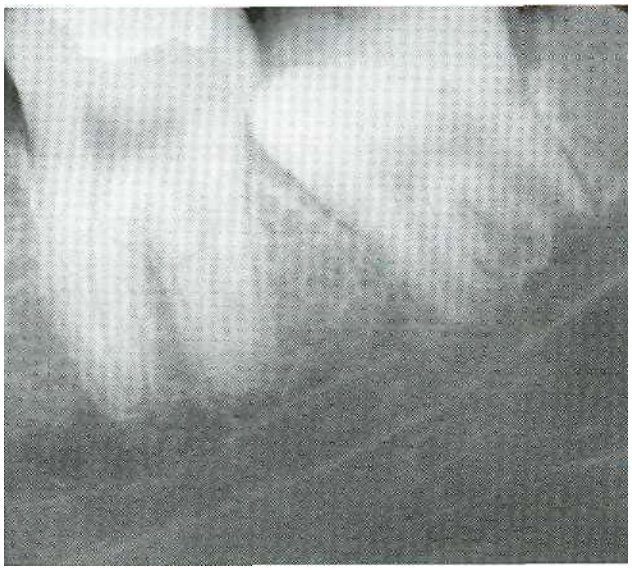


FIG. 9-29 Roots that are two thirds formed, which are less difficult to remove.

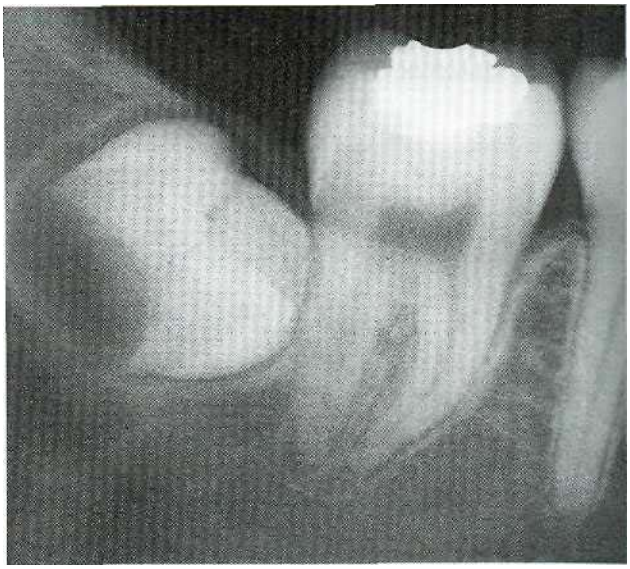


FIG. 9-30 Lack of root development. If extraction is attempted, crown will roll around in crypt, which makes it difficult to remove.

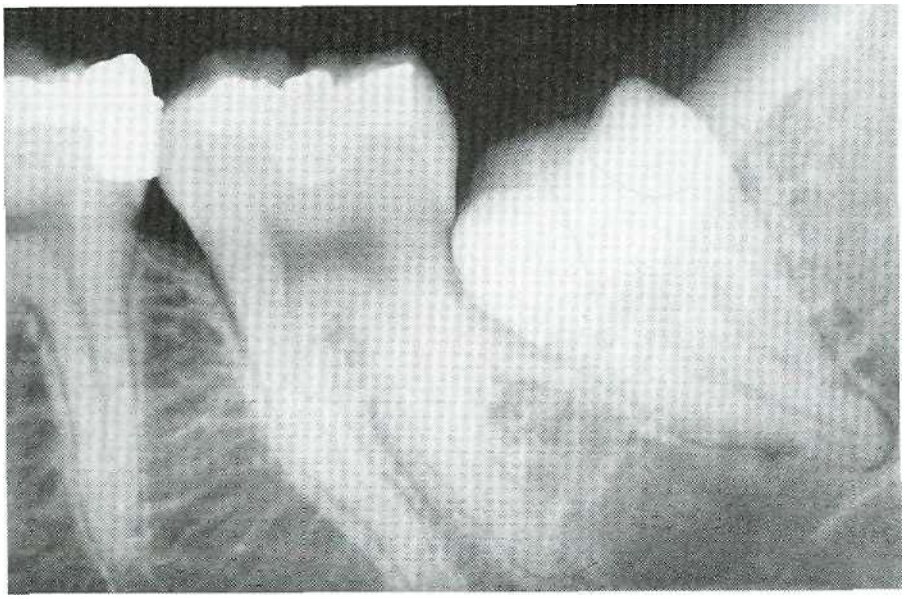


FIG. 9-31 Fused roots with conic shape.

the presence of small, abnormal, and sharply hooked roots that probably fracture if the surgeon does not give them special consideration.

The direction of the tooth root curvature is also important to examine preoperatively. During removal of a mesioangular impaction, roots that are curved gently in the distal direction (following along the pathway of extraction) can be removed without the force that can cause fracture of the roots. However, if the roots of a mesioangular impaction are curved mesially, the roots almost always fracture or must be sectioned before the tooth can be delivered.

The total width of the roots in the mesiodistal direction should be compared with the width of the tooth at the cervical line. If the tooth root width is greater, the extraction will be more difficult. More bone must be removed or the tooth must be sectioned before extraction.

Finally, the surgeon should assess the periodontal ligament space. Although in most patients the periodontal ligament space is of normal dimensions, it sometimes is wider or narrower. The wider the periodontal ligament space, the easier the tooth is to remove (Fig. 9-33). A third molar that is in the proper stage of development for removal has a relatively broad periodontal ligament space, which eases extraction. However, older patients, especially those over age 40, tend to have a much narrower periodontal ligament space, which thereby increases the difficulty of the extraction.

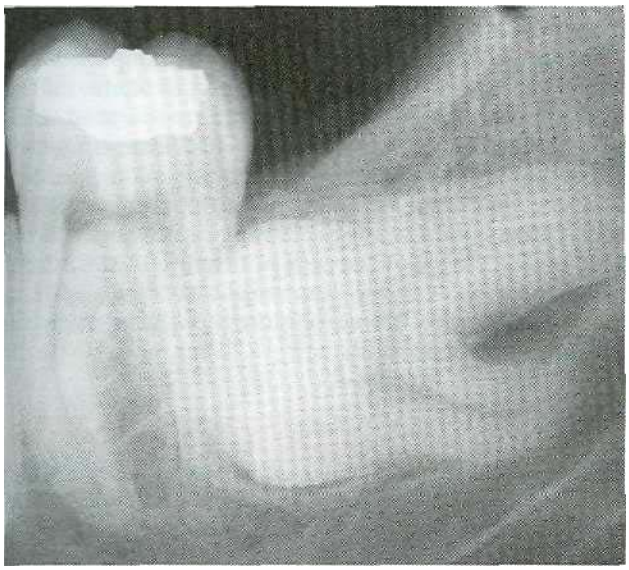


FIG. 9-32 Divergent roots with severe curvature. Such roots are more difficult to remove.

### Size of Follicular Sac

The size of the follicle around the impacted tooth can help determine the difficulty of the extraction. If the follicular sac is wide (almost cystic in size), much less bone must be removed, which makes the tooth easier to extract (Fig. 9-34). (Young patients are more likely to have large follicles, which is another factor that makes extractions easier in younger patients.) However, if the follicular space around the crown of the tooth is narrow or nonexistent, the surgeon must create space around the entire crown, which increases both the difficulty of the procedure and the time required to remove the tooth. The surgeon must carefully examine the follicle size when determining the difficulty of an extraction.

### Density of Surrounding Bone

The density of the bone surrounding the tooth plays a role in determining the difficulty of the extraction. Although some clues can be seen on the radiographs, variations in radiograph density and angulation render interpretations based on radiographs unreliable. Bone density is best determined by the patient's age. Patients

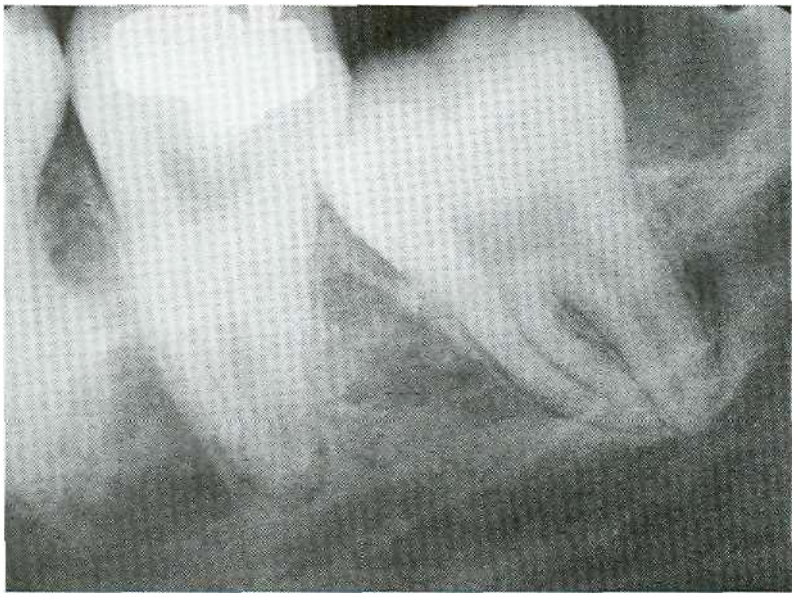


FIG. 9-33 Wide periodontal ligament space. Such space makes extraction process less difficult.

who are 18 years of age or younger have bone densities favorable for tooth removal. The bone is less dense, is more likely to be pliable, and expands and bends somewhat, which allows the socket to be expanded by elevators or by luxation forces applied to the tooth itself. Additionally, the bone is easier to cut with a dental drill and can be removed more rapidly than denser bone.

Conversely, patients who are older than age 35 have denser bone and thus decreased flexibility and ability to expand. In these patients the surgeon must remove all interfering bone, because it is not possible to expand the bony socket. In addition, as the bone increases in density, it becomes more difficult to remove with a dental drill, and the bone removal process takes longer.

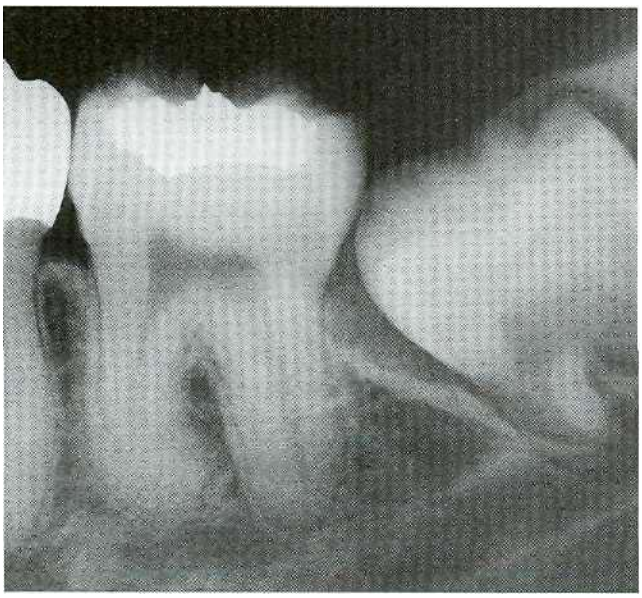


FIG. 9-34 Large follicular sac. When space of sac is large, amount of required bone removal is decreased.

### Contact with Mandibular Second Molar

If space exists between the second molar and the impacted third molar, the extraction will be easier. However, if the tooth is a mesioangular or horizontal impaction, it is frequently in direct contact with the adjacent second molar. To remove the third molar safely without injuring the second molar, the surgeon must be cautious with pressure from elevators or with the bur when removing bone. If the second molar has caries or a large restoration or root canal, the surgeon must take special care not to fracture the restoration or a portion of the carious crown (see Fig. 9-17, *B).*

### Relationship to Inferior Alveolar Nerve

Impacted mandibular third molars frequently have roots that are superimposed on the inferior alveolar canal on radiographs. Although the canal is usually on the buccal aspect of the tooth, it is in close proximity to the tooth, Therefore one of the potential sequelae of impacted third molar removal is damage to or bruising of the inferior alveolar nerve. This usually results in some altered sensation (paresthesia or anesthesia) of the lower lip on the injured side. Although this altered sensation is usually brief (lasting only a few days), it may extend for weeks or months; on rare occasions it can be permanent. If the root ends of the tooth appear to be close to the inferior alveolar nerve, the surgeon must take special care to avoid injuring the nerve (Fig. 9-35), which makes the procedure more difficult.

### Nature of Overlying Tissue

The preceding systems all classify factors that make third molar extraction easier or more difficult. The classification system discussed in this section does not fit into this category. However, it is the system used by most dental insurance companies and the one by which the surgeon charges for his services.

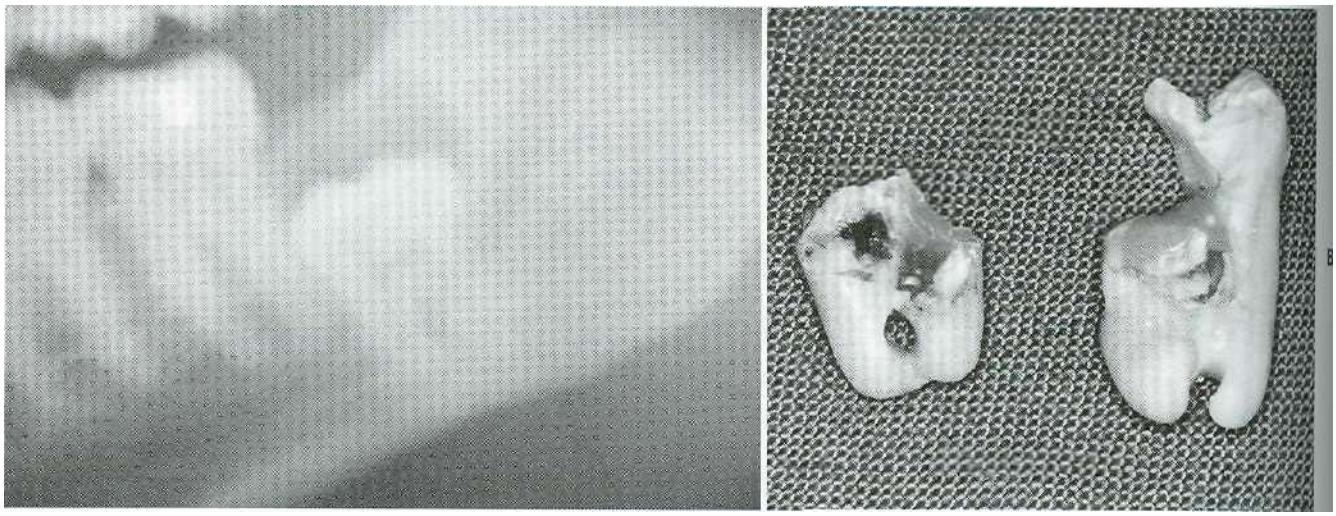


FIG. 9-35 **A**, Radiographic view of mandibular third molar suggests that it is surrounding or adjacent to inferior alveolar neurovascular canal. **B**, Hole and indentation in two roots of mandibular third molar indicate position of roots of this tooth to inferior alveolar canal. When this tooth was removed, inferior alveolar neurovascular bundle was severed (not same tooth as shown in A).

According to this scheme, the, three types of impactions are (1) soft tissue impaction, (2) partial bony impaction, and (3) full bony impaction. An impaction is defined as a *soft tissue impaction* when the height of the tooth's contour is above the level of the alveolar bone, and the superficial portion of the tooth is covered only by soft tissue (Fig. 9-36). To remove the soft tissue impaction, the surgeon must incise the soft tissue and reflect a small soft tissue flap to obtain access to the tooth to elevate it from its socket. The soft tissue impaction is usually the easiest of the three extractions.

The partial bone impaction occurs when the superficial portion of the tooth is covered by soft tissue, but the height of the tooth's contour is below the level of the surrounding alveolar bone (Fig. 9-37). To remove the tooth, the surgeon must incise the soft tissue, reflect a soft tissue flap, and remove the bone above the height of the contour. The surgeon may need to divide the tooth in addition to removing bone.

The complete bone impaction is an impacted tooth that is completely encased in bone so that, when the surgeon reflects the soft tissue flap, no tooth is visible (Fig. 9-38). To remove the tooth, extensive amounts of bone must be removed and the tooth almost always must be sectioned. The complete bony impaction is often the most difficult to remove.

Although this classification is extensively used, it frequently has no relationship to the difficulty of the extraction (Boxes 9-1 and 9-2). The parameters of angulation,

**BOX 9-1**

Factors that Make Impaction Surgery Less Difficult

1. Mesioangular position
2. Class 1 ramus
3. Class A depth
4. Roots one third to two thirds formed*
5. Fused conic roots
6. Wide periodontal ligament*
7. Large follicle*
8. Elastic bone*
9. Separated from second molar
10. Separated from inferior alveolar nerve*
11. Soft tissue impaction

'Present In the young patient.

**BOX 9-2**

Factors that Make Impaction Surgery More Difficult

1. Distoangular
2. Class 3 ramus
3. Class C depth
4. Long, thin roots*
5. Divergent curved roots
6. Narrow periodontal ligament*
7. Thin follicle*
8. Dense, inelastic bone*
9. Contact with second molar
10. Close to inferior alveolar canal
11. Complete bony impaction

*Present in older patients.

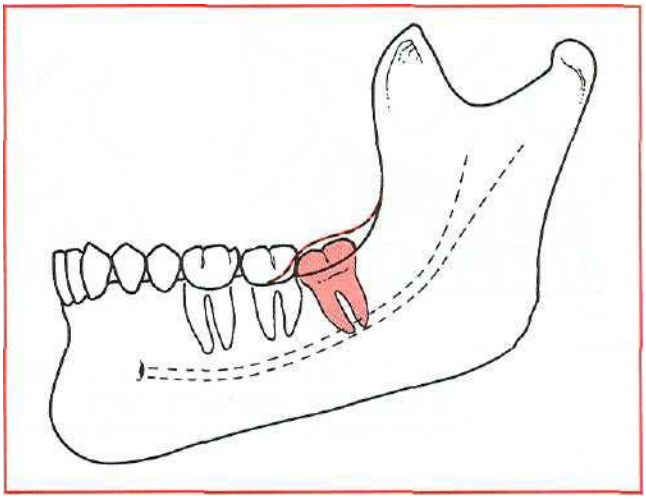


FIG. 9-36 Soft tissue impaction in which crown of tooth is covered by soft tissue only and can be removed without bone removal.

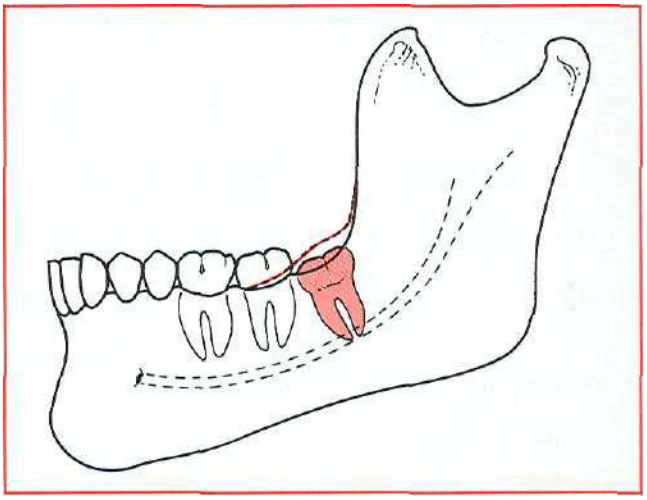


FIG. 9-37 Partial bony impaction in which part of tooth, usually posterior aspect, is covered with bone and requires either bone removal or tooth sectioning for extraction.

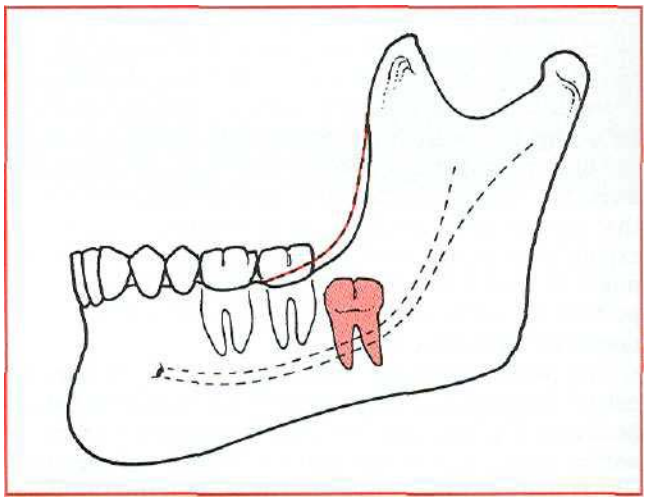


FIG. 9-38 Complete bony impaction in which tooth is completely covered with bone and requires extensive removal of bone for extraction.

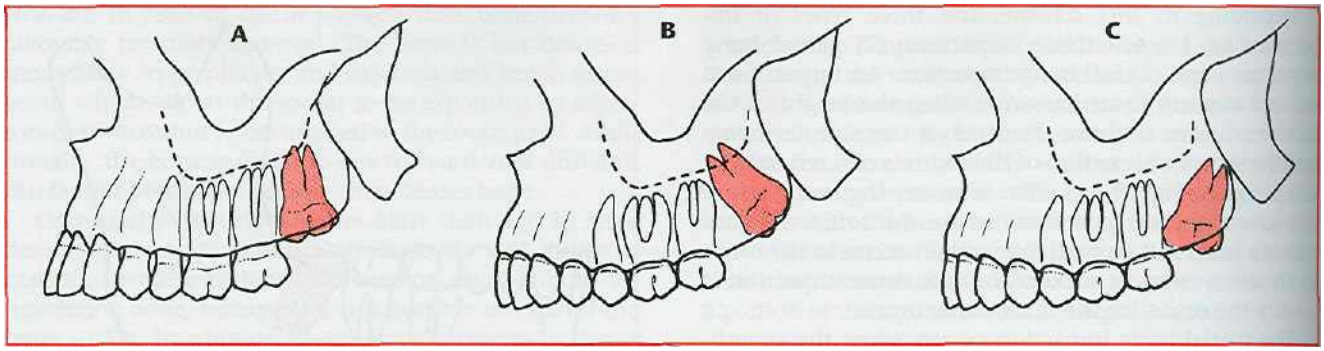



FIG. 9-39 **A**, Vertical impaction of maxillary third molar. This angle accounts for 63% of impactions. **B**, Distoangular impaction of maxillary third molar. This angle accounts for 25% of impactions. **C**, Mesioangular impaction of maxillary third molar. This angle accounts for 12% of impactions.

ramus relationship, root morphology, and patient age are more important than this system. The surgeon should use all of the information available to determine the difficulty of the proposed surgery.

## MODIFICATION OF CLASSIFICATION SYSTEMS FOR MAXILLARY IMPACTED TEETH

The classification systems for the maxillary impacted third molar are essentially the same as for the impacted mandibular third molar. However, several distinctions and additions must be made to assess more accurately the difficulty of removal during the treatment-planning phase of the procedure.

Concerning angulation, the three types of maxillary third molars are (1) the vertical impaction (Fig. 9-39, *A),* (2) the distoangular impaction (Fig. 9-39, *B),* and (3) the mesioangular impaction (Fig. 9-39, C). The vertical impaction occurs approximately 63% of the time, the dis-toangular approximately 25%, and the mesioangular position approximately 12% of the time. Rarely other posi-tions, such as a transverse, inverted, or horizontal position, are encountered; these unusual positions account for less than 1% of impacted maxillary third molars.

The same angulations in mandibular third molar extractions cause opposite degrees of difficulty for maxillary third molar extractions. Vertical and distoangular impactions are the easiest to remove, whereas mesioan-gular impactions are the most difficult (exactly the oppo-site of impacted mandibular third molars). Mesioangular impactions are more difficult to remove because the bone that overlies the impaction and that must be removed or expanded is on the posterior aspect of the tooth and is much heavier than in the vertical or distoangular im-paction. In addition, access to the mesioangularly positioned tooth is more difficult.

The position of the maxillary third molar in a bucco-palatal direction is also important for determining the difficulty of the removal. Most maxillary third molars are angled toward the buccal aspect of the alveolar process, which makes the overlying bone in that area thin and therefore easy to remove or to expand. Occasionally, the impacted maxillary third molar is positioned toward the palatal aspect of the alveolar process. This makes the tooth much more difficult to extract, because greater amounts of bone must be removed to gain access to the underlying tooth. A combination of radiographic assessment and clinical digital palpation of the tuberosity area can determine if the maxillary third molar is in the buccopalatal position. If the tooth is positioned toward the buccal, a definite palpable bulge is found in the area; if the tooth is palatally positioned, a bony deficit is found in that region. When either is determined by clinical examination, the surgeon must anticipate a longer, more difficult procedure.

The Pell and Gregory A, B, and C classification used to diagnose the depth of impaction in the mandible is also used in the maxilla (Fig. 9-40). Preoperative assessment of the remaining classifications is the same. The factors that influence the difficulty of mandibular impacted third molar removal are the same for maxillary third molar removal. For example, the individual impacted tooth root morphology plays a substantial role in determining the degree of extraction difficulty. The most common factor that causes difficulty with maxillary third molar removal is a thin, nonfused root with erratic curvature (Fig. 9-41). The majority of maxillary third molars have fused roots that are conic. However, the surgeon should examine the preoperative radiograph carefully to ensure that this is the situation with each individual impaction. The surgeon should also check the periodontal ligament, because the wider the ligament space the less difficult the tooth is to remove. In addition, similar to mandibular third molars, the periodontal ligament space tends to decrease as the patient increases in age.

The follicle surrounding the crown of the impacted tooth also has an influence on the difficulty of the extraction. If the follicular space is broad, the tooth will be easier to remove than if the follicular space is thin or nonexistent.

Bone density is also an important factor in maxillary impaction removal and is related closely to the age of the patient. The younger the patient, the less dense and more elastic—and therefore more expandable—is the bone surrounding the impacted third molar. As the patient ages, the bone becomes denser and less elastic, and the tooth becomes more difficult to remove.

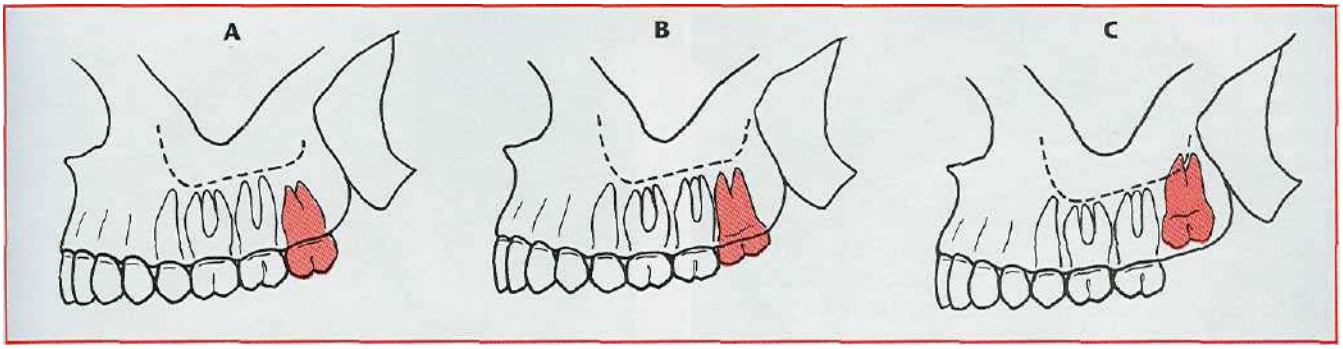



FIG. 9-40 **A**, Pell and Gregory class A occlusal surface of third molar is at same level as that of second molar. **B**, Pell and Gregory class B occlusal surface of third molar is located between occlusal plane and cervical line of second molar. **C,** Pell and Gregory class C impacted maxillary third molar is deep to cervical line of second molar.

The relationship to the adjacent second molar tooth also influences the difficulty of the extraction. It may require that additional bone be removed to displace the tooth from underneath the second molar. In addition, because the use of elevators is common in the removal of maxillary third molars, the surgeon must be aware of the existence of large restorations or caries in the adjacent second molar. Injudicious use of elevators can result in the fracture of restorations or carious teeth.

The type of impaction, with respect to overlying tissue, must also be considered for maxillary third molars. The classification system used for mandibular teeth is the same as the system that is used for maxillary teeth: soft tissue impaction, partial bony impaction, and complete bony impaction. The definitions of these types of impactions are precisely the same as those used for the mandibular third molars.

Two additional factors influence the difficulty of maxillary third molar removal but do not exist for the mandibular third molars. Both are related to the structure and position of the maxillary sinus. First, the maxillary sinus is in intimate contact with the roots of the molar teeth; and, frequently, the maxillary third molar actually forms a portion of the posterior sinus wall. If this is the case, removal of the maxillary third molar may result in maxillary sinus complications, such as sinusitis or an oroantral fistula. The presence of the maxillary sinus does not necessarily make the removal of the impacted tooth more difficult, but it increases the likelihood of postoperative complications and morbidity.

Finally, in maxillary third molar removal, the tuberos-ity of the posterior maxilla can be fractured. Such fractures are possible, especially when dense and nonelastic bone exists, such as in older patients. In addition, a large maxillary sinus makes the surrounding alveolar bone thin and more susceptible to fracture when excessive force is applied. A root morphology that is not fused but has divergent roots requires greater force to remove and can make fracture more likely. In addition, mesioangular impactions increase the possibility of fractures (see Fig. 9-39, C). In these situations the overlying tuberosity is heavier, but the surrounding bone is usually thinner. When the surgeon prepares a purchase point at the mesiocervical line, fracture of the tuberosity becomes a greater risk if: (1) the bone is nonelastic (as in older patients), (2) the tooth is multirooted with large bulbous roots (as in older patients), (3) the maxillary sinus is large and expanded to include the roots of the impacted third molar, or (4) the surgeon has to use excessive force to ele-vate the tooth. Management of the fractured tuberosity is discussed in Chapter 11.

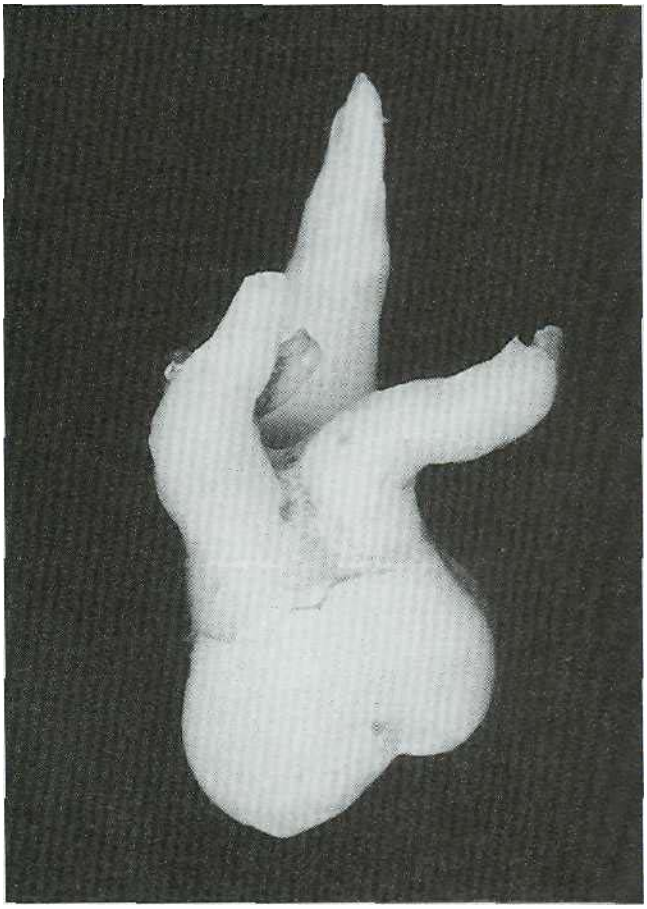


FIG. 9-41 The maxillary third molar has the most erratic and bizarre root formation of all teeth.

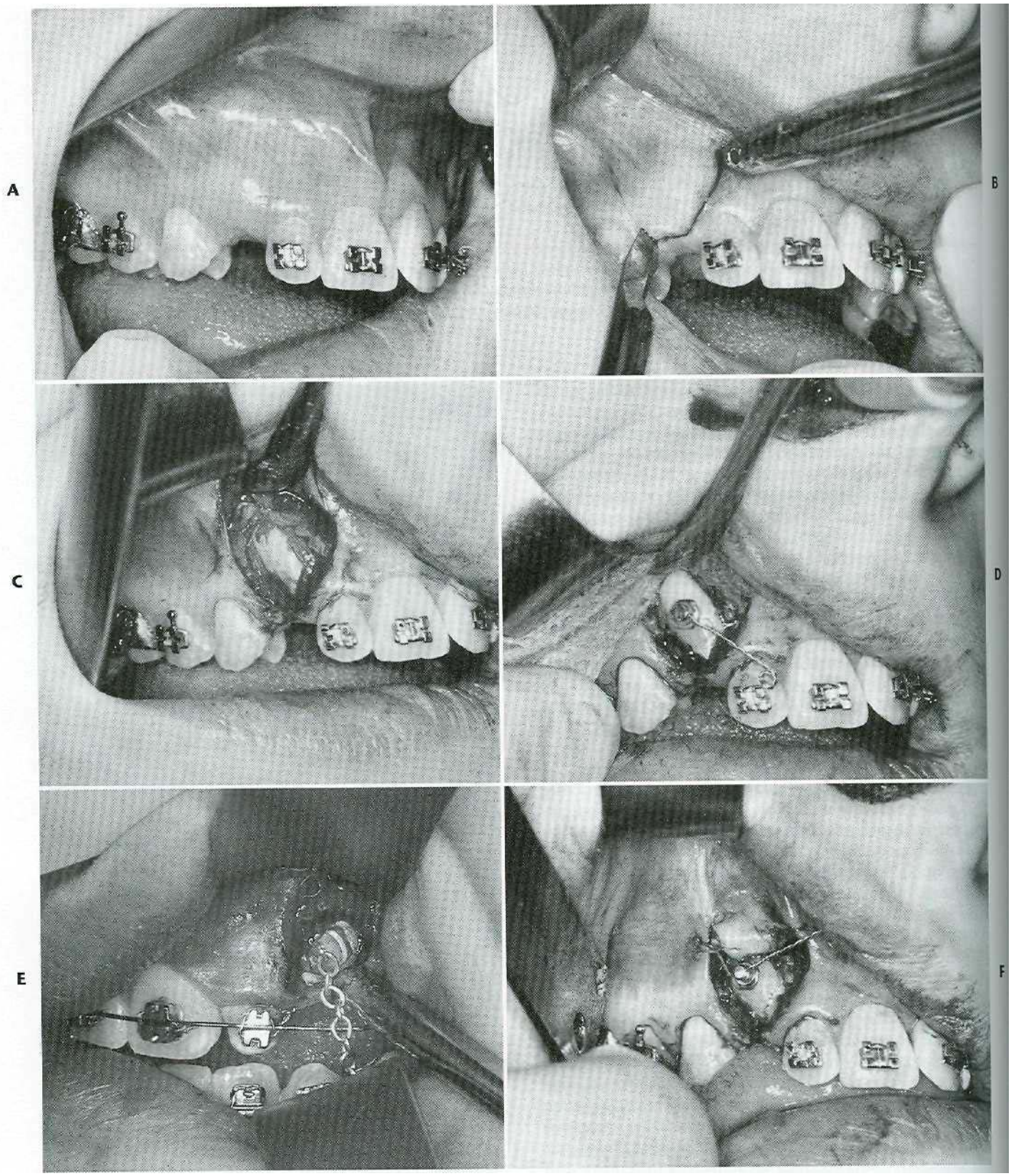



FIG. 9-42 **A**, Labially positioned impacted maxillary canine. Tooth should be uncovered with apical-ly positioned flap procedure to preserve attached gingiva. **B**, Mucoperiosteal flap is outlined, allowing for repositioning of keratinized mucosa over exposed tooth. **C**, When flap is reflected, thin overlying bone is removed. **D**, Tissue is retracted and bonded to tooth with a wire or with a gold chain (**E**).
**F**, Flap is apically sutured to tooth.

*Continued*

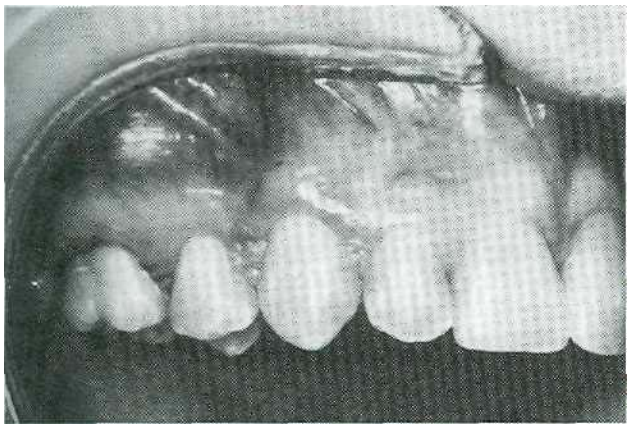


**FIG. 9-42—cont'd C,** After 6 months, exposed tooth is in desired position, with broad zone of attached gingiva.

## DIFFICULTY OF REMOVAL OF OTHER IMPACTED TEETH

After the mandibular and maxillary third molars, the next most commonly impacted tooth is the maxillary canine. If the patient seeks orthodontic care, the orthodontist will frequently request that the maxillary canine simply have the overlying soft and hard tissue removed so that the tooth can be manipulated into its proper position by orthodontic appliances. When the tooth is positioned in such a way that orthodontic manipulation can assist the proper positioning of the impacted canine, the tooth is exposed and bracketed (Fig. 9-42, *A).* A four-corner flap is created to allow the soft tissue to be repositioned apically should this be required for maximum keratinized tissue management (Fig. 9-42, *B).* The overlying bone tissue is then removed with chisel or burs as is necessary (Fig. 9-42, C). Once the area is debrided, the surface of the tooth is prepared by the usual standard procedures of etching and applying primer. The bracket is then luted to the surface of the tooth (Fig. 9-42, D). A wire can be used to connect the bracket to the orthodontic appliance or more commonly a gold chain is attached from the orthodontic bracket to the orthodontic arch wire. The gold chain provides a greater degree of flexibility and the incidence of breakage of the chain is much less than breakage of a wire. The soft tissue is then sutured in such a way as to provide the maximum coverage of the exposed tissue with keratinized tissue (Fig. 942, E). As the tooth is pulled into place with the orthodontic appliances, the soft tissue surrounding the newly positioned tooth should have adequate keratinized tissue and the tooth should be in an ideal position.

If the tooth is positioned toward the palatal aspect, the tooth may be either repositioned or removed. If the tooth is repositioned, it is surgically exposed and moved into position orthodontically. In this procedure the overlying soft tissue is excised; flaps are not needed to gain attached tissue. Because the bone in the palate is thicker, a bur is usually necessary to remove the overlying bone. The exposed tooth then is managed in the same manner as is the labially positioned tooth.

If the dentist decides the tooth should be removed, it must be determined if the tooth is positioned labially, toward the palate, or in the middle of the alveolar process. If the tooth is on the labial aspect, it is easy to reflect a soft tissue flap and to remove the underlying bone and the tooth. However, if the tooth is on the palatal aspect or in the intermediate buccolingual position, it is much more difficult to remove. Therefore when assessing the impacted maxillary canine for removal, the surgeon's most important assessment is of the buccolin-gual position of the tooth.

Similar considerations are necessary for other impactions, such as mandibular premolars and supernumerary teeth. The supernumerary tooth in the midline of the maxilla, called a *mesiodens,* is almost always found on the palate and should be approached from a palatal direction when it is removed.

## SURGICAL PROCEDURE

The principles and steps for removing impacted teeth are the same as for other surgical extractions. Five basic steps make up the technique: The first step is to have adequate exposure of the area of the impacted tooth. This means that the reflected soft tissue flap must be of an adequate dimension to allow the surgeon to retract the soft tissue and perform the necessary surgery. The second step is to assess the need for bone removal and to remove a sufficient amount of bone to expose the tooth for sectioning and delivery. The third step is to divide the tooth with a bur or chisel to allow the tooth to be extracted without removing excessive amounts of bone. In the fourth step the sectioned tooth is delivered from the alveolar process with the appropriate elevators. Finally, in the fifth step the wound is thoroughly cleansed with irrigation and mechanical debridement with a curette and is closed with simple interrupted sutures. The following discussion elaborates on these steps for the removal of impacted third molars.

Although the surgical approach to the removal of impacted teeth is similar to other surgical tooth extractions, it is important to keep in mind several distinct differences. For instance, the typical surgical extraction of a tooth or tooth root requires the removal of a relatively small amount of bone. However, when an impacted tooth (especially a mandibular third molar) is extracted, the amount of bone that must be removed to deliver the tooth is substantially greater. This bone is also much denser than it is for typical surgical extractions, and its removal requires better instrumentation and a higher degree of surgical skill.

Impacted teeth also frequently require sectioning, whereas other types of tooth extractions do not. Although erupted maxillary and mandibular molars are occasionally divided for removal, it is not a routine step in the extraction of these teeth. However, with impacted mandibular third molars, the surgeon is required to divide the tooth in a substantial majority of patients. The surgeon must therefore have the necessary equipment for such sectioning and the necessary skills and experience for dividing the tooth along the proper planes.

Unlike most other types of surgical tooth extractions, for an impacted tooth removal the surgeon must be able to balance the degree of bone removal and sectioning. Essen-

tially, all impacted teeth can be removed without sectioning if a large amount of bone is removed. However, the removal of excessive amounts of bone unnecessarily prolongs the healing period and may result in a weakened jaw. Therefore the surgeon should remove most mandibular third molars only after sectioning them. On the other hand, removal of a small amount of bone with multiple divisions of the tooth may cause the tooth sectioning process to take an excessively long time, thus unnecessarily prolonging the operation. The surgeon must remove an adequate amount of bone and section the tooth into a reasonable number of pieces, both to hasten healing and to minimize the time of the surgical procedure.

*Step 1: Reflecting adequate flaps for accessibility.* The difficulty of removing an impacted tooth depends on its accessibility. To gain access to the area and to visualize the overlying bone that must be removed, the surgeon must reflect an adequate mucoperiosteal flap. The reflection must be of a dimension adequate to allow the placement and stabilization of retractors and instruments for the removal of bone.

In most situations the envelope flap is the preferred technique. The envelope flap is easier to close and heals better than the three-cornered flap. However, if the surgeon requires greater access to the more apical areas of the tooth, which might stretch and tear the envelope flap, the surgeon should consider using a three-cornered flap.

The preferred incision for the removal of an impacted mandibular third molar is an envelope incision that extends from the mesial papilla of the mandibular first molar, around the necks of the teeth to the distobuccal line angle of the second molar, and then posteriorly to and laterally up the anterior border of the mandible (Pig. 9-43, *A).*

The incision must not continue posteriorly in a straight line, because the mandible diverges laterally. An incision that extends straight posteriorly falls off the bone and into the sublingual space and may damage the lingual nerve, which is in close proximity to the mandible in the area of the third molar. If this nerve is traumatized, the patient will probably have a lingual nerve anesthesia, which may be distracting to the patient. The incision must always be on bone; therefore the surgeon should carefully palpate the retromolar area before beginning the incision.

The flap is laterally reflected to approximately the external oblique ridge with a periosteal elevator (Fig. 9-43, *B).* The surgeon should not reflect beyond the external oblique ridge, because this results in increased morbidity and an increased number of complications after surgery. The retractor is placed on the buccal shelf, just at the external oblique ridge, and it is stabilized by applying pressure toward the bone, which results in a retractor that is stable and does not continually traumatize the soft tissue.

The Austin and the Minnesota retractors are the most commonly used for flap reflection when removing mandibuiar third molars.

If the impacted third molar is deeply embedded in bone and requires more extensive bone removal, a releasing incision may be useful (Fig. 9-43, C and *D).* The flap created by this incision can be reflected farther apically, without risk of tearing the tissue. The recommended incision for the maxillary third molar is also an envelope incision. It extends posteriorly from the distobuccal line angle of the second molar and anteriorly to the mesial aspect of the first molar {Fig. 9-44, *A* and *B).* In situations in which greater access is required (e.g., in a deeply embedded impaction), a release incision extending from the mesial aspect of the second molar can be used (Fig. 9-44, C and D).

In the removal of third molars it is vital that the flap be large enough for adequate access and visibility of the surgical site. The flap must have a broad base if a releasing incision is used. The incision must be made with a smooth stroke of the scalpel, which is kept in contact with bone throughout the entire incision so that the mucosa and periosteum are completely incised. This allows a full-thickness mucoperiosteal flap to be reflected. The incision should be designed so that it can be closed over solid bone (rather than over a bony defect). This is achieved by extending the incision at least one tooth anterior to the surgical site when a vertical releasing incision is used. The incision should avoid vital anatomic structures. Only a single releasing incision should be used.

*Step 2: Removal of overlying bone.* Once the soft tissue is elevated and retracted so that the surgical field can be visualized, the surgeon must make a judgment concerning the amount of bone to be removed. In some situations the tooth can be sectioned with a chisel and delivered without bone removal. In most cases, however, some bone removal is required.

Although chisels can be used to remove bone overlying impacted teeth, most surgeons and patients prefer that bone be removed with a drill. The preferred instrument is a handpiece with adequate speed, high torque, and the ability to be sterilized completely, usually in a steam autoclave.

The bone on the occlusal aspect and on the buccal and distal aspects down to the cervical line of the impacted tooth should be removed initially. The amount of bone that must be removed varies with the depth of the impaction, the morphology of the roots, and the angula-tion of the tooth. Bone should not be removed from the lingual aspect of the mandible because of the likelihood of damaging the lingual nerve.

The burs that are used to remove the bone overlying the impacted tooth vary with surgeons' preferences. A large round bur, such as a no. 8, is desirable, because it is an end-cutting bur and can be effectively used for drilling with a pushing motion. The tip of a fissure bur, such as a no. 703 bur, does not cut well, but the edge rapidly removes bone and quickly sections teeth when used in a lateral direction,

The typical bone removal for the extraction of an impacted mandibular tooth is illustrated in Fig. 9-45. The bone on the occlusal aspect of the tooth is removed first to expose the crown of the tooth. Then the cortical bone on the buccal aspect of the tooth is removed down to the cervical line. Next, the bur can be used to remove bone between the tooth and the cortical bone in the cancellous area of the bone with a maneuver called *ditching.* This provides access for elevators to gain purchase points and a pathway for delivery of the tooth. No bone is removed from the lingual aspect so as to protect the lingual nerve from injury.

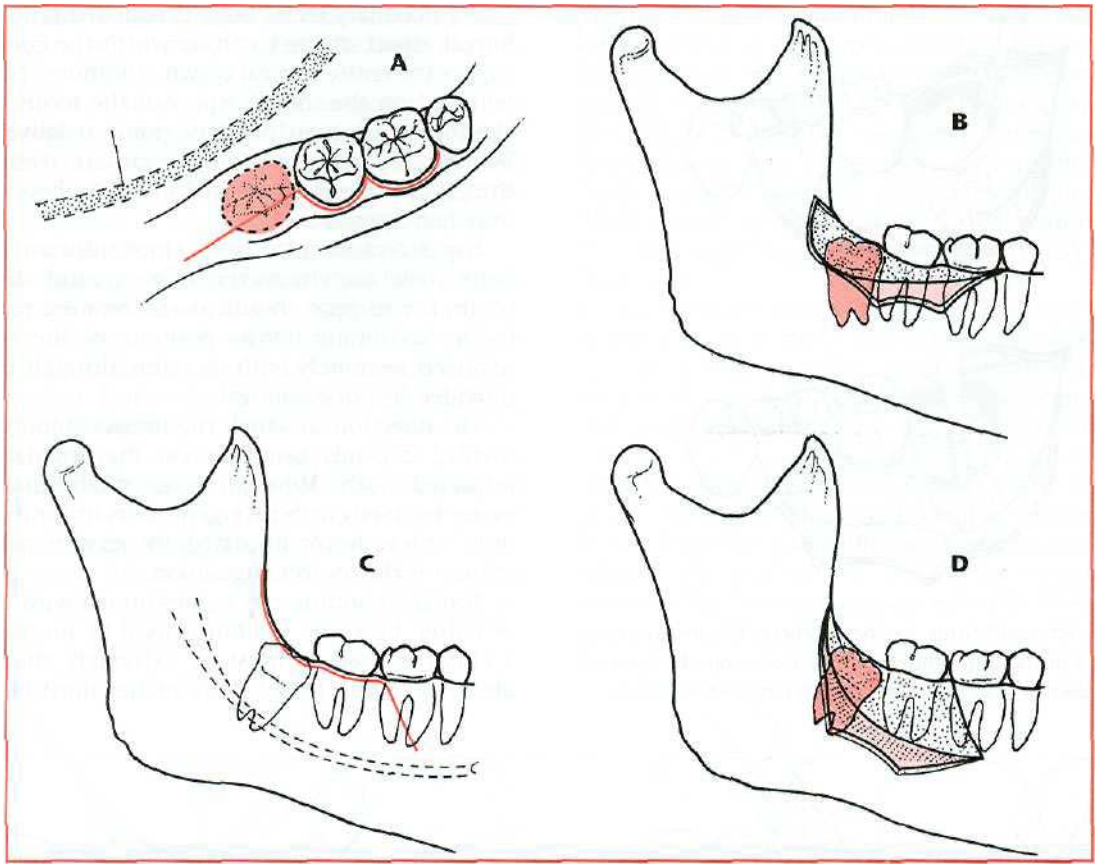



FIG. 9-43 **A**, Envelope incision is most commonly used to reflect soft tissue for removal of impacted third molar. Posterior extension of incision should laterally diverge to avoid injury to lingual nerve. **B**, Envelope incision is laterally reflected to expose bone overlying impacted tooth. **C**, When three-cornered flap is made, a releasing incision is made at mesial aspect of second molar. **D**, When soft tissue flap is reflected by means of a releasing incision, greater visibility is possible, especially at apical aspect of surgical field.

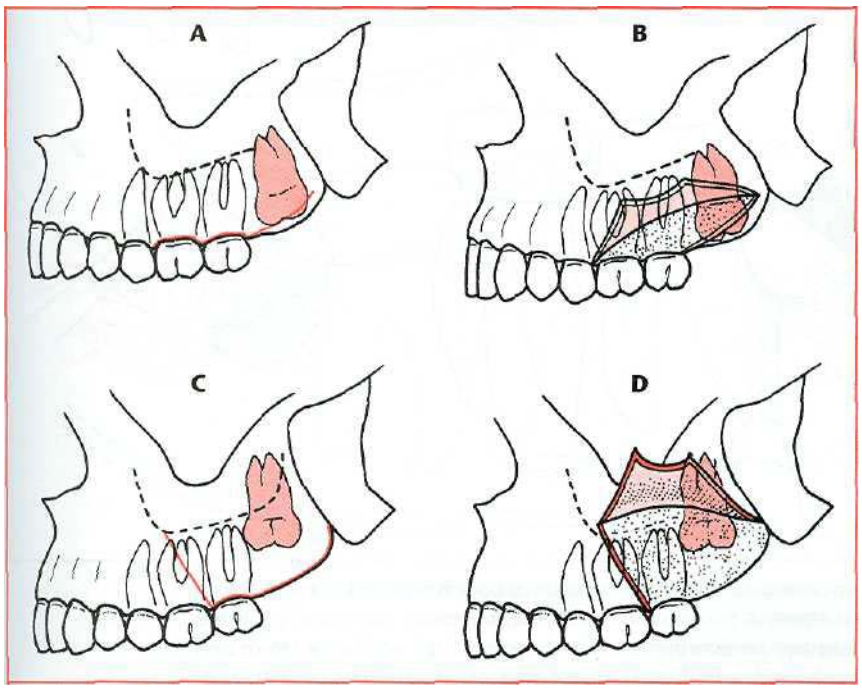



FIG. 9-44 **A**, Envelope flap is most commonly used flap for removal of maxillary impacted teeth. **B**, When soft tissue is reflected, bone overlying third molar is easily visualized. **C**, If tooth is deeply impacted, a releasing incision can be used to gain greater access. **D**, When three-cornered flap is reflected, the bone's more apical portions become more visible.

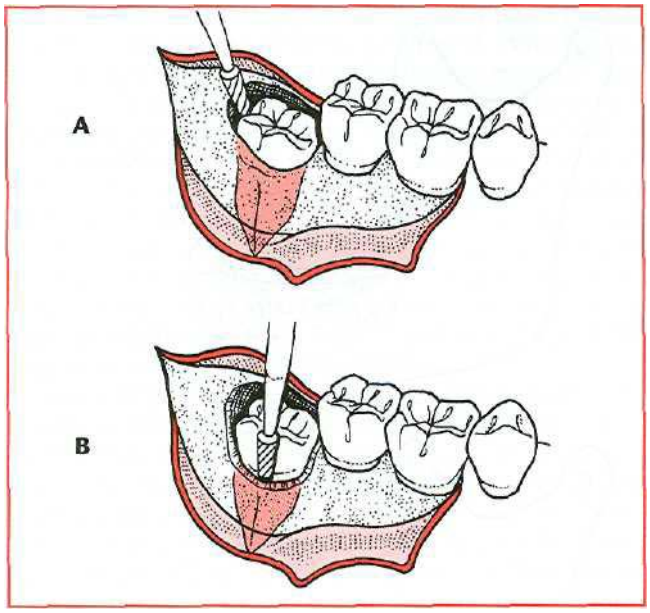



FIG. 9-45 A, After soft tissue has been reflected, bone overlying occlusal surface of tooth is removed with a fissure bur. B, Bone on buccodistal aspect of impacted tooth is then removed with bur.

For maxillary teeth, bone is removed primarily on the buccal aspect of the tooth, down to the cervical line to expose the entire clinical crown. Additional bone must be removed on the mesial aspect of the tooth to allow an elevator an adequate purchase point to deliver the tooth. Because the bone overlying maxillary teeth is usually thin, it can be easily removed with a unibevel chisel with only hand pressure.

*Step 3: Sectioning the tooth.* Once sufficient amounts of bone have been removed from around the impacted tooth, the surgeon should assess the need to section the tooth. Sectioning allows portions of the tooth to be removed separately with elevators through the opening provided by bone removal.

The direction in which the impacted tooth should be divided depends primarily *on* the angulation of the impacted tooth. Although minor modifications are necessary for teeth with divergent roots or for teeth that are more or less deeply impacted, the most important determinant is the tooth's angulation.

Tooth sectioning can be performed with either a bur or chisel; however, the bur is used by most surgeons. If a chisel is used, it must be extremely sharp, and the blows delivered to it by the mallet must be sharp and

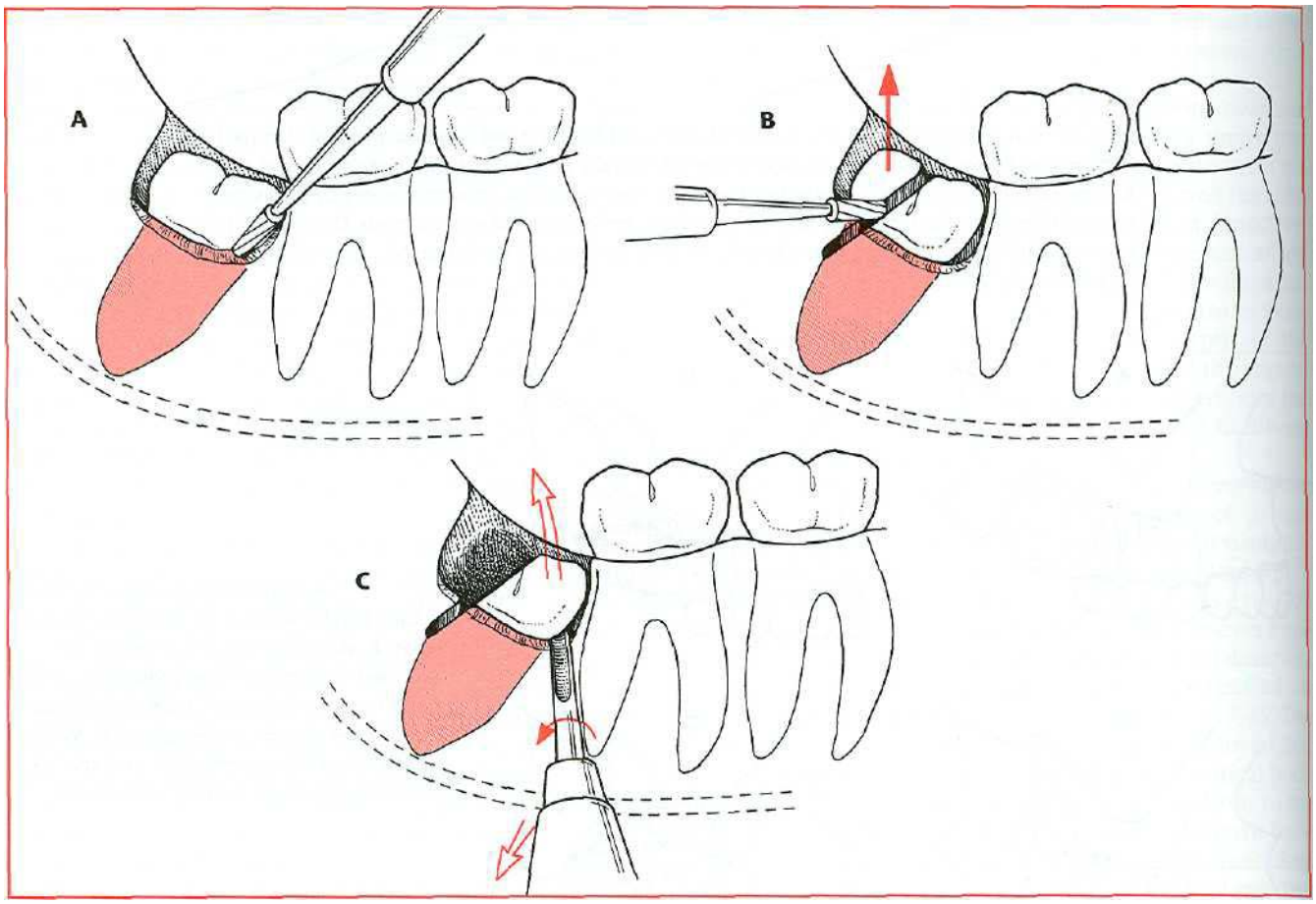



FIG. 9-46 A, When removing mesioangular impaction, buccodistal bone is removed to expose crown of tooth to cervical line. B, Distal aspect of crown is then sectioned from tooth. Occasionally, it is necessary to section entire tooth into two portions rather than to section distal portion of crown only. C, After distal portion of crown has been delivered, small straight elevator is inserted into purchase point on mesial aspect of third molar, and tooth is delivered with rotational and lever motion of the elevator.

forceful enough to split the tooth. For the conscious patient the sound of the chisel striking the tooth may be bothersome.

When the bur is used, the tooth is sectioned three fourths of the way toward the lingual aspect. A straight elevator is inserted into the slot made by the bur and rotated to split the tooth. The bur should not be used to section the tooth completely through in the lingual direction, because this is more likely to injure the lingual nerve.

The mesioangular impaction is usually the least difficult to remove of the four basic angulation types. After sufficient bone has been removed, the distal half of the crown is sectioned off at the buccal groove to just below the cervical line on the distal aspect. This portion is delivered. The remainder of the tooth is removed with a no. 301 elevator placed at the mesial aspect of the cervical line. A mesioangular impaction can also be removed by preparing a purchase point in the tooth with the drill and using a Crane pick elevator to elevate the tooth from the socket (Fig. 9-46).

The next most difficult impaction to remove is the horizontal impaction. After sufficient bone has been removed down to the cervical line to expose the superior aspect of the distal root and the majority of the buccal surface of the crown, the tooth is sectioned by dividing the crown of the tooth from the roots at the cervical line. The crown of the tooth is removed, and the roots are displaced with a Cryer elevator into the space previously occupied by the crown. If the roots of an impacted third molar are divergent, they may require sectioning into two separate portions to be delivered individually (Fig. 9-47).

The vertical impaction is one of the two most difficult impactions to remove. The procedure of bone removal and sectioning is similar to the mesioangular impaction; that is, the occlusal buccal and distal bone is removed. The distal half of the crown is sectioned and removed, and the tooth is elevated by applying an elevator at the mesial aspect of the cervical line of the tooth. This is more difficult than a mesioangular removal, because access around the mandibular second molar is difficult to obtain and requires the removal of substantially more bone on the buccal and distal sides (Fig. 9-48).

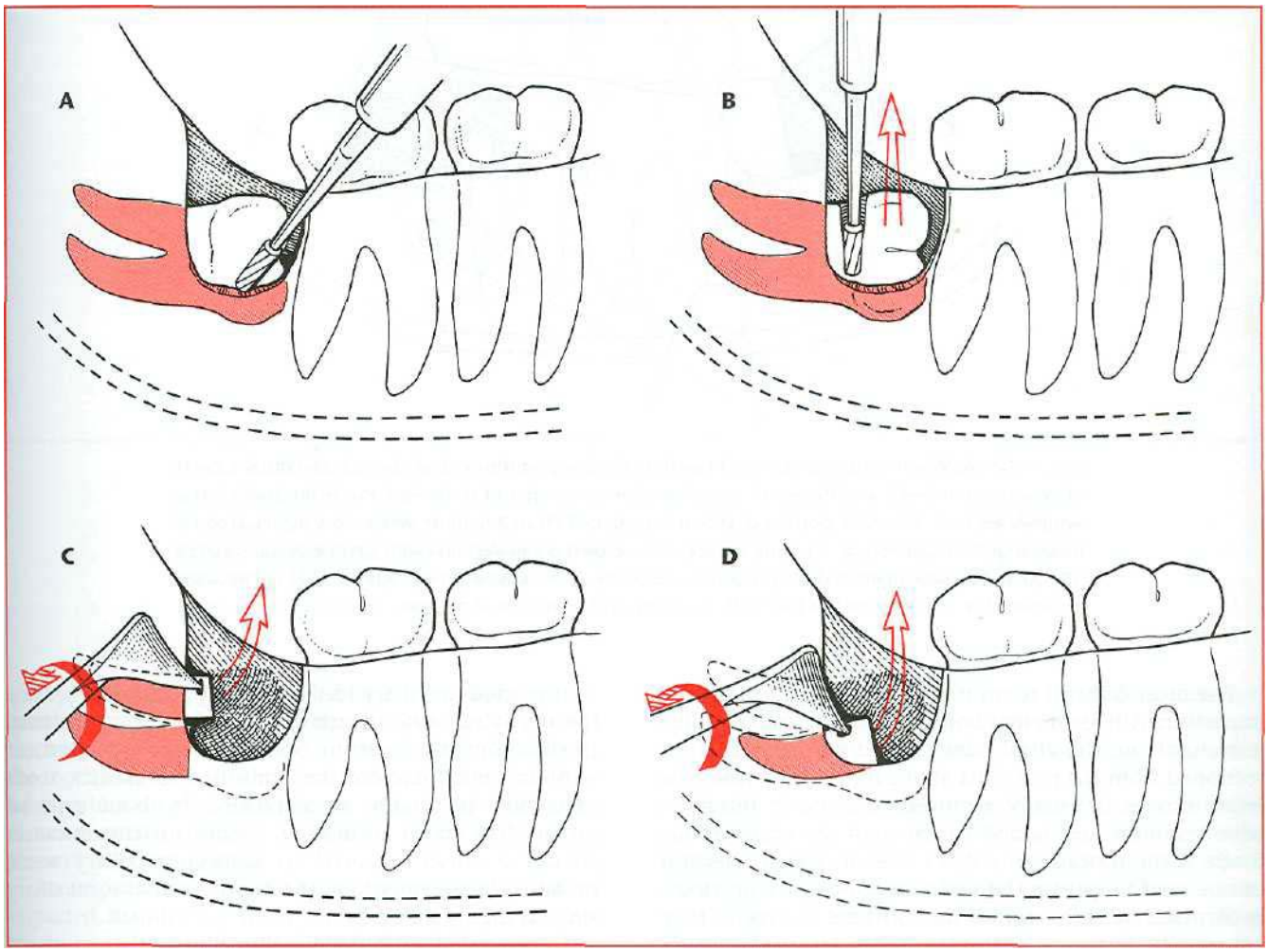



FIG. 9-47 **A**, During removal of horizontal impaction, bone overlying tooth (i.e., bone on distal and buccal aspect of tooth) is removed with bur. **B**, Crown is then sectioned from roots of tooth and delivered from socket. **C**, Roots are then delivered together or independently by Cryer elevator used with rotational motion. Roots may require separation into two parts; occasionally, purchase point is made in root to allow Cryer elevator to engage it. **D**, Mesial root of tooth is elevated in similar fashion.

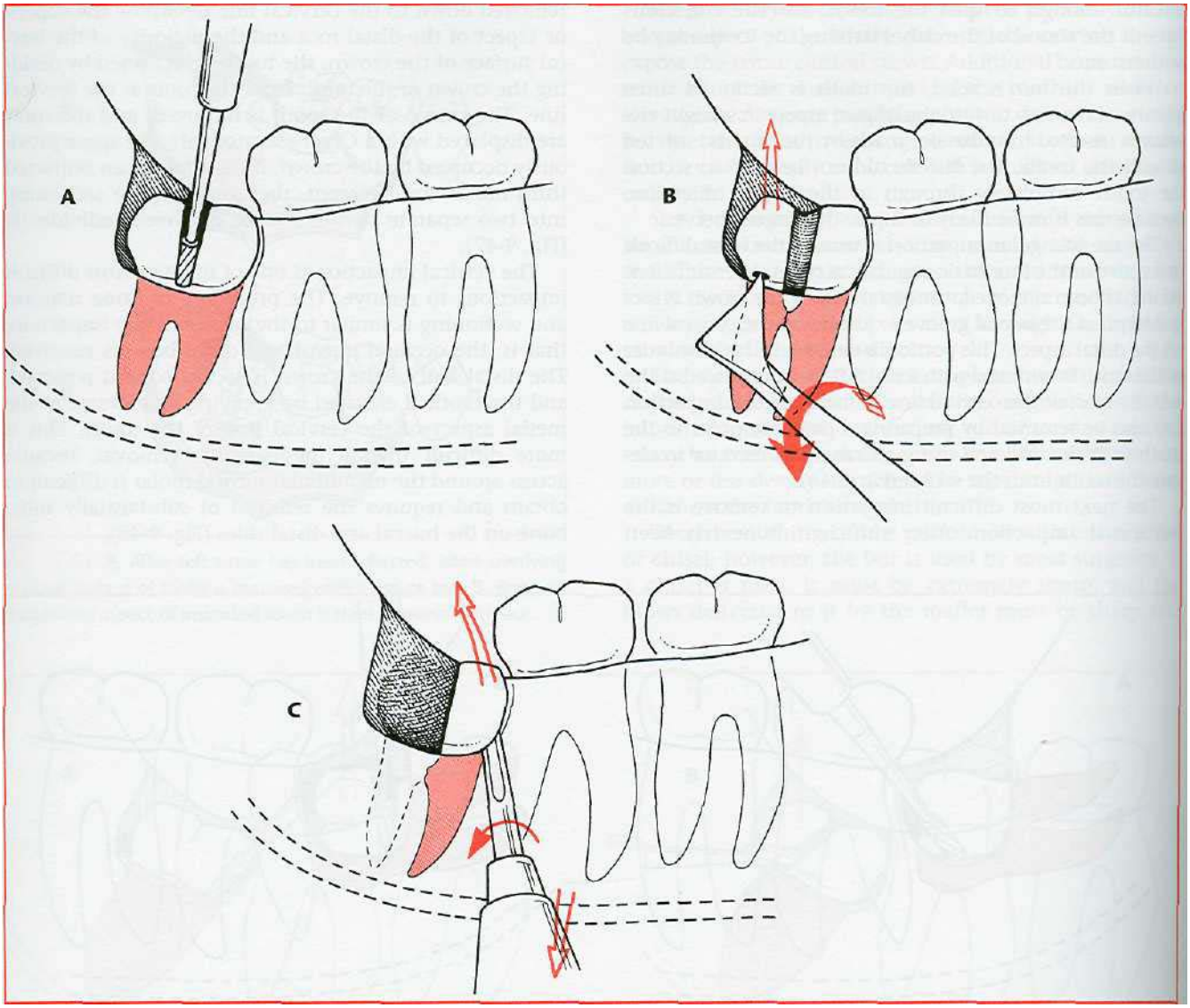



FIG. 9-48 **A**, When removing vertical impaction, the bone on the occlusal, buccal, and distal aspects of crown is removed, and the tooth is sectioned into mesial and distal sections. if the tooth has a single-fused root, the distal portion of crown is sectioned off in a manner similar to that depicted for mesioangular impaction. **B**, Posterior aspect of the crown is elevated first with Cryer elevator inserted into small purchase point in distal portion of the tooth. **C**, Small straight elevator no. 301 is then used to elevate the mesial aspect of the tooth by rotary-and-lever type of motion.

The most difficult tooth to remove is the distoangular impaction. After sufficient bone is removed from the buc-coocclusal and the distal sides of the tooth, the crown is sectioned from the roots just above the cervical line. The entire crown is usually removed, because it interferes with visibility and access to the root structure of the tooth. If the roots are fused, a Cryer or straight elevator can be used to elevate the tooth into the space previously occupied by the crown. If the roots are divergent, they are usually sectioned into two pieces and individually delivered. Extracting this impaction is difficult, because much distal bone must be removed and the tooth tends to be elevated distally and into the ramus portion of the mandible (Fig. 9-49).

Impacted maxillary teeth are rarely sectioned, because the overlying bone is usually thin and relatively elastic. In situations in which the bone is thicker or the patient is older (and therefore the bone not so elastic), tooth extraction is usually accomplished by bone removal rather than tooth sectioning. Under no circumstances should a chisel be used to section maxillary teeth, because displacement of the tooth into the maxillary sinus is highly likely.

In general, impacted teeth elsewhere in the mouth are usually sectioned only at the cervical line. This permits removal of the crown portion of the tooth, displacement of the root portion into the space previously occupied by the crown, and removal of the root portion.

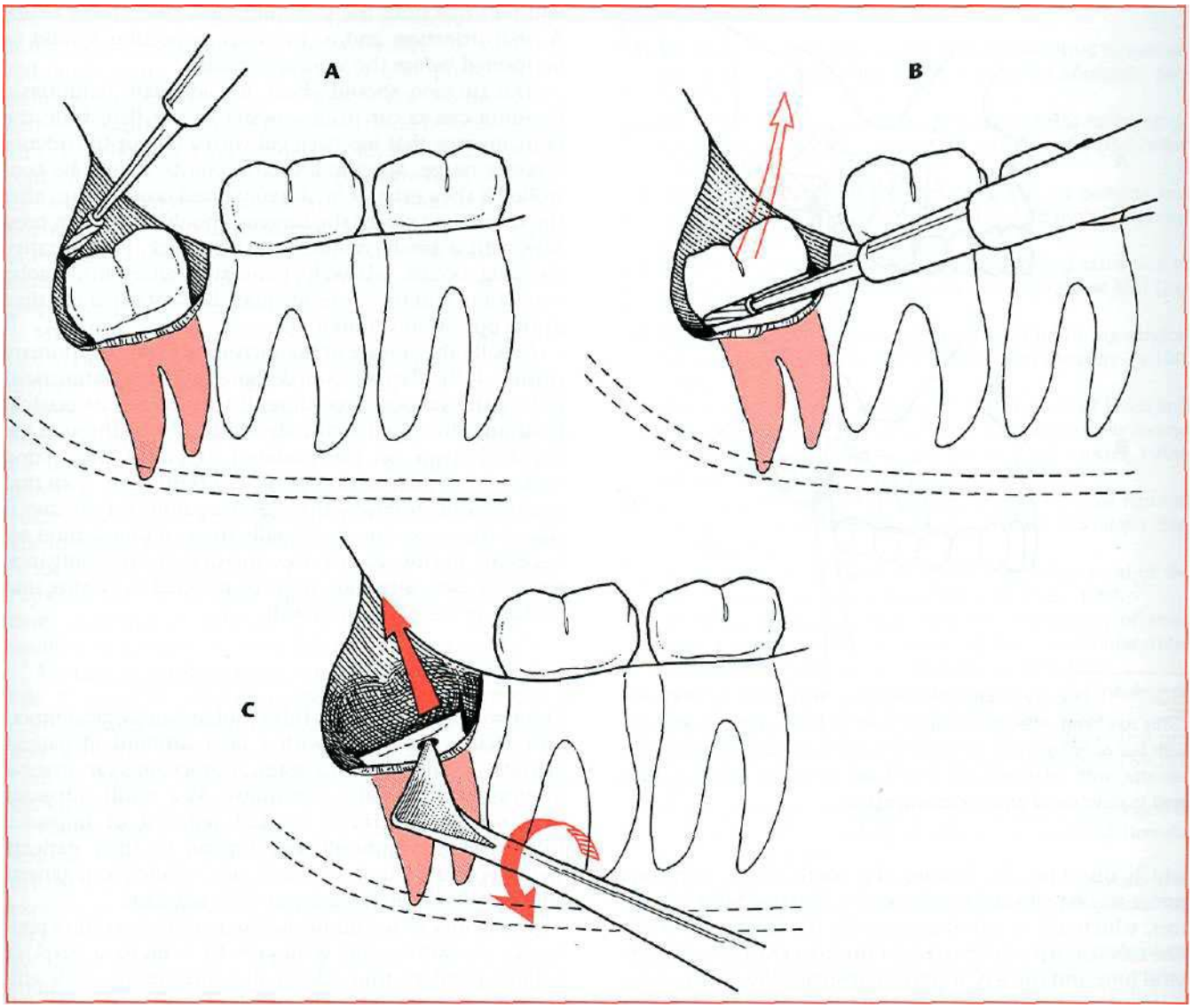



FIG. 9-49 **A**, For distoangular impaction, occlusal, buccal, and distal bone is removed with bur. It is important to remember that more distal bone must be taken off than for vertical or mesioangular impaction. **B**, Crown of tooth is sectioned off with bur, and crown is delivered with straight elevator. **C**, Purchase point is put into remaining root portion of tooth, and roots are delivered by Cryer elevator with wheel-and-axle type of motion. If roots diverge, it may be necessary in some cases to split them into independent portions.

*Step 4: Delivery of the sectioned tooth with elevator.* Once adequate bone has been removed to expose the tooth and the tooth has been sectioned in the appropriate fashion, the tooth is delivered from the alveolar process with dental elevators. In the mandible the most frequently used elevators are the straight elevator, the paired Cryer elevator, and the Crane pick.

An important difference between the removal of an impacted mandibular third molar and of a tooth elsewhere in the mouth is that almost no luxation of the tooth occurs for the purpose of expansion of the buccal or linguocortical plate. Instead bone is removed and teeth are sectioned to prepare an unimpeded pathway for delivery of the tooth.

Application of excessive force may result in unfavorable fracturing of the tooth, of excessive buccal bone, of the adjacent second molar, or possibly of the entire mandible.

Elevators are designed not to deliver excessive force but to engage the tooth or tooth root and to apply force in the proper direction. Some highly skilled surgeons use the periapical curette to remove sectioned roots from their sockets. Because the impacted tooth has never sustained occlusal forces, the periodontal ligament is weak and permits the easy displacement of the tooth root if appropriate bone is removed and force is delivered in the proper direction.

Delivery of maxillary third molars is accomplished with small straight elevators such as the no. 301 elevator,

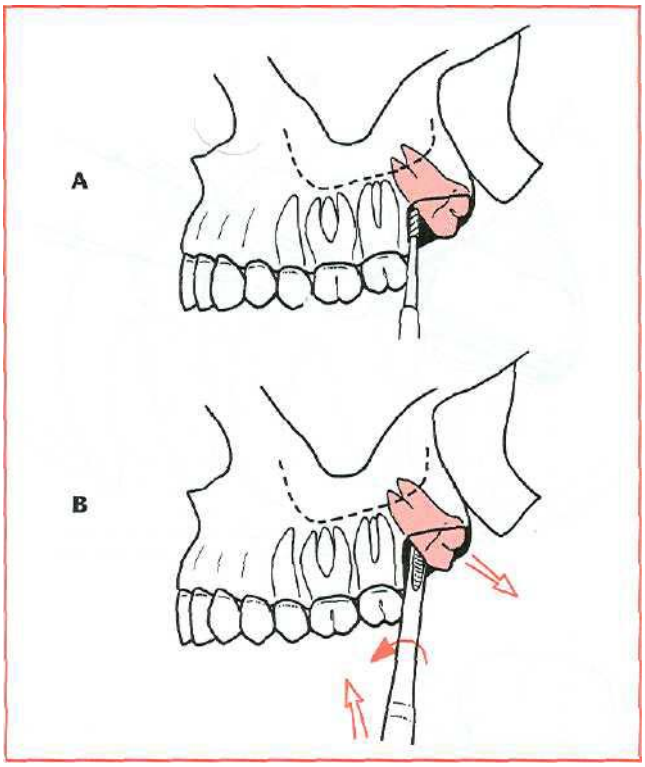



FIG. 9-50 Delivery of impacted maxillary third molar. **A**, Once soft tissue has been reflected, small amount of buccal bone is removed with bur or hand chisel. **B**, Tooth is then delivered by small straight elevator, with rotational and lever types of motion. Tooth is delivered in distobuccal and occlusal direction.

which distobuccally luxates the tooth. Some surgeons prefer angled elevators, such as the Potts or Miller elevators, which aid in gaining access to the impacted tooth. The elevator tip is inserted into the area at the mesial cervical line, and force is applied to displace the tooth in the distobuccal direction (Fig. 9-50). The surgeon should be cautious about applying excessive pressure anteriorly to avoid damage to the root of the maxillary second molar. In addition, as pressure is applied to displace the tooth posteriorly, the surgeon should have a finger on the tuberosity of the maxilla (especially if the impaction is mesioangular) so that if a fracture does occur, steps can be taken to salvage the tuberosity of the maxilla.

*Step 5: Debridement of wound and wound closure.* Once the impacted tooth is removed from the alveolar process, the surgeon must direct attention to debriding the wound of all particulate bone chips and debris. The surgeon should irrigate the wound with sterile saline, taking special care to irrigate thoroughly under the reflected soft tissue flap. The periapical curette is used to mechanically debride both the superior aspect of the socket and the inferior edge of the reflected soft tissue to remove any particulate material that might have accumulated during surgery. The bone file is used to smooth any sharp, rough edges of bone. A mosquito hemostat can be used to remove any remnants of the dental follicle. Once the follicle is grasped, it is lifted with a slow, steady pressure and will pull free from the surrounding hard and soft tissue. A final irrigation and a thorough inspection should be performed before the wound is closed.

The surgeon should check for adequate hemostasis. Bleeding can occur from a vessel in the flap, from the bone marrow that has been cut with a bur, or the inferior alveolar nerve. Specific bleeding points should be controlled if they exist. If brisk generalized ooze is seen, after the sutures are placed the surgeon should apply firm pressure with a small, moistened gauze pack. Postoperative bleeding occurs relatively frequently after third molar extraction, and therefore adequate hemostasis at the time of the operation is important.

Usually the closure of the incision should be a primary closure. If the flap was well designed and not traumatized during the surgical procedure, it will fit into its original position. The initial suture should be placed through the attached tissue on the posterior aspect of the second molar. Additional sutures are placed posteriorly from that position and anteriorly through the papilla on the mesial side of the second molar. Usually three or four sutures are necessary to close an envelope incision. If a releasing incision was used, attention must be directed to closing that portion of the incision as well.

## PERIOPERATIVE PATIENT MANAGEMENT

The removal of impacted third molars is a surgical procedure that is associated with a large amount of patient anxiety. In addition, this surgical procedure can involve unpleasant noises and sensations. As a result, surgeons who routinely perform surgical removal of impacted third molars commonly recommend to their patients some type of profound anxiety control such as a general anesthetic or deep intravenous (IV) sedation.

The choice of technique is based on the surgeon's preference. However, the goals are to achieve a level of patient comfort that allows the surgeon to work efficiently and that limits the patient's experience to the minimal number of unpleasant effects.

Whether a deep IV sedative or a light general anesthetic is used, most surgeons intend their patients to have little, if any, unpleasant memory of the surgical experience.

In addition to the increased need for anxiety control, a variety of medications are required to control the sequelae of third molar extraction surgery. The use of long-acting local anesthetics should be considered in the mandible. They will provide the patient with a pain-free period of 4 to 6 hours during which prescriptions can be filled and analgesics taken. The surgeon should consider writing a prescription for a potent oral analgesic for every patient who undergoes surgical removal of an impacted third molar. Enough tablets should be prescribed to last for 3 or 4 days. Combinations of codeine or codeine congeners with aspirin or acetaminophen are commonly used. Nonsteroidal antiinflammatory drugs (NSAIDs) may be of some value for certain patients.

To minimize the swelling common after the surgical removal of impacted third molars, some surgeons prefer to give parenteral steroids. IV administration of a modest

amount of a glucocorticoid steroid provides sufficient antiinfiammatory activity to give relief to swelling. Although many different regimens and protocols for steroids exist, a relatively common one is the single administration of 8 mg of dexamethasone before surgery. This is a relatively long-acting steroid, and its efficacy in controlling third molar postsurgical swelling is documented. Although steroids given in this manner have few side effects or contraindications, the general philosophy of weighing the risks and benefits of drug administration must be carefully followed before the decision is made to give these drugs routinely.

Many surgeons recommend the use of ice packs on the face to help prevent postoperative swelling. Although it is unlikely that the ice has much effect on preventing swelling, patients frequently report that the ice made them feel more comfortable. Something cool applied to the face often makes patients more comfortable. It also provides them the opportunity to participate in their postoperative care, which is important for many patients. The intraoral use of ice may have additional benefit. Gently sucking on small pieces of ice or even on commercial Popsicles may be of some value in helping patients feel more comfortable, although any measurable decrease in swelling in patients who use this technique is unlikely.

Another medication that is sometimes used is an antibiotic. If a patient has had a preexisting pericoronitis, it is common to prescribe antibiotics for a few days after surgery. However, if the patient is healthy and the clinician finds no systemic indication for antibiotics or a preexisting local infection, antibiotics are usually not indicated.

The normal postoperative experience of a patient after surgical removal of an impacted third molar is more involved than after a routine extraction. The patient can expect a modest amount of swelling in the area of the surgery for 3 to 4 days, with the swelling completely dissipating by about 5 to 7 days. A modest amount of discomfort usually follows the procedure. This discomfort can be effectively controlled with potent oral analgesics. Patients usually require analgesics for 2 or 3 days on a routine basis and intermittently for several more days. The patient may have some mild soreness in the region for 2 to 3 weeks after the surgery.

Patients who have had mandibular third molars surgically removed frequently have mild-to-moderate trismus. This inability to open the mouth interferes with the patient's normal oral hygiene and eating habits. Patients should be warned that they will be unable to open their mouths normally after surgery. The trismus gradually resolves, and the ability to open the mouth should return to normal by 10 to 14 days after surgery.

All of the sequelae of the surgical removal of impacted teeth are of less intensity in the young, healthy patient and of far greater intensity in the older, more debilitated patient. Even healthy adult patients between the ages of 35 to 40 years have a significantly more difficult time after the extraction of impacted third molars than do healthy 17-year-old patients.

See Chapter 10 for a more detailed description of postoperative care.

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