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Surgical treatment of iatrogenic canal blockages

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The endodontist of today is confronted with managing retreatment failures. Some of these can involve the retreatment of intracanal blockages. Many times, conventional endodontics cannot be redone, so a surgical approach may be needed. This article reviews four basic surgical techniques that can be used for retreatment of intracanal blockages. When the blockage cannot be removed, a standard retrograde amalgam technique or the Nygaard Östby procedure of reverse instrumentation-obturation can be used. Two other surgical techniques used to eliminate the blockage are the apical loosening technique and a true apicoectomy procedure. Each of these procedures is reviewed, and the advantages and disadvantages are discussed.
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With the maturation of endodontics as a specialty, retreatment of root canals after treatment failure has become a clinical reality. Many practicing endodontists have either been inadequately trained or are uncomfortable in dealing with the many difficult retreatment challenges in today's practice environment. Approximately 30% to 40% of our current practice involves retreatment. As a result of this, we have had to adapt and develop innovative techniques to manage many of these difficult retreatment cases.

It is well accepted that nonsurgical retreatment in cases of previously failed endodontic therapy provides the best prognosis.[1-3] Many apparent indications for surgery are not relevant. However, there are a limited, but significant, number of cases encountered in clinical practice in which surgery is indicated. The main indications are the inability to instrument the root canal system, resulting in an inadequate nonsurgical result, or the inability to control persistent signs and symptoms. Also, there are many cases in which either conventional endodontics cannot be redone or surgical endodontics has been previously performed and has now failed.[4] The basic problem with many of these surgical failures is that conventional retreatment should have been performed before the surgery, and thus the surgery could have been avoided. This is well substantiated in the literature.[4-15] However, in today's practice environment, endodontists are seeing surgical failures that many times need both conventional and surgical retreatment. In addition, the intracanal blockage is a common retreatment problem that often needs both conventional and surgical treatment. Many endodontists have discovered that clinical correction of this type of problem is perhaps the most difficult and challenging. The purpose of this

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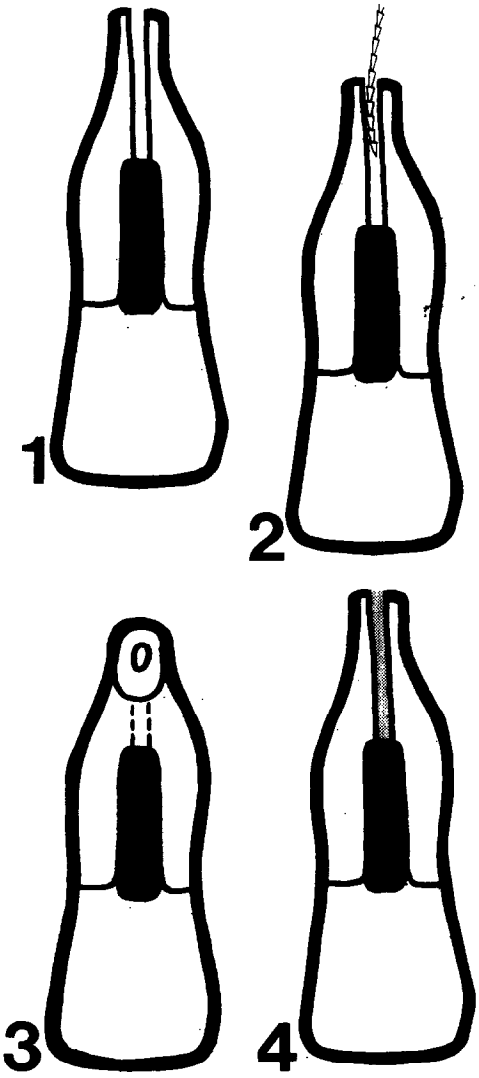
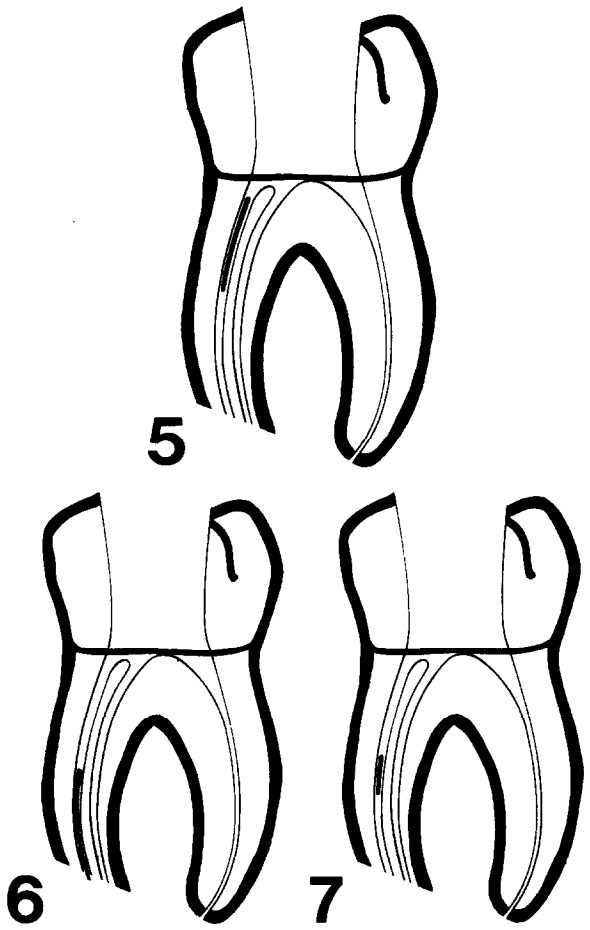


Figs. 1 to 4. Post present in occlusal two thirds of canal; apical one third of canal not instrumented or filled adequately (Fig. 1). Surgical approach, apical one third of canal instrumented from reverse direction (Fig. 2). Apical one third of canal prepared for obturation; surgically, apical bevel, preparation placed (Fig. 3). With use of surgical approach, apical one third of canal filled (Fig. 4).



Figs. 5 to 7. Canal blockage in occlusal half of mesiolingual canal (Fig. 5). Canal blockage in apical half of mesiolingual canal (Fig. 6). Canal blockage in middle third of mesiolingual canal (Fig. 7).

article is to identify some guidelines and techniques in the surgical management of conventionally untreatable iatrogenic blockages such as posts, silver cones, and broken instruments.

TECHNIQUES AND PROCEDURES

Other than removing the involved root or the tooth, there are four basic ways in which surgical treatment of iatrogenic canal blockages can be accomplished. The choice of a particular treatment modality depends on whether the blockage can be removed.

Blockage remains

1. *Traditional—retrograde amalgam.* When a post, an instrument, or a silver cone cannot be bypassed or removed, the apex must be sealed with a retrograde amalgam. In our view, this is the least desirable manner in which to perform retreatment. The failure is due to an inadequately instrumented and filled canal (Figs. 27*A* and 28*A*). Our preference is to always attempt to redo the root canal treatment in a conventional manner and to therefore avoid the surgery. Every effort should be made to conventionally bypass or remove the blockage nonsurgically. However, when nonsurgical retreatment is not possible and the blockage is in a position such that it cannot be removed (Figs. 1 to 8, 23, 27*A*, 28*A* and *B*), a retrograde amalgam is the method of choice.

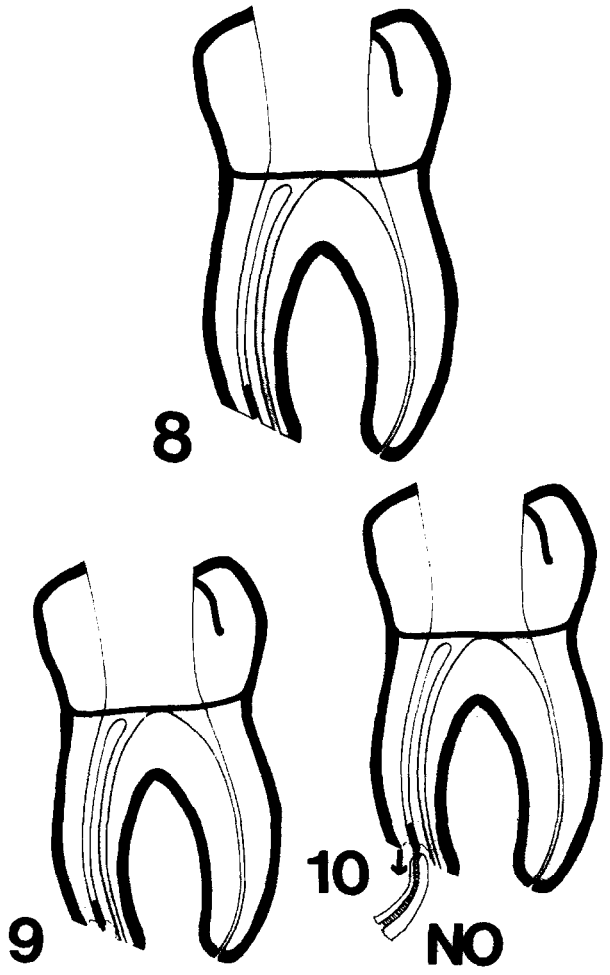
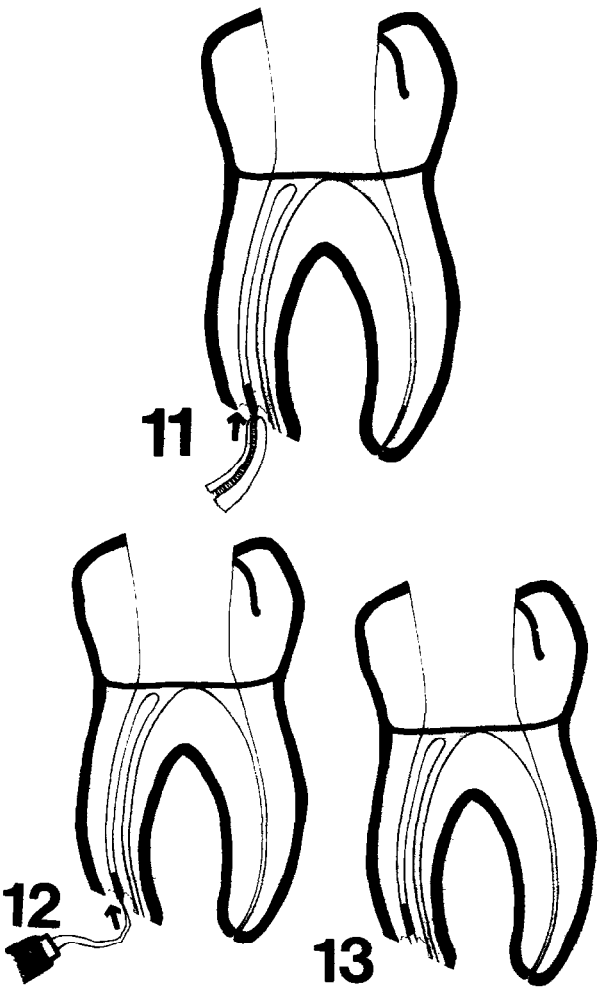


Fig. 8 to 10. Mesiobuccal and distal canals filled; mesiolingual canal remains unfilled with apical blockage (Fig. 8). With use of surgical approach, small surgical round bur removed root structure around apical blockage (Fig. 9). Hemostat used to grip apical extension of blockage; do not pull out in apical direction (Fig. 10).



Figs. 11 to 13. Hemostat used to grip apical extension of blockage; blockage pushed upward in occlusal direction and dislodged (Fig. 11). Sharp angle of curette used to push upward in occlusal direction to further dislodge blockage (Fig. 12). Blockage has been dislodged and canal below it is now open (Fig. 13).

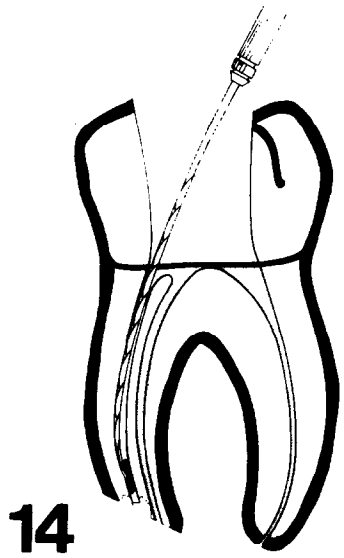
2. *Nygaard Östby technique.*[16, 17] A second type of surgical treatment can be used when there is an irretrievable post present (Figs. 1 to 4, 29). In this technique, the apex is approached and the canal is instrumented in a reverse direction (Fig. 2). Obturation may be accomplished with gutta-percha alone, only amalgam, or a combination of both materials (Figs, 3, 4, and 29*B, C*).

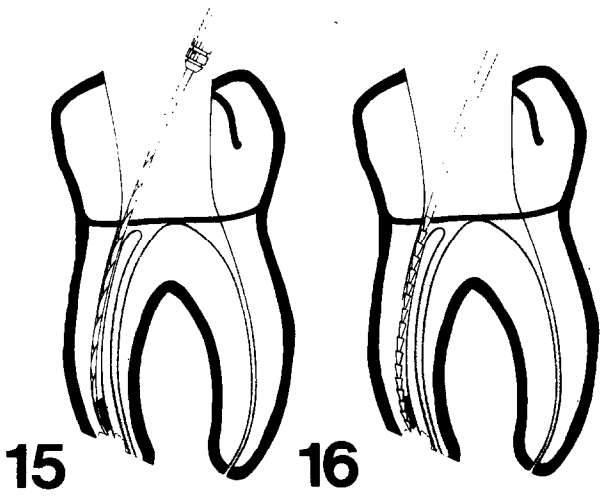
Blockage removed

1. *Apical loosening technique.* This technique involves surgical loosening of a blockage at the apex, the removal of the blockage up through the canal, and conventional retreatment followed by a retrograde amalgam restoration (Figs., 8 to 22, 30 to 32). In a single-rooted tooth (Fig. 30), the canal that has an intracanal blockage cannot be bypassed and the blockage cannot be removed; the tooth apex is approached surgically. The blockage from the canal is freed apically. The blockage is then removed nonsurgically—occlusally through the canal—and conventional retreatment is performed. Treatment is completed by placing a retrograde amalgam. This technique can also be used in a multirooted tooth (Figs 31 and 32) and is outlined in Figs. 8 to 22.

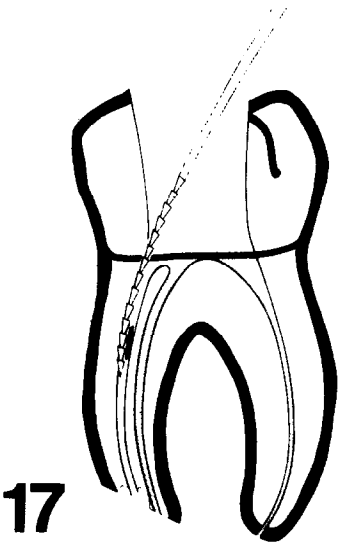
By means of the standard surgical procedure, the mandibular molar is approached.

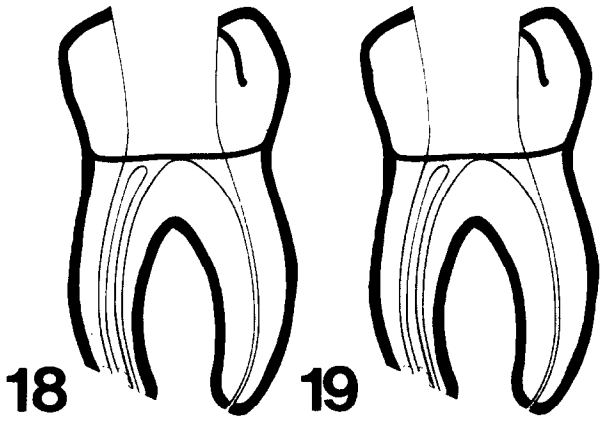
Step 1 (Fig. 8). The bone has been removed around the mesial root, and the root end has been beveled with the use of a 701 surgical length crosscut





Figs. 14 to 16. Rubber dam placed; instrumentation (reamer) begins to bypass blockage (Fig. 14). Instruments (reamers) bypass apical blockage (Fig. 15). Sequential hand or ultrasonic instrumentation used with Hedström files to enlarge canal beyond blockage (Fig. 16).





Figs. 17 to 19. Large Hedström files used to remove blockage (Fig. 17). Blockage removed and canal instrumentation completed (Fig. 18). Canal is obturated with gutta-percha, Cavit placed, rubber dam removed (Fig. 19).

fissure bur. The bevel at the apex should allow for access and visibility of the apical extent of the intracanal blockage.

Step 2 (Fig. 9). With the use of a ¼-½ round surgical length bur, a portion of the root structure around the apical blockage is removed.

Step 3 (Fig. 10). A curved hemostat is used to grip the apical extension of the intracanal blockage. *Do not* pull apically on the blocked fragment. The use of force in an apical direction could result in root fracture and lodging the blockage further so that it cannot be removed.

Step 4 (Fig. 11). Use a curved hemostat to grasp the apical blockage and gently, but firmly, push upward—occlusally on the blockage. If enough tooth structure has been removed around the blockage, it will easily be dislodged.

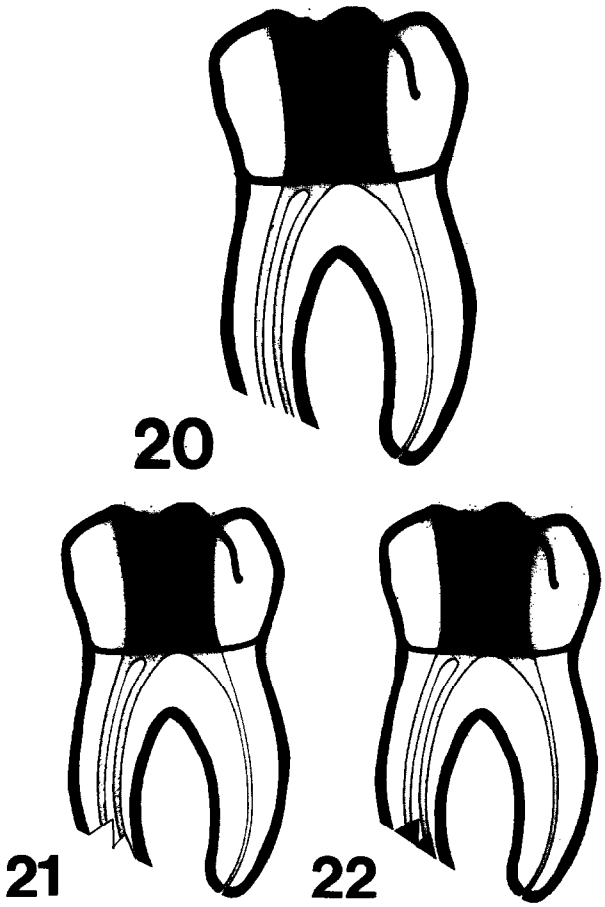
Step 5 (Fig. 12). The sharp angle of the 13R/14R Gracie curette can be used to further dislodge and push upward (occlusally) on the blockage.

Step 6 (Fig. 13). Once the blockage has been dislodged, the apex is open.

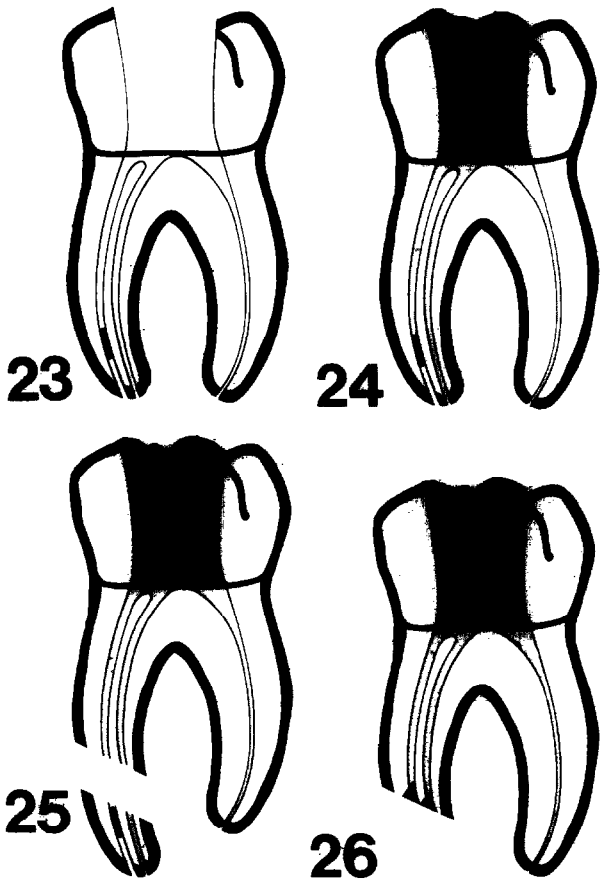
Step 7 (Fig. 14). The rubber dam is placed. Sequential instrumentation, beginning with 6 and 8 reamers, can be used to bypass the blockage.

Step 8 (Fig. 15). Copious amounts of irrigant and solvent are used to lubricate a path for the reamers to bypass the blockage.

Step 9 (Fig. 16). Once instrumentation with reamers has bypassed the blockage, 8, 10, 15, 20



Figs. 20 to 22. Surgical bevel of mesial root apex (Fig. 20). Surgical preparation of mesiobuccal and mesiolingual apices (Fig. 21). Retrograde amalgams placed in mesiobuccal and mesiolingual apices (Fig. 22).



Figs. 23 to 26. Patent canal apical to blockage in mesiolingual canal (Fig. 23). Gutta-percha filling of mesiobuccal and distal canals. Gutta-percha placed in mesiolingual canal occlusal to apical blockage (Fig. 24). With use of surgical approach, apicoectomy of mesial root. Removal of apical root portion containing blockage in mesiolingual canal (Fig. 25). Retrograde amalgams placed in mesiolingual and mesiobuccal apices (Fig. 26).

Hedström files are sequentially used to enlarge the canal beyond the blockage. Sonic instrumentation is quite effective.

Step 10 (Fig. 17). The blockage can be instrumented from the canal by means of larger Hedström files. A radiograph should be taken at this step to check for total removal of the intracanal blockage.

Step 11 (Fig. 18). The canal is now prepared for filling. After drying of the canal and filling with gutta-percha, the Cavit is placed and the rubber dam is removed.

Step 12 (Fig. 19). Surgical removal of any excess gutta-percha filling material with a curettage is accomplished.

Step 13 (Fig. 20). The root end is rebeveled with the use of a 701 surgical length crosscut fissure bur.

Step 14 (Fig. 21). Mesiobuccal and mesiolingual apical preparations are made by means of a 33½ surgical length inverted cone bur.

Step 15 (Fig. 22). Apical amalgams are placed; suturing is completed.

2. *True apicoectomy technique.* In this technique, surgical resection and removal of the root that contains the blockage are performed. The root end is sealed with a retrograde amalgam(s) (Figs. 23 to 26, 33, and 34).

This surgical technique in approaching canal blockages is very dependent on the size and length of the blockage. Its indication is when the blockage is in the most apical portion of the canal, usually less than the apical one third or extruding from the apex (Figs. 8, 23, 33A, and 34A). In this technique, the root canal is conventionally retreated. The root canal filling is placed adjacent to the most occlusal portion of the canal blockage (Fig. 24). Surgical resection of the most apical portion of the root that includes the blockage is performed (Fig. 25). Retrograde amalgam(s) is placed to seal the apices (Figs. 26, 33*C, D,* and 34*D, E*).

Fig. 27. *Case 1.* Mandibular right second premolar of 22-year-old white man. Root canal treatment with post and crown was performed 2 years previously by general dentist. **A,** Preoperative radiograph of mandibular right second premolar with large apical bone lesion. Patient has pain, buccal swelling, and percussion sensitivity. Mandibular right first molar is asymptomatic but has carious exposure. **B,** Immediate postoperative radiograph shows retrograde amalgam on mandibular right second premolar and completed root canal therapy on mandibular right first molar. **C,** Recall radiograph 1 year later shows asymptomatic tooth with complete apical bony regeneration on mandibular right second premolar. The molar has not been restored, Cavit is leaking, and apical bony lesions are still present.

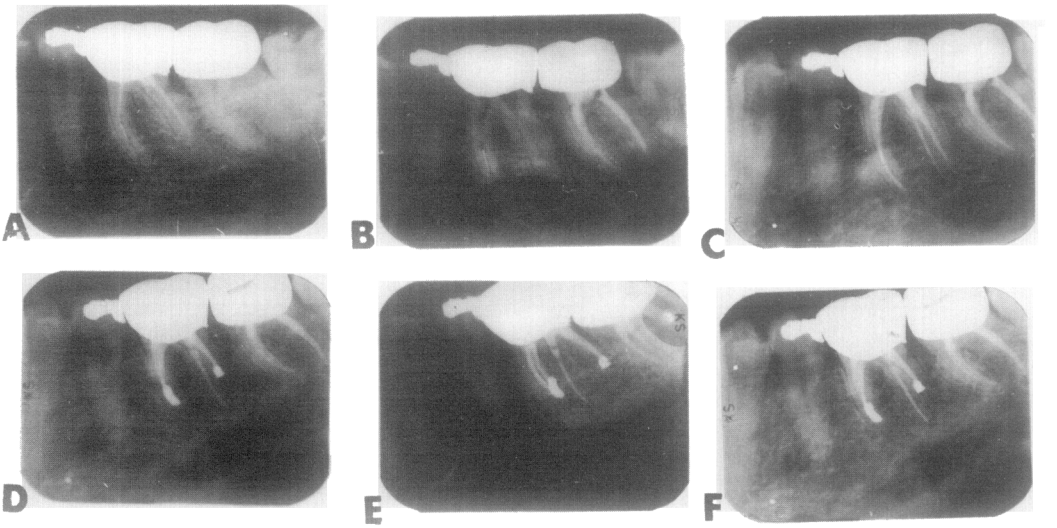


Fig. 28. *Case 2.* Mandibular right first molar of 26-year-old white woman. Root canal treatment was performed by general dentist with paste technique 2 months previously. **A,** Preoperative radiograph of paste-filled root canal with broken instrument in mesiolingual canal. Patient has continuous pain. Mandibular right second molar is devital, symptomatic, and needs treatment. **B,** Radiograph shows paste removed from canals and broken file still lodged in mesiolingual canal. Third root and all four canals are located and instrumented. Unable to remove or bypass broken file; patent canal is present below blockage. Root canal treatment of mandibular right second molar is completed. **C,** Radiograph shows gutta-percha fillings of all four canals. Only able to fill up to broken file on mesiolingual canal. **D,** Patient has recurrent pain and tenderness. Surgical treatment is performed. Unable to remove piece of broken instrument on mesiolingual canal without sacrificing too much root during apicoectomy. Apical exits of mesiobuccal and mesiolingual canals are connected by groove, slot preparation is made, and retrograde amalgam sealing both mesial canals is placed. Distal canal has paste blockage below gutta-percha filling on distal buccal root; retrograde amalgam is placed. Immediate postoperative radiograph is shown. **E,** Mesial view radiograph 1½ years later shows asymptomatic tooth with bony regeneration. File in mesiolingual canal can be seen. **F,** Different view of recall film 1½ years later shows asymptomatic tooth with apical bony regeneration.

DISCUSSION

One of the most difficult problems endodontists face is the proper diagnosis of root canal failures and the subsequent retreatment. It is important in treating the iatrogenic blockage to properly identify all aspects of the case before formulating a treatment plan. Iatrogenic blockages can occur in the form of an irremovable post, a broken instrument, a silver

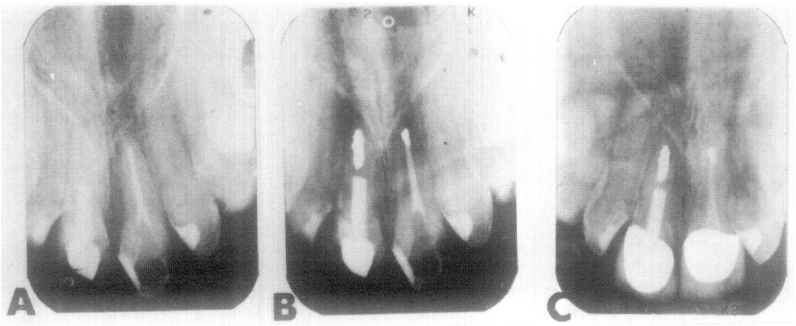


Fig. 29. *Case 3.* Maxillary right and left central incisors of 30-year-old white woman. Root canal and restorative treatment (acrylic crowns) was done 3 years previously by general dentist. No root canal therapy had been performed on maxillary left central incisor. Patient refused conventional retreatment. **A,** Preoperative radiograph showing apical bony lesion on maxillary right central incisor. Patient has pain, buccal swelling, and percussion sensitivity on both teeth. **B,** Immediate postoperative radiograph shows retrograde amalgams on both teeth. **C,** Recall radiograph 1 year later shows asymptomatic teeth with complete apical bony regeneration. Teeth have been restored with new crowns.

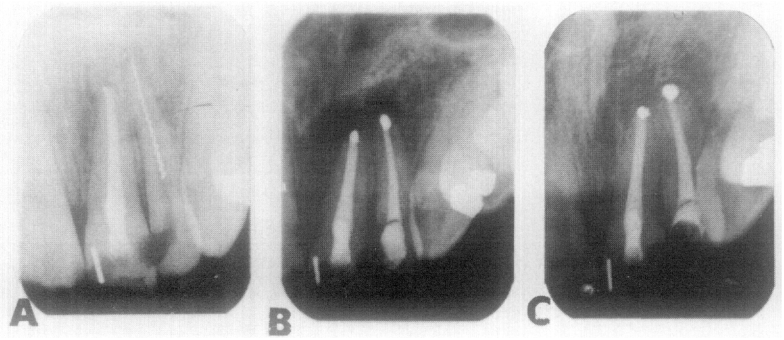


Fig. 30. *Case 4.* Maxillary right lateral incisor of 16-year-old white boy. General dentist was performing root canal treatment and Hedström file separated during instrumentation. **A,** Preoperative radiograph showing broken instrument in canal. Patient has no pain or swelling, but there is apical bone loss. Instrument could not be removed by means of conventional treatment. **B,** Immediate postoperative radiograph. Surgical flap is reflected, apical portion of root removed to loosen instrument fragment, and piece of Hedström file is pushed up and out of canal through occlusal opening. Canal is reinstrumented and filled with gutta-percha; retrograde amalgam is performed. Since the maxillary right central incisor has an apical bony lesion and apical root resorption, a retrograde amalgam and curettage are performed. **C,** Recall radiograph approximately 2 years later showing composite restored asymptomatic teeth with apical bony regeneration.

cone, or a paste with assorted calcifications. The general concept as advocated by Grossman[18, 19] and supported by Weine[20] is that instruments that are separated in a canal can rarely be recovered or bypassed during conventional retreatment. Grossman[18, 19] states that there is a relatively good prognosis for the tooth in which an instrument is broken in cases involving the apical one third of vital teeth without periapical involvement. However, most other situations result in failure.[17-20] In addition, many authors[17-24] state that the position and location of the instrument in the canal, its size, and where it is wedged determine subsequent treatment and prognosis. Irretrievable posts and silver cones that cannot be removed or bypassed during instrumentation provide the same type of clinical challenge as a separated instrument.[25-27]

Fortunately, with many new studies[26-28] demonstrating the ability of ultrasonic instrumentation to remove blockages, the necessity of surgical intervention has diminshed. However, despite these advances, there is still a demonstrated need, in very select cases, for surgical treatment. This is supported by a recent study by Nagai and coworkers,[28] which showed that in 32 out of 39 teeth, broken instruments could be removed by ultrasonic instrumentation.

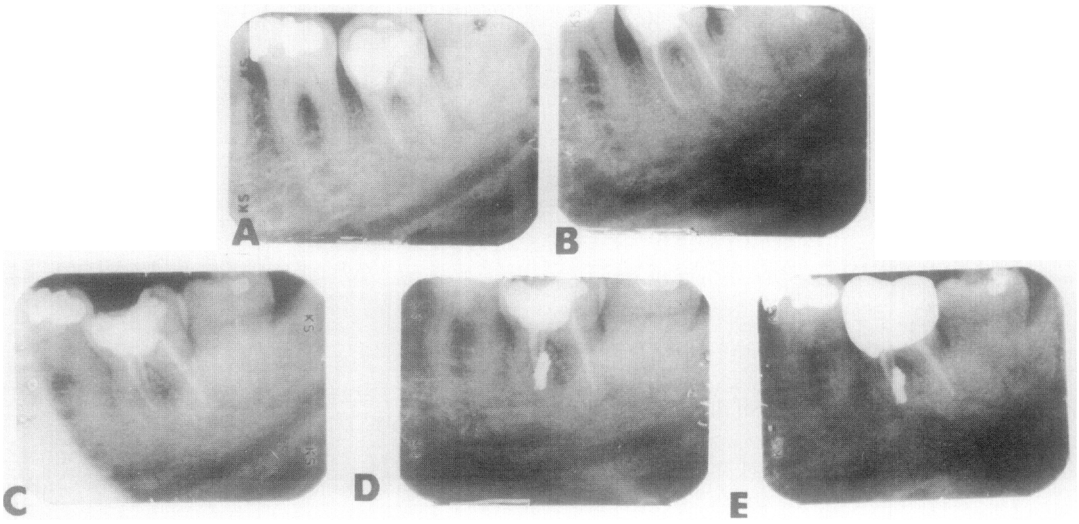


Fig. 31. *Case 5.* Mandibular right second molar of 46-year-old white man. **A,** Preoperative radiograph showing broken instrument in mesiobuccal canal. Patient has no pain or swelling, but there is apical bone loss. **B,** Radiogram showing mesiolingual and distal canals after instrumentation and filling with gutta-percha. **C,** Surgical flap is reflected; apical portion of mesial root is removed to loosen instrument fragment on mesiobuccal canal. Piece of instrument is pushed out of canal through occlusal opening. Radiograph shows mesiobuccal canal having been instrumented and filled with gutta-percha. **D,** Immediate postoperative surgical radiograph. Apical exits of two mesial canals are connected by groove, slot preparation is made, and retrograde amalgam sealing both mesial canals is placed. **E,** Recall film approximately 1½ years later showing restored, asymptomatic tooth with apical bone regeneration.

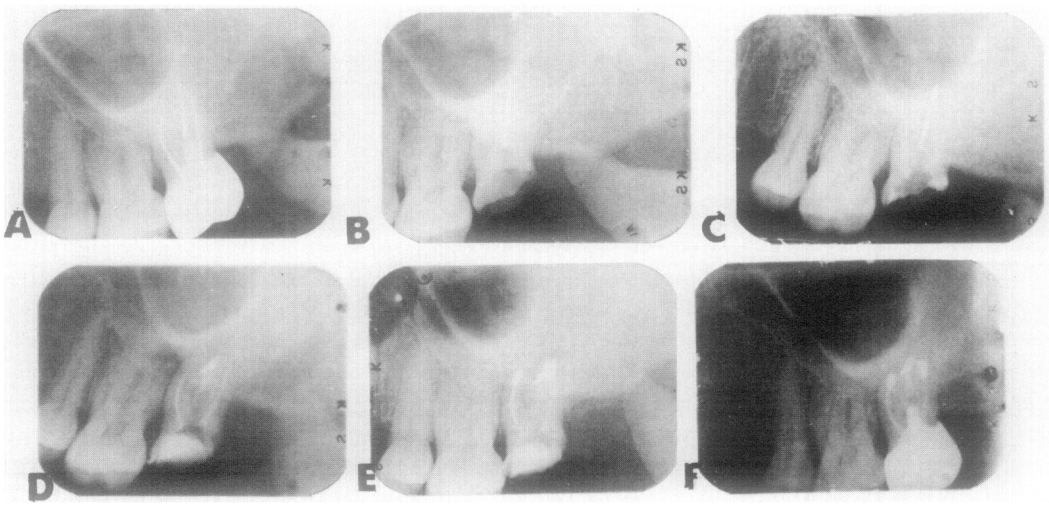


Fig. 32. *Case 6.* Maxillary right second molar of 44-year-old white woman. **A,** Preoperative radiograph showing previous root canal treatment performed with silver cone technique. Post is present in palatal root. Treatment has been performed 3 years previously by general dentist. Patient now has pain and percussion sensitivity. **B,** Conventional retreatment is attempted. Radiograph shows crown, post, and mesiobuccal and distobuccal silver cones removed. Silver cone is lodged in palatal canal. **C,** Radiograph demonstrating mesiobuccal and distobuccal canals filled with gutta-percha. Silver cone is present in palatal canal. **D,** Immediate postoperative surgical radiograph. Surgical flap is reflected on palatal aspect. Apical portion of palatal root is removed to loosen silver cone. Silver cone is pushed up and out of canal through occlusal opening. Canal is reinstrumented and is filled with gutta-percha. Post preparation is made in palatal root; retrograde amalgam is placed. **E,** Immediate postoperative surgical radiograph. Surgical flap is reflected on buccal aspect. Because of apical blockage from silver cone byproducts, mesiobuccal and distobuccal roots are sealed with retrograde amalgams. **F,** Recall radiograph approximately 3 years later demonstrating restored, asymptomatic tooth with apical bony regeneration.

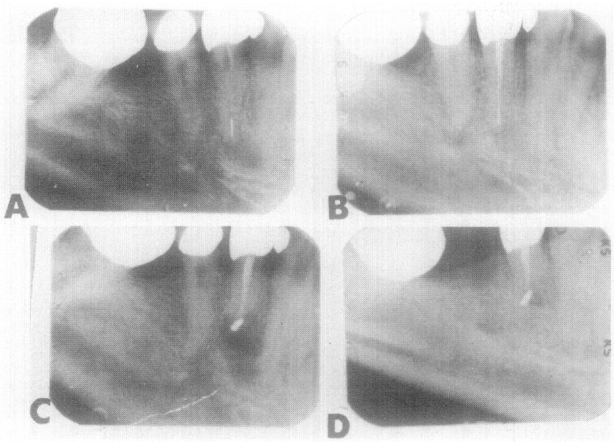


Fig. 33. *Case 7.* Mandibular left first premolar of 38-year-old white man. **A,** Preoperative radiograph showing split-cone technique of root canal therapy with silver cone in apical one fourth and poorly condensed gutta-percha in remaining canal. Treatment was performed 2 years previously by general dentist. Patient now has apical bone loss, severe pain, and percussion sensitivity. An attempt, during conventional retreatment, to bypass and remove the silver cone was unsuccessful. **B,** Radiograph showing root canal occlusal to silver cones instrumented and refilled with gutta-percha. **C,** Patient continues to have pain and percussion tenderness, so surgery is indicated. Immediate postoperative radiograph shows retrograde amalgam at root apex. Note removal of apical one fourth of root that contained silver cone. **D,** Recall radiograph 5 years later shows asymptomatic tooth with apical bony regeneration.

However, in seven of these cases, nonsurgical treatment was not possible. Some of the complications that resulted from sonic instrumentation were root perforation, pushing of the blockage out the apex, and breakage of the sonic instrument in the canal. The authors also found that instrument blockages that could not be removed by ultrasonic instrumentation occur more frequently in round-shaped canals in the apical one half of the root. Surgical treatment in this type of case can best be managed either with the apical loosening technique or the apicoectomy procedure. Often broken instruments or intracanal blockages are left in the canal simply because it is rationalized that healing will occur or that the operator cannot remove them.[21-23] In retreatment of a blockage, if the nonsurgical result is questionable, surgical treatment is needed to seal the apex. This usually consists of placement of a retrograde amalgam (Fig. 27).

Before determining which of the four outlined surgical techniques should be used, one should attempt to redo all root canals by means of conventional nonsurgical treatment. This cannot be overemphasized. However, since the nature of the retreatment entity is different in character, previous attempted therapy puts the endodontist at a disadvantage. Therefore, one should clinically evaluate the occlusal access opening, the location, and the number of canals and carefully examine the chamber floor for a perforation. Location of the blockage is critical in the development of treatment alternatives. If an instrument or silver cone blockage is in the occlusal one third of the root (Figs. 1 to 5, 27, and 29), every attempt should be made to drill down along the blockage and use grasping instruments[17] (Masserann kit,[29] Stieglitz, hemostats, ophthalmologic forceps) to remove the blockage. Solvents[30] small hand reamers, and ultrasonic instrumentation[28] can also be useful. It is essential an attempt is made to remove the blockage or bypass it by means of instrumentation, especially since much of the canal below the blockage is patent and uninstrumented (Figs. 7 and 28). If this is unsuccessful, a retrograde amalgam is often placed at the apex. However, if instrumentation and obturation are accomplished and then a retrograde amalgam restoration is performed (Fig. 28) the prognosis is enhanced. When the blockage is irretrievable (Figs. 5, 7, and 27) in the middle or occlusal one third of the root, a retrograde amalgam restoration may be the only treatment modality available other than sacrificing the root or the tooth.

Sometimes a post cannot be removed from the occlusal one half of the canal. When this occurs and the apical portion of the canal is inadequately treated, a different surgical approach can be used[16, 17] (Figs. 1 to 4, 29). After surgical access is achieved, instrumentation can be performed in a reverse direction from the apex upward toward the blockage (Fig. 2). Obturation can then be performed conventionally with gutta-percha, or amalgam can be placed (Figs. 3 and 4). This is determined by the size and length of the patent canal (Figs. 3 and 4). One disadvantage of this technique is the difficulty with access. As a result, there may be a need for substantial removal of apical bone and/or root to perform this technique. If the apical one third of the canal is patent below the midroot blockage, one can resect the root and place a retrograde amalgam (Figs. 3, 4, and 29*B, C*). The length of root removed through this resection varies with each case. Obviously, the greater the amount of root removed, the weaker the remaining tooth, the greater the risk of periodontal complications, and the poorer the prognosis. If the blockage extends from the midroot apically (Fig. 6) or is present in the apical one third (Figs. 8 and 23) of the canal, two

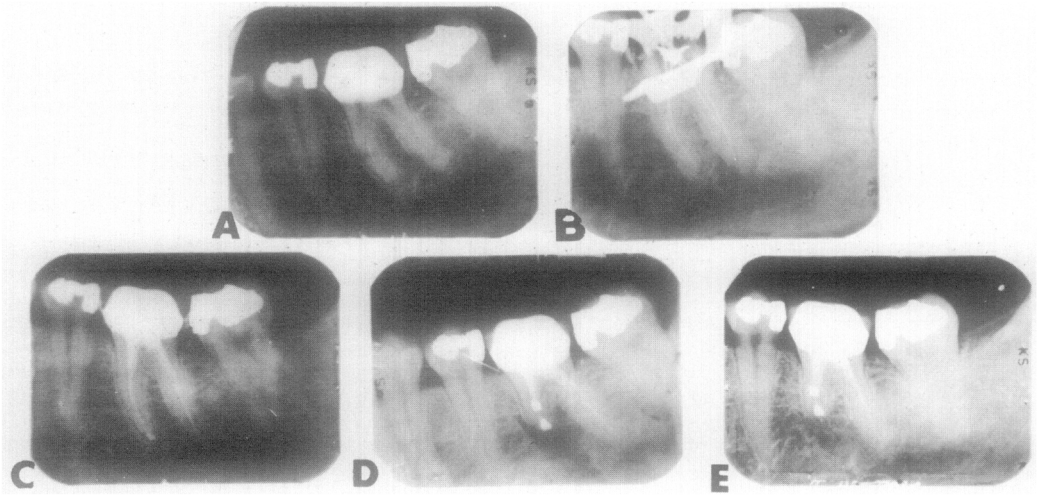


Fig. 34. *Case 8.* Mandibular right first molar of 27-year-old white woman. Root canal treatment was begun by general dentist 2 weeks previously; one Hedström file was broken at midroot in mesiolingual canal. **A,** Preoperative radiograph showing piece of broken Hedström file in mesiolingual canal. Apical one half of mesiolingual canal could not be negotiated. **B,** Working radiograph taken during instrumentation. Piece of broken Hedström file is clearly visible in mesiolingual canal. **C,** Immediate postoperative radiograph taken after obturation with gutta-percha. Patient experiences continuous postoperative pain and there is inability to negotiate apical one half of mesiolingual canal, so surgical intervention is indicated. **D,** Immediate postoperative surgical radiograph taken after mesial root apicoectomy with removal of Hedström file blockage. Retrograde amalgams were placed in mesiolingual and mesiobuccal apices. **E,** Recall radiograph 1⅓ years later shows asymptomatic tooth with complete apical bony regeneration.

other surgical techniques for removal of blockages are available. In the apical loosening technique, the blockage at the apex is surgically loosened and pushed upward and removed through the canal. The canal is retreated conventionally and then sealed surgically (Figs. 8 to 22, 30 to 32). Since one is removing the cause of the problem and performing conventional endodontic treatment, with the aid of surgery, these cases would appear to have the greatest chance of a successful prognosis. This procedure has the disadvantage of taking the greatest operator skill and the most surgical time. Therefore, the chair time for a patient can be a problem. A second surgical approach to remove blockages in the apical one third of the canal requires a true apicoectomy (Figs. 23 to 26, 33 and 34). With this technique, the blockage is removed with the apical portion of the root (Fig. 25). The disadvantage of this technique is the necessary sacrifice of root and bone support. Also, periodontal complications can develop into a significant problem, especially in the furcation.

Whenever surgical intervention is performed, factors such as flap design, periodontal condition, root anatomy, apical bony access, and support, as well as numerous other factors, can determine a successful prognosis. The use of any of these surgical techniques must be weighed carefully. Proper diagnosis and careful treatment planning are essential. The patient's attitude and the operator's ability are critical factors. Emphasis should always be placed on conventional retreatment in the most judicious manner. However, when the operator's treatment options are limited, the surgical techniques outlined can be used on a selected case-by-case basis. The endodontist with today's instrumentation and surgical training can provide treatment solutions for teeth that previously would have been extracted.

SUMMARY

This article reviews for the endodontist successful surgical treatment modalities for managing intracanal blockages. Four basic surgical techniques for treatment of intracanal blockages are presented. When conventional nonsurgical retreatment has been attempted and is inadequate or cannot be performed, surgical intervention is indicated. The importance of the position and the location of the intracanal blockage is addressed. Surgical treatment when the intracanal blockage remains irretrievable may consist of a traditional retrograde amalgam or the Nygaard Östby technique of reverse instru-

mentation-obturation. Surgical therapy to remove an intracanal blockage may also be accomplished through the apical loosening technique or a true apicoectomy procedure. The advantages and disadvantages of each of these techniques are discussed.

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