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DENTAL TRAUMATOLOGY

Case Report

Infected immature teeth treated with surgical endodontic treatment and root-reinforcing technique with glass ionomer cement

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Abstract – The authors propose surgical endodontic treatment of immature teeth characterized by necrosis and infection, especially after failure of apexification or in the presence of older, fibrous, and extensive lesion. A glass ionomer cement, autopolymerizable and condensable, is used as retro-filling material and as a reinforcement material for the canal walls. The variety of different cases presented here show that this rapid technique is reliable and reproducible.

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Key words: surgical endodontic treatment; reinforcing; resin glass ionomer; immature teeth; apexification

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The endodontic treatment of necrotic immature anterior teeth after trauma remains complicated because of large open apices, divergent root walls, thin dentinal walls, and frequent periapical lesions.

Calcium hydroxide apexification is well documented (1, 2), and is the most widespread technique (3, 4) used to stimulate a hard-tissue deposition (calcified barrier) at the apex against which a three-dimensional root canal filling can be carried. The basic pH of calcium hydroxide is thought to provide an antibacterial effect and accelerate healing of the periapical tissues (5).

If apexification is not successful, extraction is the ultimate solution. Nevertheless, periapical surgery with placement of root-end filling material is a possible alternative treatment to apexification (6). Several kinds of material have been proposed as retrograde filling materials (7, 8).

This article proposes an endodontic surgery protocol for necrotic and infected immature teeth using condensable autopolymerizable glass ionomer cement (GIC) as root-end filling material. The advantages and the drawbacks of this material, and the circumstances in which this treatment is advisable or not, are presented in this article.

Protocol

The surgical endodontic treatment described here is prescribed for necrotic immature anterior teeth with severe long-standing periapical lesions or a sinus tract. It can also be used following unsuccessful apexification. The protocol comprises first the endodontic preparation of the canal followed 1 week later by the surgical operation itself, and is completed by endodontic filling in the last session.

Endodontic preparation of the canal

After the tooth was isolated with rubber dam, an access cavity is made followed by careful biomechanical preparation with large files, taking into consideration the thin root walls. During preparation, the canal is irrigated with 2.5% sodium hypochlorite irrigating solution. The canal is dried with paper points and then filled with a combination of calcium hydroxide powder and sterile distilled water by the use of pluggers (Fig. 1A,B).

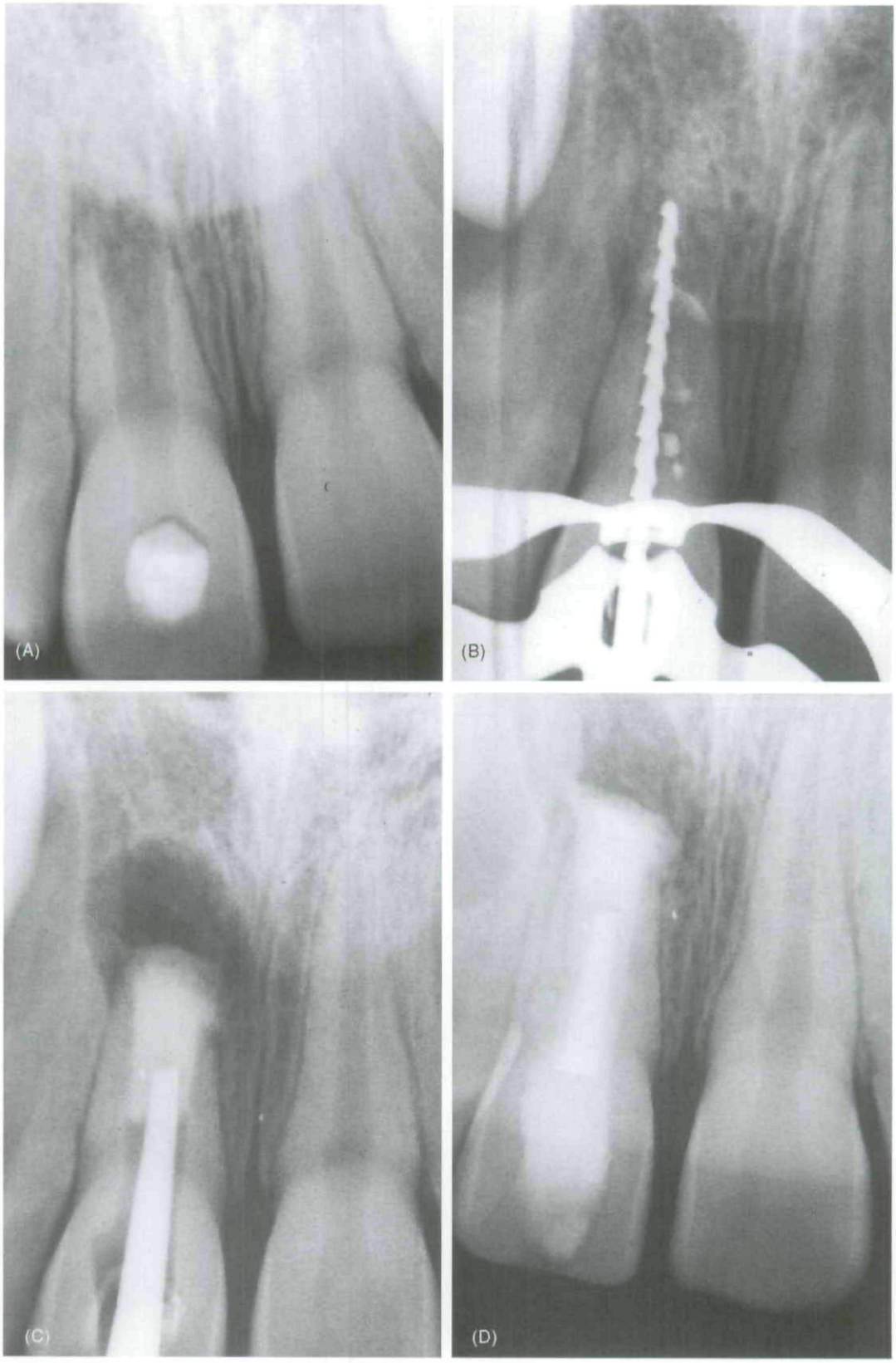

Fig. 1. Endodontic surgical treatment showing the different stages of the treatment. (A) Preoperative film of right central incisor with open apex and periapical lesion. (B) Endodontic preparation of the canal with large files. (C) X-ray after surgery, showing the glass ionomer cement (GIC) retro-filling and the gutta-percha cone used to pack the GIC material. (D) X-ray after endodontic closure showing the injection of GIC along the canal walls to strengthen the root and make the fitting of the gutta-percha cone easier. (E) X-ray control 41 months after surgery showing complete periapical healing.

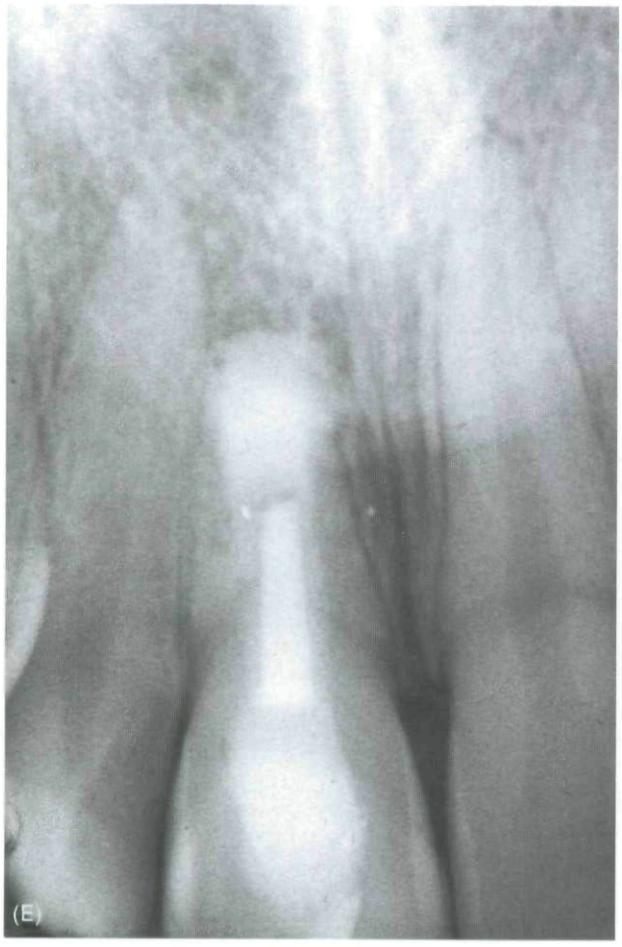

Fig. 1. continued

Surgical intervention 1 week after

Once the soft tissues have been disinfected with an antiseptic rinse and a local anesthesia has been administered, a full-thickness mucoperiosteal flap is then elevated and an osteotomy is performed with a sterile tungsten carbide bur generously sprayed. The periapical lesion is removed using surgical curettes.

As the apex opening is very wide and the root short and incompletely formed, no widening of the apex is necessary.

The canal is cleaned from apex and crown using ultrasonic tips (Piezon Endodontic System 401, EMS SA, Switzerland) and a 2.5% sodium hypochlorite solution.

The root canal is rinsed with distilled water and then dried from apex and crown with paper tips.

A 'large' size gutta-percha cone (Mynol, Block Drug Corporation, Jersey City, New Jersey) is cut 3 mm from the planned apical end and is inserted into the canal from the crown. It is not a molded cone as there must be a small space left between the root walls and the gutta cone in order to allow the GIC to fuse in the canal. The inserted cone is then pulled back 3 mm, thus creating a 6-mm vacuum in the apical part of the root.

A GIC, autopolymerizable and condensable (Fuji IX, GC Corporation, Tokyo, Japan) is injected into the apical cavity according to the manufacturer's instructions with a syringe (NUGUN by Centrix, Hawes Neos Dental, Switzerland) and a mounted tube (Centrix Needle Tube, Hawes Neos Dental) and then condensed. The cone located in the canal is then pushed back 3 mm towards the apex to create a 3-mm GIC plug at the apex. X-ray clearly shows the plug and also a GIC deposit along the root walls on the final apical third of the root (Fig. 1C). After removing excess GIC having fused outside the apex, and after autopolymerization of the GIC, the retro-restoration is finished with a 12-fluted finishing bur, 20-fluted finishing bur, and polishing mini-points.

Then, the flap is initially positioned and secured with interrupted sutures. The gutta cone used to pack the GIC material is removed from the canal. Then, the canal is cleaned, dried, and filled with calcium hydroxide. The coronary access cavity is plugged with GIC.

Antibiotics and an antalgic are prescribed, together with an alcohol-free mouthrinse to be used after each meal over the following week.

Root canal filling

One week later, a dam is placed, and root canal filling is carried out:

A 'wide' gutta-percha cone is placed in the canal to function as a master cone. If the canal is too large along the two-thirds of the coronary end, the gutta-percha cone is withdrawn, and a coronary injection of GIC is carried out, which also reinforces the canal wall along the whole length of the root. Then, the gutta cone is put back into the canal, before the GIC has set. Root canal filling is carried out by ultrasonic condensation or with the help of System B (Kerr, France) (Fig. 1D).

The retro-filled apical closure and the GIC reinforcement of the canal walls allowed a complete three-dimensional root canal filling.

The patients were seen 1 month later, and then at 6-month intervals to assess bone healing (Fig. 1E).

Case reports

The different cases treated (Figs 2–4) illustrate cases justifying endodontic surgery on immature infected teeth.

The need for endodontic surgery on an old lesion is shown in the case of a 25-year-old patient whose maxillary left central incisor shows immature apex,

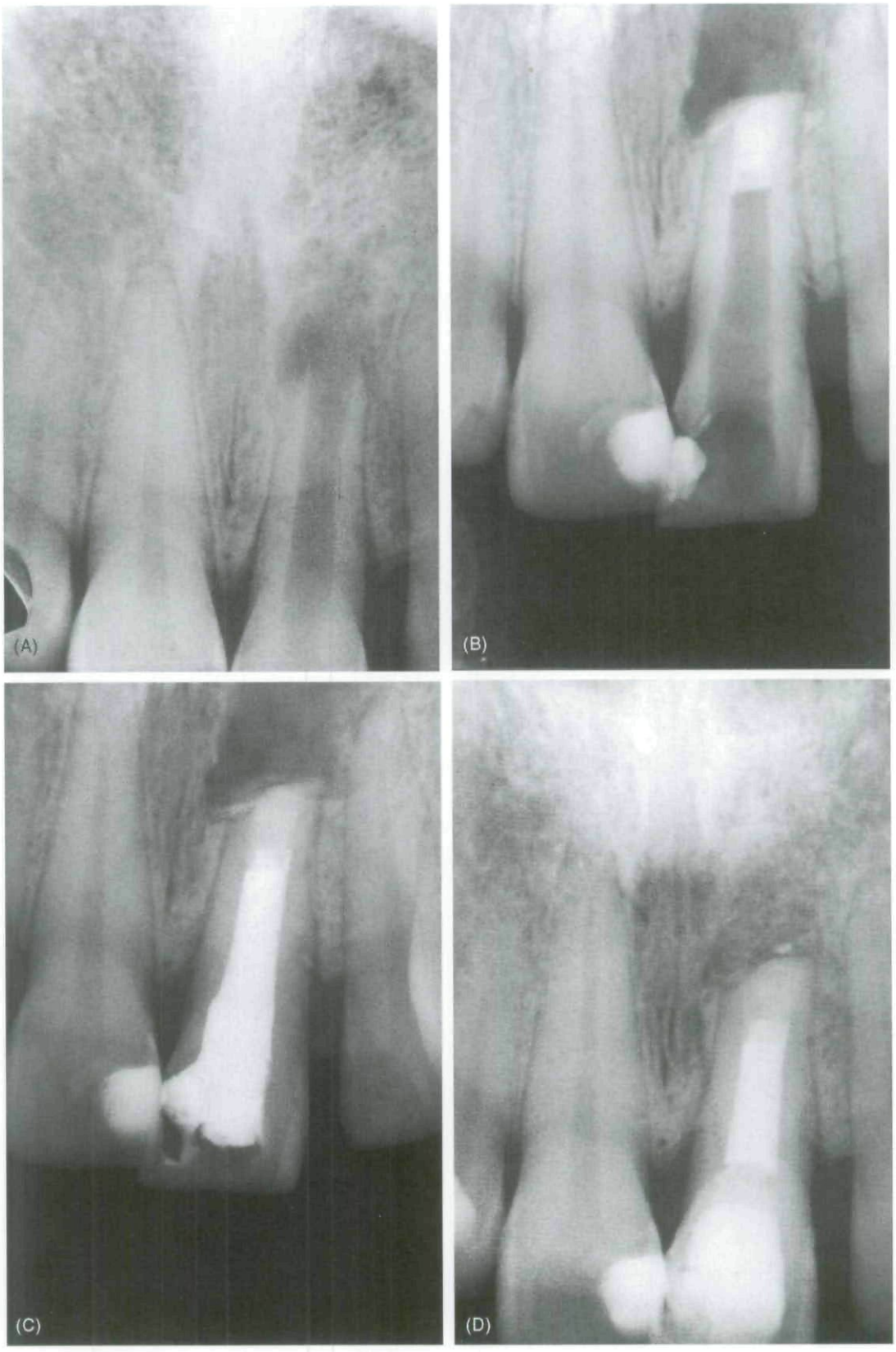

Fig. 2. Surgical endodontic treatment of an old lesion. (A) Preoperative film of left maxillary incisor with a large immature apex and periapical lesion. (B) X-ray taken immediately after endodontic surgery and retrograde filling with glass ionomer cement. (C) X-ray 1 week after endodontic closure. (D) X-ray after 1 year showing endodontic closure and complete healing of the lesion.

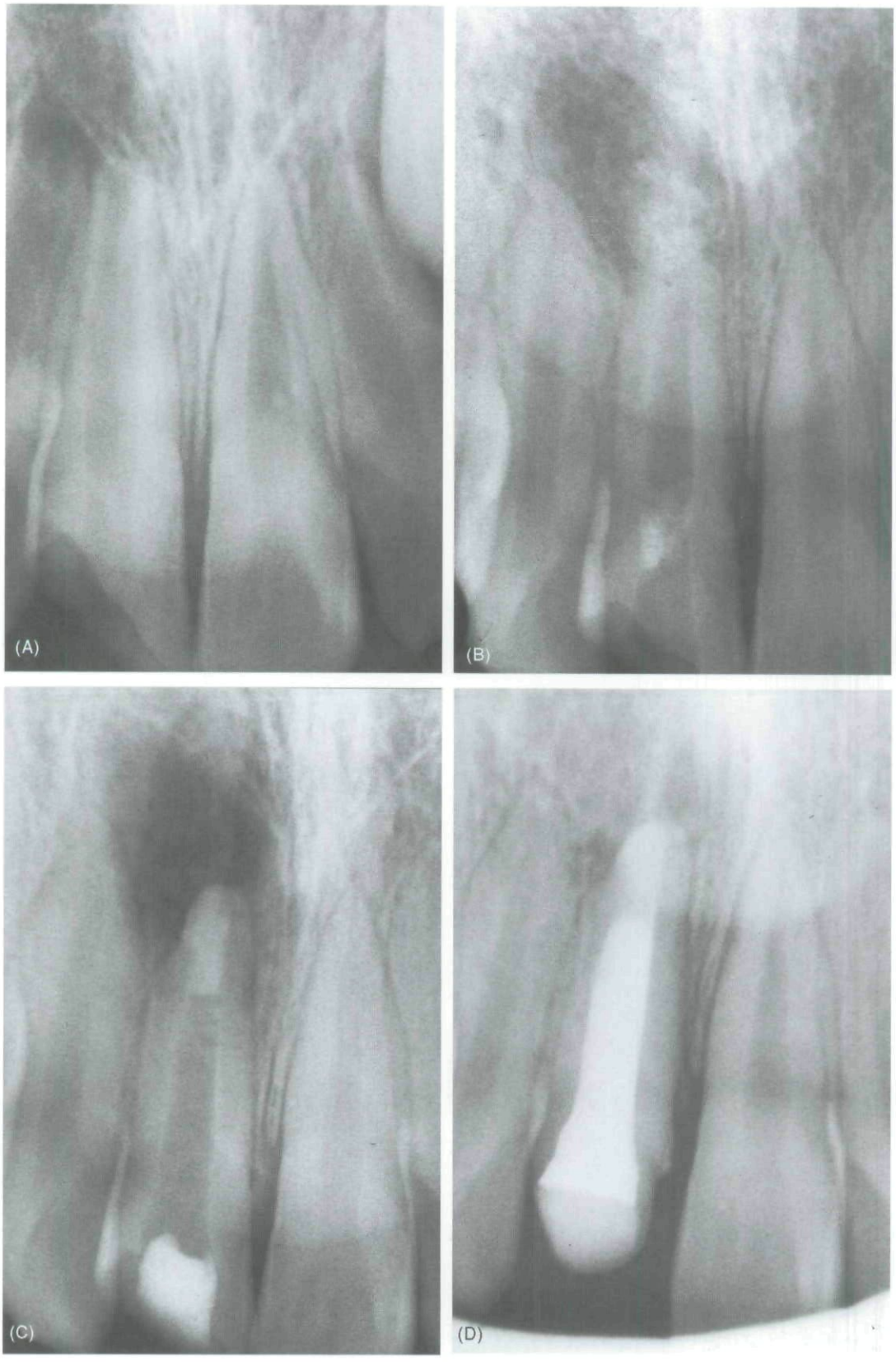

Fig. 3. Surgical endodontic treatment after unsuccessful apexification. (A) X-ray of necrotic right central incisor 2 years after trauma. (B) X-ray of right central incisor 3 years later, showing failure of treatment by apexification, with large periapical lesion following patient's suspension of treatment. (C) X-ray after endodontic surgery showing retro-filling with glass ionomer cement material. (D) X-ray after 1 year showing complete healing.

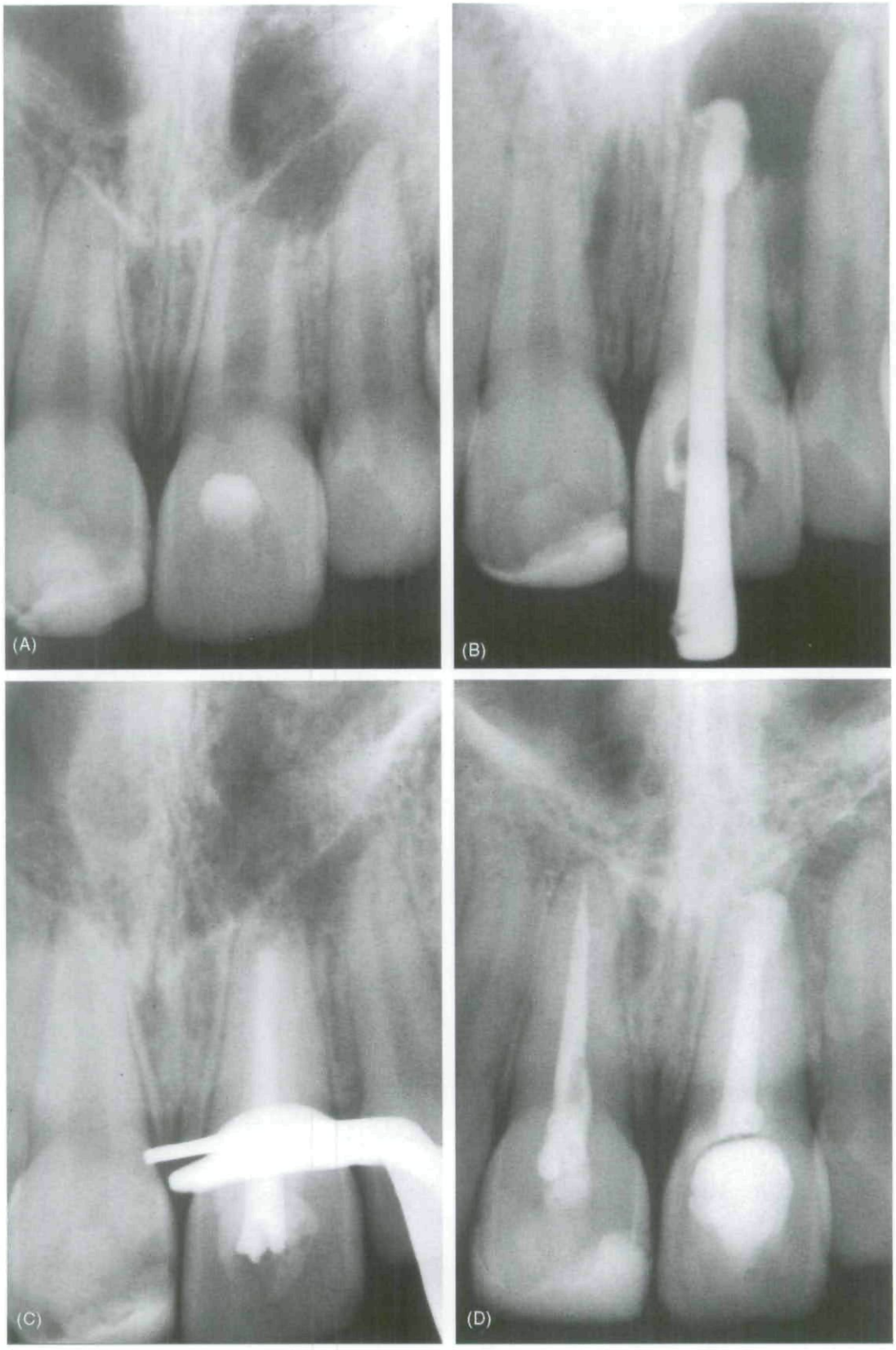

Fig. 4. Surgical endodontic treatment on large periapical lesion. (A) X-ray previous to surgery on left central incisor showing large periapical lesion. (B) X-ray after surgery showing curing of the lesion and gutta-percha cone used in retro filling with glass ionomer cement (GIC). (C) X-ray of endodontic treatment, 1 week after surgery, showing the strengthening of the canal walls with GIC along their whole length. (D) X-ray 11 months after surgery.

periapical lesion, and fistula resulting from trauma at age 9 (Fig. 2A–D). No previous treatment had been carried out on this 14-year-old lesion, which was seen when the patient consulted for toothache and a fistula.

The choice of surgical treatment after apexification failure is illustrated by the case of an 11-year-old boy who had come in, the first time, for treatment at the age of 8 for necrosis of his right central traumatized incisor (Fig. 3A). Apexification treatment had been undertaken, but the child had stopped consulting. He returned 3 years later with a large periapical lesion (Fig. 3B), and the need for surgical treatment was diagnosed (Fig. 3C,D).

Figure 4A–D illustrates the case of a large periapical lesion in a 12-year-old girl as a result of trauma at age 10. Clinical and radiologic examination revealed a very large lesion on the left central incisor, comprising the apex of the left lateral incisor (Fig. 4A), and a fistula between the lateral incisor and the canine. The lesion was so large that surgery was carried out immediately (Fig. 4B–D).

Discussion

Trauma on immature teeth mainly concern the incisors and can result in pulpal necrosis, which can produce no symptoms for many years (9). Apexification is the preferred treatment with the aim of removing the periapical infection and creating a mineral barrier at the apex, resulting in a perfectly leak-resistant three-dimensional treatment (1, 2). Apexification is sometimes unsuccessful for the following reasons:

- The length of the treatment – sometimes up to 18 months – can be be too long for the patient to maintain motivation (10).
- The presence of widespread chronic apical lesions on immature teeth at an evolutionary stage, which does not correspond to the patient's age. The necrosis of these immature teeth, generally the result of a trauma, often produces no symptoms for many years. The biologic action of calcium hydroxide is not enough to destroy these large fibrous lesions (4).
- The risk of fracturing the root during and after the apexification treatment (11).
- The fragility and porosity of the calcified apical barrier, resulting in possible apical extrusion of gutta-percha during treatment (12).

Surgical endodontic treatment is therefore commended:

- initially, when large chronic apical lesions are present on an immature tooth at an evolutionary stage, which no longer corresponds to the patient's age, and
- secondly, after failure of apexification.

The advantages of this surgical approach are:

- rapidity of treatment, with fewer appointments than in treatment by apexification (6),
- reduction of the risk of fractures by reinforcing dentin walls with GIC,
- immediate suppression of periapical lesions, and
- an efficient, reliable GIC apical barrier, ensuring better and easier three-dimensional canal filling.

Several materials have been proposed for use in endodontic surgery on immature teeth such as super-Etoxy benzoic acid cement (6), and, more recently mineral trioxide aggregate (8, 13). The retro-filling material chosen in our study is the latest generation of condensable autopolymerizable GIC. The characteristics that led us to choose this material for endodontic surgery are (7, 14):

- chemical adherence to the dentine resulting in good sealing ability,
- coefficient leakage resistance,
- biocompatibility of the material with the apical tissues,
- little tendency to dissolve in tissue fluids after setting,
- ease of handling and of insertion because of its condensable and autopolymerizable qualities,
- ease with which it can be polished, resulting in a better link with the periapical tissues,
- radio-opacity,
- good mechanical properties, and
- low cost.

In this study, GIC is used for retro-filling and is also injected into the canal wall around the gutta-percha cone in order to strengthen the thin canal walls of the immature tooth (15, 16). This reduces the risk of root fractures considerably (11). This also reduces the diameter of the canal, making endodontic closure easier and ensuring an anchor point for an inlay-core or crown.

Possible causes of unsuccessful treatment could be linked to:

- hidden root failure,
- inefficient leakage resistance of the retrograde closure resulting from inappropriate handling of GIC, and
- insufficient curing of the periapical lesion, resulting in the appearance of further lesion.

Endodontic surgery on immature teeth is not recommended:

- for patients whose general health is poor,
- for children not inclined to cooperate, and
- when there is insufficient bone substance for the tooth needing treatment.

Conclusion

Endodontic surgery on immature teeth is an attractive alternative to apexification when periap-

ical lesions are old or large, and when apexification has been unsuccessful. The use of GICs as retrofilling material and as a means of strengthening the canal walls makes three-dimensional endodontic closure easier and more reliable for necrotic and infected immature teeth.

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