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MODERN SURGICAL ENDODONTICS: ACOMPREHENSIVE CLINICAL APPROACH

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Abstract

Introduction

Endodontic microsurgery, combining advanced technology and biological principles, offers predictable healing of complex endodontic lesions. This technique has greatly improved outcomes, particularly for apical lesions due to necrosis or incomplete orthograde treatments. This paper illustrates the enhanced prognosis of endodontic microsurgery through a clinical case.

Observation

A 49-year-old female patient presented with pain in tooth 11, which had no prior endodontic treatment. Periapical radiographs and preoperative CBCT revealed a radiolucent lesion (Estrella PAI score: 5D) with buccal cortical bone destruction. Initial root canal treatment failed to resolve the lesion, necessitating endodontic microsurgery. Follow-up confirmed complete healing and reossification of the lesion.

Discussion

Endodontic surgery is indicated for persistent lesions, complex anatomies, or when retreatment is unfeasible. It is also advantageous for preserving prosthetic restorations. Preoperative CBCT ensures accurate planning, while modern tools like operating microscopes and ultrasonic instruments enhance precision and outcomes. Success depends on healed tissues, bone regeneration, and factors like lesion size, tooth location, and restoration quality. Meticulous planning and execution are critical for optimal results.

Conclusion

Technological advancements have revolutionized endodontic surgery, making it a precise, predictable, and effective treatment. Innovations such as CBCT, microsurgical instruments, and bioceramics ensure high success rates and establish the procedure as a reliable therapeutic option.

Keywords:
surgical endodontics, microsurgery, MTA, ultrasonic retropreparation, Apical surgery.

Introduction

Endodontic surgery has advanced into microsurgery, employing cutting-edge equipment, instruments, and materials that integrate biological principles with clinical application. Microsurgical techniques are recognized for achieving predictable outcomes in the healing of endodontic lesions. These improvements have notably enhanced treatment results, especially in cases of apical lesions caused by necrotic tissue or incomplete orthograde endodontic procedures. (1)

The aim of this paper is to provide a current perspective on endodontic microsurgery through a clinical case, demonstrating how this advanced approach can enhance the prognosis of endodontic treatment.

Observation

An 49-year-old female patient in good general condition presented to the Department of Dentistry at EPS Farhat Hached in Sousse, due to pain related to tooth 11. Clinical examination shows that tooth number 11 has a dental crown (Fig.1). Axial percussion is painful, while transverse percussion is painless.

The periapical radiographs reveal a periapical lesion associated with tooth 11, which has not undergone endodontic treatment (Fig. 2). Preoperative CBCT imaging confirms a radiolucent lesion with an Estrella PAI score of 5D, accompanied by localized destruction of the buccal cortical bone (Fig. 3).

Figure 1 : preoperative clinical view.

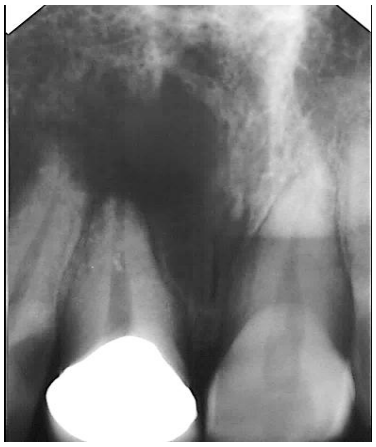

Figure 2 : preoperative radiograph.

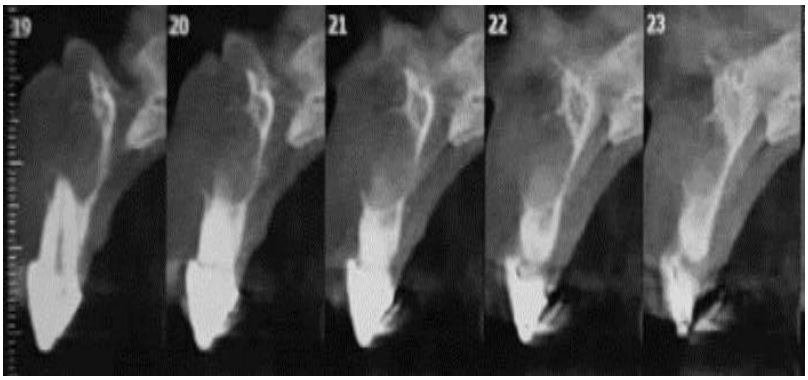

Figure 3: Preoperative sagittal slices of the CBCT.

Thus, the primary treatment plan involved one session nonsurgical root canal therapy. So, after rubber dam isolation, access cavity was correctly performed through the dental crown. After radiographic determination of the working length, the root canal preparation was conducted using PlexV (Orodeka) (Fig.4) . During sequential instrumentation, a copious irrigation with 5.25% sodium hypochlorite was frequently renewed. The final activation sequence was performed with an alternation of 5.25% NaOCl, 17% EDTA, and 5.25% NaOCl for 30 seconds each. Then the tooth was obtured with gutta-percha and bioceramic sealer (One-Fil, MDCLUS). (Fig.5)

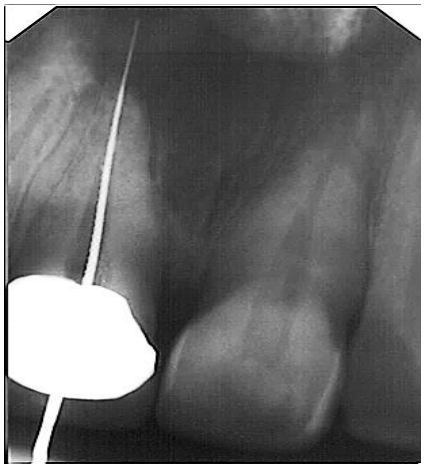

Figure 4 : Working length determination Radiograph.

Figure 5 : Immediate postoperative radiograph

After 6 months and with no change in the periapical lesion, endodontic surgery was performed. The procedure included flap incision (Fig. 6), access to the periapical lesion (Fig. 7), enucleation of the lesion (Fig.8 and 9), apical resection, retrograde preparation and obturation (Fig.10, 11, 12).

Figure 6 : Flap incision and reflection.

Figure 7 : access to the periapical lesion.

Figure 8 : Enucleation of the lesion.

Figure 9 : Surgical site after enucleation

Figure 10 : Surgical site after root-end resection and filling.

Figure 11 : Post-operative clinical view.

Figure 12 : Post-operative radiograph.

During the clinical and radiographic follow-ups at 1, 3 and 6 months, complete healing of the lesion and reossification of the site were observed. (Fig.13 and 14)

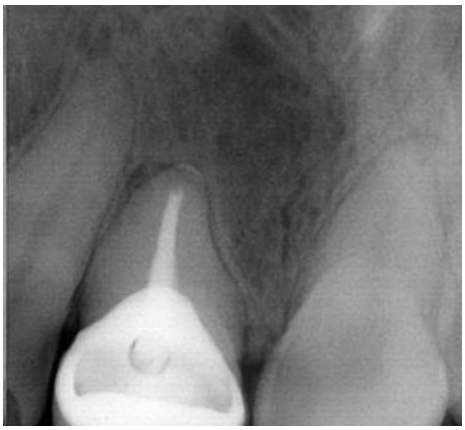

Figure 13 : Follow-up X-ray after 3 months.

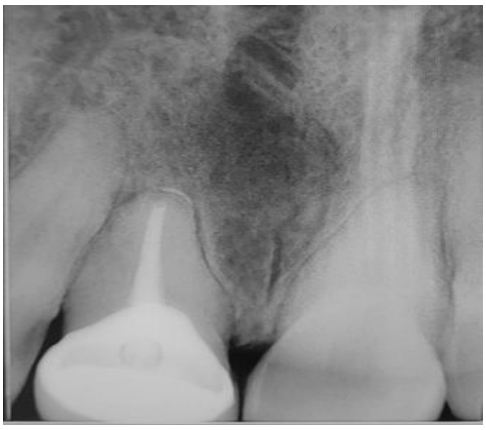

Figure 14 : Follow-up X-ray after 6 months

Discussion

Endodontic surgery is indicated in cases of persistent periapical lesions despite adequate treatment, due to factors such as complex root canal anatomy, apical infections, or cystic lesions. Limitations of conventional techniques, such as the inability to disinfect all canal surfaces, often necessitate surgical intervention. (2)

Surgery is also required when orthograde retreatment is impossible, as with severe root curvatures, fractured instruments, or radicular perforations. Additionally, it is a preferred option for preserving well-adapted prosthetic restorations without compromising their integrity (3). Specific cases, such as calcified canals or developmental anomalies like dens in dente, may also require retrograde surgical approaches to ensure healing and long-term success.

In the present case, a persistent periapical lesion was observed, and the affected tooth had a prosthetic restoration. Hence, endodontic surgery was indicated.

Preoperative analyses and techniques

Clinical assessment involves reviewing the patient's medical and dental history and performing extraoral and intraoral examination. Analyzing soft tissues, gingival type, smile line, and existing prostheses helps identify potential challenges, determine incision sites, and select the appropriate flap design. (4)

Radiographic evaluation is essential throughout the process, from diagnosis to complete healing. Two-dimensional radiographs provide initial data on lesion

size, and adjacent anatomical structures, but three-dimensional imaging like Cone-Beam CT (CBCT) is required. These scans ensure accurate localization and guide surgical decisions to minimize risks. (5)

Technological advancements, including operating microscopes and ultrasonic instruments, have revolutionized endodontic surgery. The integration of magnification and microinstruments enhances precision and preserves tissue improving surgical outcomes. (2)

The operating microscope offers up to 30x magnification, enabling meticulous execution of each step. Micro-surgical tools, including retractors, micro-mirrors, ultrasonic tip, and pluggers, are designed for the confined operative field, ensuring optimal handling and visibility. (2)

Surgical protocol :

After flap incision and reflection, The osteotomy process, guided by CBCT, aims to access the root and lesion while minimizing tissue damage. Lesion size often appears smaller radiographically than in reality, emphasizing the need for precise techniques. In fact, large lesions with thinned cortical bone require careful curettage, when cortical fenestrations simplify osteotomy.

For small lesions, the osteotomy is performed solely to create adequate space for the access of ultrasonic tips (Fig.17). (6)

In fact,the optimal size of the osteotomy depends on the lesion and the instruments used. Traditional endodontic surgery often requires larger osteotomies (~10 mm) to accommodate standard mirrors and handpieces, but this can delay recovery and increase pain. Modern microsurgical instruments allow for smaller osteotomies (~ 4 mm), reducing invasiveness and facilitating faster recovery (Fig.15). (6)

In this case, an intra-sulcular flap was performed, revealing an exteriorized lesion with destruction of the buccal cortical layer. A minor osteotomy was then carried out to improve access to the lesion.

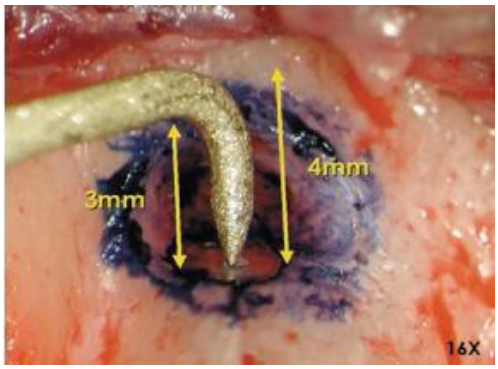

Figure 15 : The size of the osteotomy. (6)

Once the root and its apex are visible and accessible, it is necessary to completely remove the pathological tissue and any materials projected into the periapical region. Curettage is performed using instruments such as the Lucas or Molt curette for medium to large lesions, and the Columbia or Jaquette curettes for smaller lesions. (7)

Apical resection is then performed with an axis perpendicular to the root. In fact, excessive beveling exposes many dentinal tubules, increasing the risk of leakage (8). This can be avoided by using a surgical microscope and micro-instruments, allowing for a more conservative approach. (9)

For a long time, apex preparation was performed with a round bur on a miniaturized contra-angle, but this method often led to oversized cavities and risks of perforations (10). The introduction of ultrasonics in the 1990s by Gary Carr revolutionized the process by enabling precise and minimally invasive preparations aligned with the root's long axis. Ultrasonic inserts are adaptable, generating fewer debris through cavitation and vibration, simplifying cleaning. They allow 3 mm deep root-end shaping with intermittent brushing motions, efficiently removing gutta-percha while preserving canal anatomy. The final cavity is inspected microscopically to ensure smooth, parallel walls for better obturation adaptation and retention. Ultrasonics require minimal pressure to function effectively, maintaining structural integrity, and Selection of the appropriate ultrasonic tip is based on accessibility and visual visibility during retrograde preparation (Fig.16 and 17). (11)

Figure 16 : Système Endo Success Apical Surgery ® (de 3mm, 6mm, 9mm).(11)

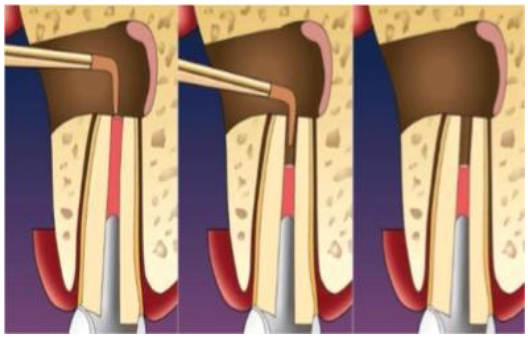

Figure 17 : Root-end preparation with the ultrasonic tip aligned along the long axis of the root. (2)

Then, retrograde filling involves placing a material in the retro-prepared cavity to achieve a hermetic seal of the root canal system, preventing leakage of residual irritants into periapical tissues. It also aims to promote cementum neoformation, periodontal healing, and bone regeneration. (8, 12)
Among the latest retrograde filling materials, Mineral Trioxide Aggregate (MTA), Root Repair Material (RRM), and Biodentine are noted for their sealing ability, biocompatibility, and bioactivity, though none fully meet the ideal material criteria (13).
In the present case, MTA was used to fill the retro-cavity. It was choosen due to its superior sealing properties, marginal adaptation, and resistance to bacterial penetration.
After placement of the filling material with Lee's Block or MAP System (Micro-Apical Placement), it should be condensed with a plugger and sculpted at the margins with a micro-brush or fine instrument, ensuring no excess material remains. The cavity should not be irrigated post-filling to avoid dissolving the MTA outside the prepared area. (14-16)

Prognosis and cicatrization

Clinical success in endodontic surgery is defined by a non-inflamed apical area with a well-healed soft tissues without aesthetic defects, absence of swelling, or fistulas and normal responses to percussion and palpation. Radiological success includes optimal obturation density, complete bone regeneration, and gradual apical bone healing, typically visible after three months.

In this case, a complete healing and reossification of the lesion was observed after 6 months.

Prognosis is influenced by factors such as the quality of coronal restoration, tooth location, retrograde filling material and the lesion size. In fact, smaller lesions (<5 mm) have better healing outcomes, when difficult access increases complexity and failure risk. (11)

This comprehensive understanding of success and prognostic factors emphasizes the critical role of careful planning and technique in achieving optimal outcomes in endodontic surgery.

Conclusion

Over the past three decades, endodontic surgical techniques have significantly evolved, driven by technological and methodological advancements. These innovations have enhanced the reproducibility of the procedures and improved the predictability of outcomes. When performed with precision, it delivers excellent results. Its high success rate justifies its position as a viable and effective therapeutic option.

This positive shift is attributed to several key factors, including the integration of the CBCT, the use of minimally invasive micro-surgical instruments such as ultrasonic tips, the application of visual aids like the operating microscope, and the development of advanced materials like bioceramics. These advancements have transformed endodontic surgery from a once uncertain procedure into a reliable and safe therapeutic alternative.

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