Modern Endodontic Surgery: A Case Report on Root Amputation & Apicoectomy of Maxillary Molar Using Guided Endodontics

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ABSTRACT

Endodontic surgery has significantly advanced with the incorporation of modern technologies such as guided endodontics, which has revolutionized the precision and predictability of surgical procedures like root amputation and apicoectomy. This case report describes the management of a complex case involving a maxillary first molar (tooth #26) with persistent periapical pathology despite prior conventional root canal therapy. The patient, a 30-year-old female, presented with symptoms of recurrent pain, swelling, and the presence of a periapical lesion with bony defect in the upper left maxillary region, which had not resolved following initial endodontic treatment.

A thorough diagnostic examination that included cone-beam computed tomography (CBCT) identified a significant periapical radiolucency involving the maxillary molar's distobuccal and palatal roots. The best course of action was found to be a combined technique comprising apicoectomy and root amputation due to the intricacy of the situation. Guided endodontics was used to improve surgical accuracy and reduce the likelihood of intraoperative complications. Using CBCT data, a 3D model of the tooth and surrounding anatomical components was created, and a surgical guide that was specifically tailored to the treatment was made to enable accurate navigation. The surgery involved the amputation of the affected roots at the furcation level, followed by apicoectomy of the remaining roots using ultrasonic instruments under magnification. The root-end cavities were subsequently filled with Biodentine to promote optimal healing. Postoperatively, the patient exhibited significant clinical and radiographic improvement, with complete resolution of symptoms and evidence of bone regeneration at the six-month follow-up.

This case emphasizes how important guided endodontics is to improving the success rates of difficult endodontic procedures. Clinicians can enhance patient outcomes, decrease the risk of iatrogenic injury, and gain more precision by utilizing modern imaging and navigation tools. The example emphasizes how crucial it is to incorporate contemporary surgical methods into the care of persistent periapical diseases, especially when all other therapeutic options have been exhausted.

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Introduction:

The success of endodontic treatment is measured by the tooth being clinically symptomless as well as the prevention or treatment of periapical pathologies. These biological objectives are achieved when the entire root canal system (RCS) is cleaned and disinfected with endodontic instruments and irrigation solutions, procedures that enable hermetic sealing of the RCS.[1]

Tooth with deep dental caries and chronic periapical pathology leads to multiple defects in root and alveolar bone that could not be appreciated except for CBCT[2]. Inadequate treatment and root canal therapy will often lead to recurrence of the pathology and eventually a root canal failure . This necessitates the need for an endodontic surgery. When compared to conventional therapy, endodontic microsurgery has a success rate of up to 89%. Apical excision is the crucial step in endodontic microsurgery in order to reduce the risk of microleakage and maintain the remaining tooth tissue as much as possible.[3] However, because of the small surgical field in terms of clinical experience, it is challenging for the surgeon to perform exact apical excision.[3]

There have been successes in the clinical application of 3D printed surgical guides in apical surgery, realizing the precise positioning of the root apical lesion area, the reduction of surgical trauma, and the protection of adjacent tissue structure to a certain extent[4]. These advancements are due to the development of contemporary digital technologies such as 3D imaging, CBCT, and CAD/CAM. Three different types of apical surgery helping guides have been identified in the current studies: localized bone-removing guide, fixed-depth bone-removing guide, and localized fixed-depth bone-removing guide[4]. While these types of guides offer a notable improvement in bone elimination, none of them were able to precisely resect the root apex in terms of length and angle, which is particularly important in apical surgery[5]. Clinical qualitative markers, such as the long-term results of apical surgery and the target teeth's survival and healing condition, were the primary focus of earlier research. The same research group assessed the surgical precision of digitally guided endodontic microsurgery in an earlier in vitro investigation, which also confirmed that the surgical guide considerably decreased the length and angular deviation of the resection[6]. In order to reconstruct the periapical lesion models from CBCT and oral digital scanning data, as well as to design a novel 3D printed metal surgical guide based on apical surgery simulation, localized digital guide manufacture and image fitting comparison is needed. The report aims to show that guided endodontics may be the treatment of choice for certain teeth with complications that require special root canal treatment. The apical resection may be guided by the novel kind of surgical guide, which could precisely localize the root apex [7].

Case Presentation:

A 30-year-old female reported with the chief complaint of pain and swelling in upper left back tooth region for 2 weeks. On inspection, deep dental caries w.r.t 26 was present, along with tenderness on percussion. Furthermore, deep pockets were seen distal to 26. Electric pulp test was negative. On radiographic examination, a periapical radiolucency (>5 mm) was revealed associated with the distobuccal and mesiobuccal roots w.r.t 26 and vertical bone loss was present . Furthermore, root resorption in the apical third was present.

Diagnosis:

The case was provisionally diagnosed as pulpal necrosis with Chronic Periapical Abscess w.r.t 26. The tooth was advised for root canal therapy and further endodontic surgery if the condition didn't resolve. An informed consent was obtained from the patient.

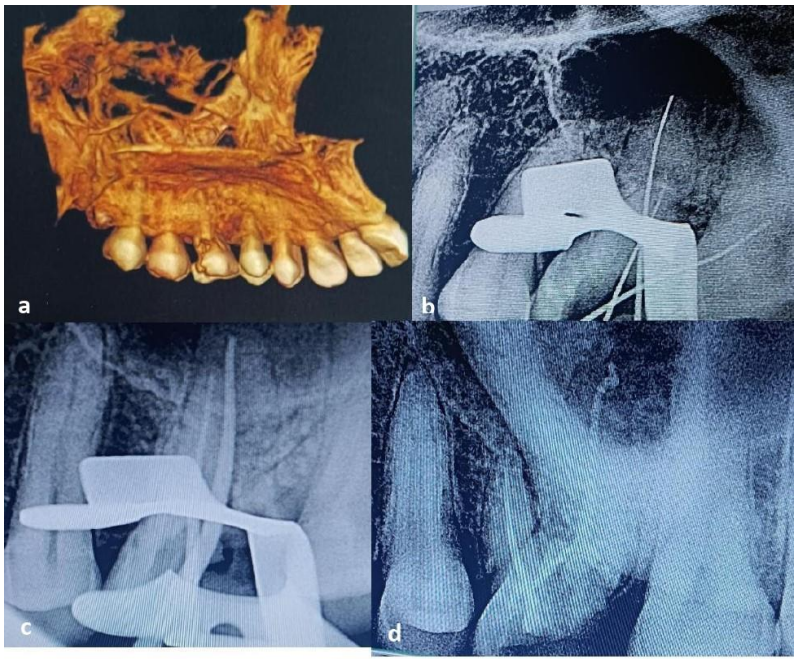

Fig. 1: a) CBCT analysis of pathology in distobuccal root and mesiobuccal root of 26.
b) Working length determination of 26
c) Master cone of 26
d) Obturation of 26

Management:

Under proper isolation and anesthesia, a root canal treatment was performed. After 2 weeks the patient was still symptomatic with persistent radiolucency at apex in 26, hence, periapical surgery was planned .

A CBCT scan (Carestream, CS 3D Imaging Software) was obtained to evaluate the extent of the lesion and plan the surgery. Using guided endodontic software, a 3D model of the maxillary molar and surrounding structures was created. A surgical guide (Vinvent) was fabricated using blue sky plan and meshmixer software with autoclavable surgical 3D printer by Power resins with the technology of resin LCD printer to assist in precise root amputation and apicoectomy.

Under local anesthesia, a full-thickness mucoperiosteal flap was raised to expose the buccal cortical bone. A trephine was pushed with the guidance of the template with constant sterile saline flushing. A high-speed long shaft diamond surgical bur was used to amputate the distobuccal roots at the furcation level after the surgical guide was positioned. Next, using the same bur under magnification, apicoectomy of the residual mesiobuccal root was carried out. After the periapical tissues were curetted, root end filling was performed using Biodentine. The flap was approximated and sutured with 4-0 silk sutures. Postoperative instructions were provided, and the patient was prescribed antibiotics and analgesics.

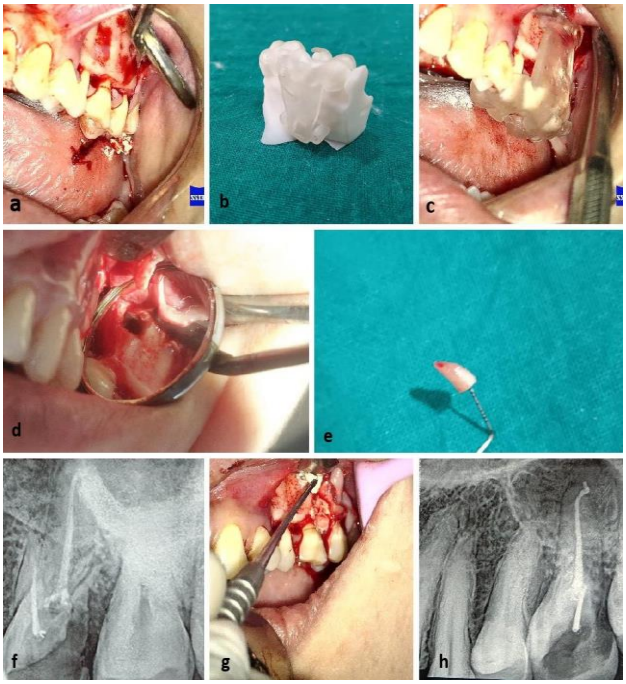

Fig. 2:

a) Full thickness mucoperiosteal flap raise.
b) 3D Guide template for the surgery.
c) Guide template fit on the tooth (#26)
d) Surgical window created using the template for root amputation and apicoectomy.
e) Amputated Distobuccal root.
f) Radiograph after distobuccal root amputation.
g) Retrograde Biodentine Filling of the window.
h) Post-op radiograph after mesiobuccal root apicoectomy and distobuccal root amputation.

Follow - Up:

Patient was kept under follow up and recalled after 10 days for suture removal w.r.t 26. Healing was uneventful. Patient was recalled again after 1 month, 3 months & 6 months. Healing was seen to be satisfactory. Crown preparation was done and a permanent crown was cemented w.r.t 26.

Fig. 3: Suture in 10 days follow-up with uneventful healing

Fig. 4: Crown placement and 6 months follow -up

Discussion:

The advancement of endodontic techniques, particularly in surgical procedures like root amputation and apicoectomy, has significantly improved outcomes in cases where conventional treatment methods may not suffice. The use of guided endodontics in this case report highlights the precision and effectiveness achievable in modern endodontic surgery.

Guided endodontics, utilizing advanced imaging and 3D printing technology, has revolutionized the way complex cases are approached, particularly in anatomically challenging areas like the maxillary molar region[8]. In this case, the precise localization and removal of the affected root, along with the apicoectomy, were facilitated by these technologies, allowing for a minimally invasive approach that preserved much of the surrounding healthy tissue. Traditional approaches to managing such cases, particularly when multiple roots are involved, often carry a higher risk of complications and may require more invasive surgical interventions[9].

In this particular case, the guided endodontics template facilitated a more controlled and targeted approach to the root amputation and apicoectomy procedures[8]. The ability to visualize the anatomy in three dimensions prior to and during the surgery provided invaluable guidance, leading to the successful removal of the infected tissue while preserving the integrity of the remaining tooth structure[10].The dynamics of guide template is illustrated in the image representing the depth of the surgical bur that would be facilitated through the template (fig.5. a - 1mm dimension of the window for apicectomy , b - depth of the guide being 2-3 mm deep into the bone , c - 2.5 mm depth in guide tube , d - slit being 2-3 mm in the bone for root amputation). The slit being angulated at 23° for resection , perpendicular to root surface .These dimensions are in accordance with the indication through CBCT study and anatomical limitations, thus helping in easy accessibility and clean , precise incision .

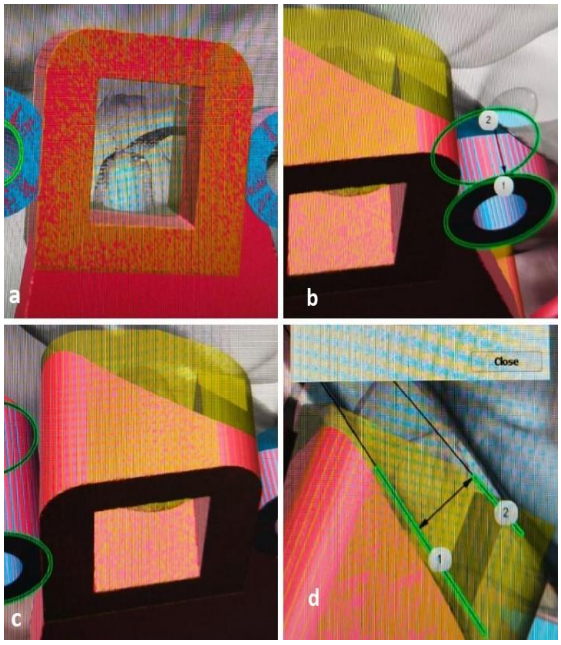

Fig.5: Dynamics of Guide Template

The use of guided templates also contributed to reducing patient discomfort and recovery time[11]. By ensuring that the surgical procedure was as minimally invasive as possible, the post-operative healing process was expedited, and the patient's overall experience was improved[7].

This case report highlights the significant advantages of incorporating guided endodontics into the treatment of complex cases involving multiple roots and periapical lesions. The precision and predictability offered by this technology represent a notable advancement in endodontic surgery, allowing for more effective management of conditions that might otherwise present substantial challenges[12].

Overall, the successful outcome in this case reinforces the growing body of evidence supporting the use of guided endodontics as a valuable tool in modern dental practice[13]. As this technology continues to evolve, it is likely to become an increasingly integral part of the endodontist's armamentarium, offering enhanced outcomes for patients with complex endodontic needs[14].

Conclusion:

In conclusion, this case report demonstrates the value of guided endodontics in enhancing the precision and success of endodontic surgical procedures like root amputation and apicoectomy. The use of advanced imaging and 3D technology in planning and executing these surgeries represents a significant step forward in the field, offering a promising approach for managing complex endodontic cases with greater efficacy and predictability.

The successful management of the periapical lesion in this case highlights the significant role that guided endodontics can play in modern endodontic surgery. By employing a guided template, we were able to achieve a high level of precision in both root amputation and apicoectomy, leading to a favorable clinical outcome. This case demonstrates that guided endodontics not only improves the accuracy of complex procedures but also enhances patient comfort and reduces recovery times.

As technology continues to advance, the integration of such innovative approaches into routine practice holds great promise for improving the prognosis of challenging endodontic cases. This case serves as a testament to the potential of guided endodontics in elevating the standards of care in endodontic surgery.

References:

1. Moreira Maia L, Maria Toubes K, Moreira Júnior G, Quadros Tonelli S, de Carvalho Machado V, Ferreira Silveira F, et al. Guided Endodontics in Nonsurgical Retreatment of a Mandibular First Molar: A New Approach and Case Report. Iran Endod J. 2020;15: 111–116.
2. Yoshioka T, Kikuchi I, Adorno CG, Suda H. Periapical bone defects of root filled teeth with persistent lesions evaluated by cone-beam computed tomography. Int Endod J. 2011;44: 245–252.
3. Zhao D, Xie W, Li T, Wang A, Wu L, Kang W, et al. New-designed 3D printed surgical guide promotes the accuracy of endodontic microsurgery: a study of 14 upper anterior teeth. Sci Rep. 2023;13: 15512.
4. Rai M, Kon K. Nanotechnology in Diagnosis, Treatment and Prophylaxis of Infectious Diseases. Academic Press; 2015.
5. Setzer FC, Kratchman SI. Present status and future directions: Surgical endodontics. Int Endod J. 2022;55 Suppl 4: 1020–1058.
6. Mekhdieva E, Del Fabbro M, Alovisi M, Scotti N, Comba A, Berutti E, et al. Dynamic Navigation System vs. Free-Hand Approach in Microsurgical and Non-Surgical Endodontics: A Systematic Review and Meta-Analysis of Experimental Studies. J Clin Med Res. 2023;12. doi:10.3390/jcm12185845
7. Fayad M, Johnson BR. 3D Imaging in Endodontics: A New Era in Diagnosis and Treatment. Springer; 2016.
8. Kinariwala N, Samaranayake L. Guided Endodontics. Springer Nature; 2020.
9. Nibali L. Diagnosis and Treatment of Furcation-Involved Teeth. John Wiley & Sons; 2018.
10. Gutmann JL. Surgical Endodontics. Ishiyaku EuroAmerica, Incorporated; 1994.
11. American Academy of Orofacial Pain. Temporomandibular Disorders: Guidelines for Classification, Assessment, and Management. Quintessence Publishing (IL); 1993.
12. Vega FM. Non-canonical Kinases and Substrates in Cancer Progression. 2022.
13. de Troyes C. Yvain: The Knight of the Lion. Yale University Press; 1987.
14. Shabahang S, American Association of Endodontics Research and Scientific Affairs Committee. State of the art and science of endodontics. J Am Dent Assoc. 2005;136: 41–52; quiz 89–90.