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Guided Endodontic Surgery: A Digital Approach to Precision Apical Surgery – A Case Report

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Abstract

Guided endodontic surgery using three-dimensional (3D) printed templates has emerged as a promising approach for improving surgical precision while minimizing bone removal. This case report describes the use of a customized surgical guide for accurate localization of the root apex during periapical surgery. After CBCT imaging, data were transferred to stereolithography and a 3D model was fabricated. With the help of the 3D model, a template was fabricated using tray material. This guided surgical template minimized the extent of osteotomy and enabled precise targeting of the apex.

Keywords: Guided Endodontics, Apicoectomy, 3D Surigcal Template, Precision Endodontics, Root-End Resection.

Introduction

Endodontic microsurgery is often required when conventional treatment or retreatment fails. Despite technological advances, apical surgery remains complex due to restricted surgical fields and the proximity of critical anatomical structures.[1,2]

Recent innovations, such as cone-beam computed tomography (CBCT) and magnification systems, have improved diagnostic and surgical precision.[4] The major advantages of guided endodontic surgery over conventional surgery are preservation of non-pathological tissue, easier identification of root apices, soft tissue retraction, less operative time, less postoperative complication, and high success rates and clinical outcomes.[3]

The introduction of guided endodontics (GE) in 2016 allowed integration of CBCT and intraoral scans with 3D printing to design surgical guides. These guides demonstrated improvements in precision, reproducibility, and safety in a range of scenarios.[4] The aim of this case report is to introduce a novel surgical endodontic technique using a 3D printed surgical template for guided osteotomy and root resection.

Case presentation

A 30-year-old male patient reported to the Department of Conservative Dentistry and Endodontics with the chief complaint of discoloration of the maxillary right central incisor (tooth 11). The patient gave a history of dental trauma to the anterior maxillary region approximately two years earlier, for which no dental treatment had been sought.

On clinical examination, tooth 11 exhibited noticeable crown discoloration without any associated swelling, sinus tract, or periodontal pocket. The tooth was non-tender to percussion and palpation. Pulp vitality testing using thermal and electric pulp tests elicited no response from tooth 11, whereas the adjacent teeth responded within normal limits, confirming loss of pulpal vitality. Radiographic examination demonstrated a well-defined periapical radiolucency associated with tooth 11. The case was provisionally diagnosed as pulp necrosis with asymptomatic apical periodontitis.

Management

Under local anaesthesia (LA) and rubber dam isolation, root canal treatment was initiated in tooth 11. After two calcium hydroxide dressings (Apexcal, Ivoclar-Vivadent) in intervals of 12 days each, Obturation was completed in tooth 11 using Ceraseal Endo root canal sealer with gutta-percha (Dentsply Tulsa Dental Specialties, Tulsa, Oklahoma, the United States). Non-surgical root canal treatment was performed, and the patient was kept under periodic follow-up. Despite adequate treatment, radiographic evaluation at 8 months revealed persistence of the periapical lesion with no evidence of healing. Therefore, periapical surgery was planned. After obtaining informed consent, CBCT scan was taken. CBCT revealed buccal cortical bone loss in relation to tooth 11. The Digital Imaging and Communications in Medicine (DICOM) files from the CBCT images were uploaded into a conversation software (Blue Sky Bio 5.0) and converted into STereoLithography (STL) file for virtual template planning using Exocad software. The virtual template was exported as an STL file and was fabricated using an SLA 3D printer (Ackuretta Sol, Koria) using D-Tech Surgical guide resin material.

Under LA, Semilunar incision was made in teeth 11 to 12 with two vertical releasing incisions distal to tooth 12 and 11. A full-thickness mucoperiosteal flap was reflected. The template was positioned after reflecting the flap. A trephine (H 161 Lindmann bur, Komet Dental, Siegel, Germany) was pushed with the guidance of the template with constant sterile saline flushing. Soft pathological tissue around the root end was curetted using Columbia curette (2R/2L #7, Hu-Friedy Mfg. Co. LLC). After completion of curettage, root resection was carried out using a long-length surgical bur (HP 702, Prima Classic, Prima Dental, GL 2 2 HA, UK) with continuous saline irrigation. Root-end cavity preparation was carried out using an angled microsurgical ultrasonic (KiS 2D, Kerr Dental, California, the United States) to a depth of 3 mm. After sufficient drying with paper points, root-end fillings were performed using MTA(Angleus). The flap was approximated and sutured. One-month recall showed satisfactory healing.

Discussion

Endodontic surgery has evolved over the past. The use of state-of-the-art guided endodontic surgical procedures produces a predictable outcome in the healing of lesions of endodontic origin. Surgical-guided endodontics is a relatively new area of study that is still maturing. It has many applications such as root canal access and localization, microsurgical endodontics, endodontic retreatment, and glass fiber post removal. Additionally, the procedure can be completed for the patient in less time and provides greater accuracy and safety than conventional endodontics. In our case the virtual surgical template was fabricated using a 3D printer with D-Tech Surgical Guide Resin to accurately transfer the preoperative CBCT-based surgical plan to the clinical setting. The guide enabled precise localization of the root apex and the overlying cortical bone, facilitating a conservative flap design and targeted osteotomy. By minimizing unnecessary bone removal and limiting the extent of flap reflection, the guided approach reduced surgical trauma while preserving the surrounding healthy tissues. Such accuracy is particularly advantageous in the anterior maxillary region, where preservation of esthetics and adjacent anatomical structures is of paramount importance. Furthermore, guided endodontic surgery enhances the predictability and reproducibility of the procedure by translating the virtual treatment plan into precise intraoperative execution.

The level of evidence regarding guided endodontics is low, as majority of the available studies correspond to preclinical studies and case reports.[5] Pinsky *et al.* (2007)[6] and Ackerman *et al.* (2019)[7] carried out ex-vivo studies to assess accuracy of guided surgery, by comparing the use of a guide to a freehand procedure for locating the root apex. However, the accuracy-measuring methods were heterogeneous between studies. However, all the currently available studies conclude that endodontic surgery using 3D guides is more precise in targeting the apex, thereby achieving predictable outcomes with less intraoperative and postoperative complications.[8] The surgical template allowed precise targeting of the root apex while minimizing the extent of osteotomy. The procedure was completed efficiently with reduced bone removal and improved surgical accuracy. Postoperative healing was uneventful, and satisfactory clinical and radiographic outcomes were observed during follow-up.

Conclusion

The use of a customized 3D-guided surgical template in endodontic microsurgery can enhance precision, reduce surgical invasiveness, and facilitate predictable management of periapical lesions. This technique represents a valuable adjunct for modern endodontic surgical procedures.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

References

1. Setzer F.C., Kratchman S.I. Present status and future directions: Surgical endodontics. Int. Endod. J.

2022;55((Suppl. 4)):1020–1058. doi: 10.1111/iej.13783.

2. Hawkins T.K., Wealleans J.A., Pratt A.M., Ray J.J. Targeted endodontic microsurgery and endodontic microsurgery: A surgical simulation comparison. Int. Endod. J. 2020;53:715–722. doi: 10.1111/iej.13243.
3. Mahendran K, Hussain MA, Maloor SA, Saminathan K. Guided endodontic surgery-Case series. Indian Journal of Dental Research. 2023 Jan 1;34(1):94-7.
4. Romero Mora NS, Peñaherrera Manosalvas MS, Valverde Haro HP. Accuracy of Surgical Guides in Guided Apical Surgery: An In Vitro Comparative Study. Dent J (Basel). 2025 Dec 1;13(12):561. doi: 10.3390/dj13120561. PMID: 41440319; PMCID: PMC12731615.
5. Moreno-Rabié C, Torres A, Lambrechts P, Jacobs R. Clinical applications, accuracy and limitations of guided endodontics: A systematic review Int Endod J. 2019;53:214–31
6. Pinsky HM, Champleboux G, Sarment DP. Periapical surgery using CAD/CAM guidance: Preclinical results J Endod. 2007;33:148–51
7. Ackerman S, Aguilera FC, Buie JM, Glickman GN, Umorin M, Wang Q, et al Accuracy of 3-dimensional-printed endodontic surgical guide: A human cadaver study J Endod. 2019;45:615–8
8. Lio F, Mampieri G, Mazzetti V, Leggeri A, Arcuri L. Guided endodontic microsurgery in apicoectomy: A review J Biol Regul Homeost Agents. 2021;35(3 Suppl 1):47–55

Legend Figures

Figure A: Preoperative radiograph

Figure B: Obturation

Figure C: Clinical Pre-operative

Figure D and E: 3D model with apicectomy template

Figure F: Fit of template

Figure G: Incision

Figure H: Semilunar flap reflected

Figure I: Ostectomy using template

Figure J: Osteotomy

Figure K: Root end resection

Figure L and M: Root end preparation

Figure N and O: Retrograde Filling with MTA

Figure P: Suturing

Figure Q: Follow Up