Case Report

Targeted Endodontic Microsurgery: A Guided Approach – A Report of Two Cases

Abstract

Targeted endodontic microsurgery combines a precisely designed three-dimensional (3D)-printed surgical guide in which the osteotomy site and angulation is defined preoperatively to avoid damaging anatomically important structures. The current endodontic microsurgical procedures have been progressing in pace with technological advances as a predictable alternative to nonsurgical treatment of persistent and recurrent apical periodontitis. The 3D-printed template has been used earlier in the guided endodontic procedure (access openings). The endodontic microsurgery utilizes the surgical microscope and microsurgical instruments which help in enhanced magnification, illumination, and visualization compared to conventional endodontic surgery. Cone beam computed tomography (CBCT) plays an important role in surgical endodontics as it helps in measuring the distance between the cortical plate and the apex, position of the roots within the bone, and the proximity of vital structures can be assessed. The true size, location, and extent of the periapical lesion can also be appreciated preoperatively. In the present cases, the guide allowed the clinicians to precisely reach the targeted tissues in a faster and more accurate manner with a more conservative and less traumatic treatment procedure. A 1-year CBCT follow-up of both cases showed complete 3D healing of the surgical site.

Keywords: *Cone-beam computed tomography, endodontic microsurgery, guided surgery, mineral trioxide aggregate, three-dimensional–printed template*

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Introduction

Endodontic surgery is a recommended treatment option in persistent and recurrent apical periodontitis[1] involving exposure of the periapical lesion through osteotomy, curettage of the lesion, and root-end resection. A good access to the apex of the tooth and the lesion is important for a successful outcome. Endodontic microsurgery helps in enhanced magnification, illumination, and visualization with postsurgical healing rate of 35% faster than conventional endodontic surgery.[2] Cone beam computed tomography (CBCT) plays an important role in the surgical endodontics as it helps in measuring the position of the roots, proximity of vital structures, size, location, and extent of the periapical lesion preoperatively.[3] Newer measures that reduce the possibility for human error which is common in freehand endodontic microsurgery might help in achieving better treatment outcomes.

CBCT digital imaging and communications in medicine (DICOM) files converted into stereolithographic files have been used in the production of three-dimensional–printed surgical guides (3DSGs) for implant placement. However, there is great interest in the possibility of performing radiation-free diagnostic imaging, in particular magnetic resonance imaging (MRI), which avoids the biological damage related to other techniques such as CT and CBCT. It provides excellent soft-tissue contrast and allows for the evaluation of specific tissue components and diagnostic visualization of soft tissues such as the alveolar inferior nerve.[4] A greater interest in the development of this diagnostic imaging in the fabrication of a 3D template will be an added advantage to this procedure. Targeted endodontic microsurgery (TEMS) was introduced recently which has been beneficial in anatomically challenging scenarios (Giacomino *et al.*, 2018), demonstrating precise osteotomy site, angulation depth, and diameter.

3D-printed templates have been used earlier in guided endodontic procedures for

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minimally invasive and accurate access. This technique is fast becoming an aid in surgical endodontics.[5] The present two case reports elucidate the application of 3DSG using CBCT along with microsurgery.

Case Reports

Case 1

A 23-year-old male patient reported with a chief complaint of pain in the upper front tooth region for the past 2 months. Clinically, fracture of tooth 11 was seen with tender on percussion in both 11 and 21. Cold test showed no response. Radiographically, periapical radiolucency was seen. A diagnosis of pulpal necrosis with periapical abscess was made in relation to 11 and 21 [Table 1]. A multi-visit root canal treatment was performed following standard protocols. The patient was symptomatic even after 6 months with a persistent periapical lesion in relation to 11 and 21. For a detailed examination, CBCT (HDX WILL North America) was advised, which revealed a well-defined radiolucent lesion with an approximate size – 3 mm × 4 mm and 4 mm × 5 mm in relation to 11 and 21, respectively.

3D-guided microsurgery was planned [Figure 1].

Methods and methodology

Designing the template

An impression of the patient's upper arch was made with polyvinyl siloxane (Aquasil Ultra; Dentsply), and study models were prepared. STL (Stereolithography files) were obtained after scanning the study model with a 3D scanner (Straumann). Blue Sky Plan 3, an implant navigation system, was used for treatment planning by merging the STL files with the CBCT DICOM files (digital imaging and communication), and a 3D virtual template was designed. On the obtained 3D virtual model, step-by-step presurgical planning was done. The dimension and direction of the port for surgical bur entrance to the osteotomy site were defined. According to the digital plan, a 3DSG made of polylactide material was printed using a 3D printer (Stratasys Ltd) and checked for fit before the surgical procedure.

Surgical procedure

The surgical site and the guide was disinfected using Betadine solution (10% w/v) and stabilized on the teeth. Soft-tissue marking was made with a probe. The guide was removed, and 2% lidocaine hydrochloride 1:80,000 epinephrine (Indico Remedies) was administered. The incisions were made along the markings using no. 11 surgical blade. A full-thickness horizontal mucoperiosteal flap was elevated using a periosteal elevator following which a template was placed directly onto the exposed bone. Osteotomy was performed under a microscope (Seiler Instrument Inc.) through the port using a round surgical bur (No. 4 SS white) in a straight handpiece (NSK) under saline irrigation. Curettage was done using mini jacquette curettes 34/35 in a scraping fashion to free the soft tissue lining the bony crypt.

Resection of 3 mm from the apex was done with a shallow bevel using a no. 702 tapered fissure bur and inspected under ×36 magnification to assess the anatomy and confirm the absence of cracks or root fracture.

After root end preparation and mineral trioxide aggregate (Dentsply Tulsa), retrograde filling flap was repositioned and sutured.

Case 2

A 21-year-old male patient reported with a chief complaint of pain in the upper front tooth region for the past

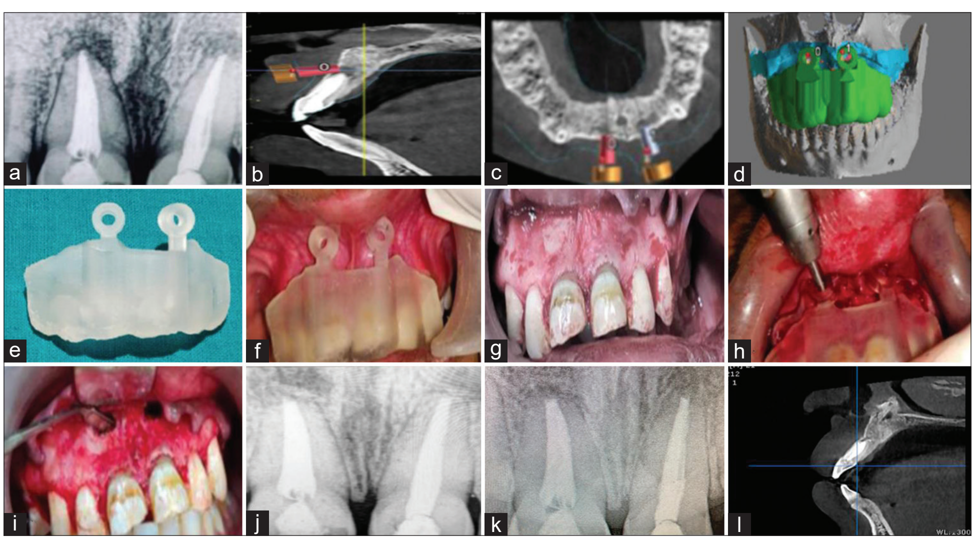

Figure 1: (Case report 1) (a) Radiograph after endodontic treatment. (b and c) Cone beam computed tomography images showing lesion dimension in sagittal and axial view. (d) Template designing using implant planning software (Bluesky). (e) Fabricated surgical template. (f) Checking the fit of the template. (g) Flap reflection. (h) Osteotomy procedure through the port. (i) Root-end preparation and filling. (j) Immediate postoperative radiograph. (k) 1-year follow-up radiograph. (l) 1-year follow-up cone beam computed tomography image

3 months. The patient had a history of trauma in the same region 10 years back with no treatment initiated. Clinical examination revealed discoloration and fracture of 21, having tender on percussion and cold test showing no response. Radiographically, an open apex with periapical lesion was seen [Table 1]. A diagnosis of pulpal necrosis with periapical abscess was made. CBCT revealed a well-defined radiolucent lesion with an approximate size – 5 mm × 6 mm. 3D-guided microsurgery was planned and performed similar to Case 1 [Figure 2].

Based on the pulpal and periapical diagnosis, tooth anatomy and morphology, remaining tooth structure, and periodontal support, prognosis was estimated to be good for both the cases.

In both the cases, the patients were prescribed analgesics (ibuprofen 600 mg) and instructed to rinse twice daily with chlorhexidine 0.2% mouth rinse for 1 week and recalled after 7 days for suture removal.

Outcome assessment of cases 1 and 2

Follow-up after 6 months revealed no complaints of postoperative pain. Healing was uneventful. Periapical healing around the root was observed radiographically. The sagittal view of the CBCT scans showed healing with a uniform radiodense area around the apex.

Discussion

Limitations and disadvantages of endodontic surgery have become evident due to the rapid advancement in technology. However, based on the application of CBCT, CAD, and 3D printing technology in conjunction with microsurgery, these problems can be solved.[6] An alternative noninvasive diagnostic approach such as MRI could be further explored to be used with CAD and 3D printing technology.[4]

For instance, one major clinical problem during microsurgery in cases where apical lesion has not fenestrated the buccal bone, is to clearly distinguish the root tip from the surrounding bone. In such situations, locating the apex can be a challenge, resulting in a deviation from the original osteotomy site which can damage important anatomical structures such as maxillary sinus, mental foramen, and mandibular nerve.[7]

Guided endodontic microsurgery enables an accurate visualization; identification; and a more accessible, precise, and minimally invasive treatment permitting faster postoperative healing.[8] Osteotomy diameters <5 mm resulted in improved osseous healing compared with those in excess of 5 mm, which resulted in fibrous tissue formation and delayed healing.[9] During an apicoectomy procedure, freehand drilling deviation 70% of the time is 2 mm and 22% of the time is 3 mm; however, with guided approach, a deviation of 0.79 mm (0.33 mm standard deviation) has been noted,[10] enabling dentists without extensive surgical skills to achieve predictable results.[11]

This approach has improved patient-centered outcomes such as no postoperative pain and increased comfort.

Limitations

The template designed with a water port provides constant irrigation which is devoid in the current template. The technique is more helpful for anatomically complex scenarios involving the maxillary sinus, greater palatine artery, mental nerve, and fused roots in posterior teeth to prevent damage to these structures. In the present case reports, guided endodontic microsurgery was performed on anterior teeth for an accurate osteotomy.

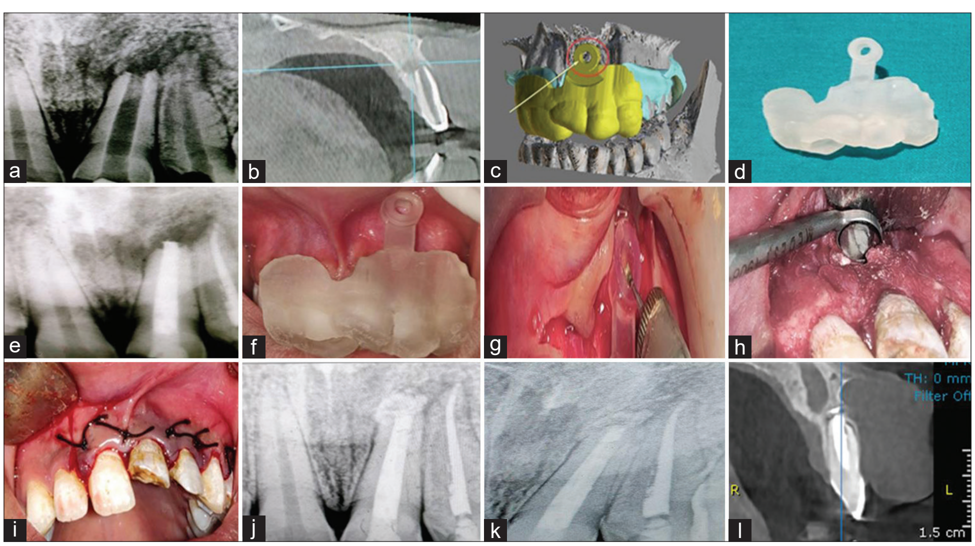

Figure 2: (Case report 2) (a) Preoperative radiograph. (b) Cone beam computed tomography images showing lesion dimension in sagittal view. (c) Template designing using implant planning software (Bluesky). (d) Fabricated surgical template. (e) Radiograph after endodontic treatment. (f) Checking the fit of the template. (g) Osteotomy procedure through the port. (h) Root-end preparation and filling. (i) After suturing. (j) Immediate postoperative radiograph. (k) 1-year follow-up radiograph. (l) 1-year follow-up cone beam computed tomography image

Table 1: Timeline of history

Case 1	Case 2
1st visit	1st visit
Case history – pain in the upper front tooth region for the past 2 months	Chief complaint – pain in the upper front tooth region for the past 3 months
Clinical and radiographic examination was done	Patient had a history of trauma in the same region 10 years back with no treatment initiated
Root canal treatment was initiated and intracanal medicament was placed in relation to 11 and 21	CBCT advised and guided microsurgery planned
2nd visit	
Root canal treatment was completed on 14th day	
3rd visit	
Patient was found to be symptomatic even after 6 months with a persistent periapical lesion in relation to 11 and 21	
CBCT was advised and guided microsurgery was planned	

CBCT: Cone beam computed tomography

Conclusion

In the present cases, targeted EMS produced an osteotomy site with predictable angulation and diameter, proving it to be more precise and minimally invasive than conventional surgery.

TEMS represents a viable alternative to EMS developing technological and clinical expertise within the specialty of endodontics.

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.

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Conflicts of interest

There are no conflicts of interest.

References

1. Setzer FC, Kohli MR, Shah SB, Karabucak B, Kim S. Outcome of endodontic surgery: A meta-analysis of the literature–Part 2: Comparison of endodontic microsurgical techniques with and without the use of higher magnification. J Endod 2012;38:1-10.
2. Tsesis I, Rosen E, Schwartz-Arad D, Fuss Z. Retrospective evaluation of surgical endodontic treatment: Traditional versus modern technique. J Endod 2006;32:412-6.
3. Kruse C, Spin-Neto R, Wenzel A, Vaeth M, Kirkevang LL. Impact of cone beam computed tomography on periapical assessment and treatment planning five to eleven years after surgical endodontic retreatment. Int Endod J 2018;51:729-37.
4. Reda R, Zanza A, Mazzoni A, Cicconetti A, Testarelli L, Di Nardo D. An update of the possible applications of magnetic resonance imaging (MRI) in dentistry: A literature review. J Imaging 2021;7:75.
5. Kim S, Kratchman S. Modern endodontic surgery concepts and practice: A review. J Endod 2006;32:601-23.
6. Strbac GD, Schnappauf A, Giannis K, Moritz A, Ulm C. Guided modern endodontic surgery: A novel approach for guided osteotomy and root resection. J Endod 2017;43:496-501.
7. Gagliani MM, Gorni FG, Strohmenger L. Periapical resurgery versus periapical surgery: A 5-year longitudinal comparison. Int Endod J 2005;38:320-7.
8. Hirsch V, Kohli MR, Kim S. Apicoectomy of maxillary anterior teeth through a piezoelectric bony-window osteotomy: Two case reports introducing a new technique to preserve cortical bone. Restor Dent Endod 2016;41:310-5.
9. Wang N, Knight K, Dao T, Friedman S. Treatment outcome in endodontics - The Toronto Study. Phases I and II: Apical surgery. J Endod 2004;30:751-61.
10. Pinsky HM, Champleboux G, Sarment DP. Periapical surgery using CAD/CAM guidance: Preclinical results. J Endod 2007;33:148-51.
11. Ye S, Zhao S, Wang W, Jiang Q, Yang X. A novel method for periapical microsurgery with the aid of 3D technology: A case report. BMC Oral Health 2018;18:85.