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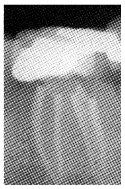

CASE REPORT

Endodontic-periodontal management of two rooted maxillary lateral incisor associated with complex radicular lingual groove by using spiral computed tomography as a diagnostic aid: a case report

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Abstract

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Aim To present the successful endodontic and periodontal management of a two rooted maxillary lateral incisor tooth with a complex radicular lingual groove and severe periodontal destruction using spiral computed tomography as a diagnostic aid.

Summary A 30-year-old male patient presented with a chief complaint of mobility and discharge of pus in an upper front tooth. Clinical examination revealed a sinus tract on the labial gingival surface and a 10-mm-deep periodontal pocket associated with maxillary left lateral incisor tooth. On the lingual side, a groove emerging from cingulum, continuing mesioapically down the lingual aspect of tooth was found. Intraoral periapical radiographs demonstrated a lateral periodontal defect around the mesial aspect and a diffuse radiolucency at the apex of maxillary left lateral incisor tooth. The sinus tract was traced with gutta-percha to the maxillary left lateral incisor that showed an accessory root surrounded by a large radiolucent area. A spiral computed tomographic scan for better understanding of the complicated root canal morphology of the tooth was performed. Based on the clinical, radiographic and spiral computed tomographic findings, a diagnosis of an endo-perio lesion in tooth 22 was made. Management consisted of conventional root canal treatment, radiculoplasty, root resection of accessory root and surgical curettage of the periodontal defect. Follow-up with radiographic examination at 3 months and 1 year was performed. At 1-year recall, the patient was asymptomatic, there was no evidence of

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the sinus tract and a 3-mm nonbleeding pocket was present in relation to tooth 22. Progression of hard tissue healing was observed in the periapical radiograph taken 1 year postoperatively.

Key learning points

- The key to achieving favourable results in this particular type of developmental anomaly is accurate diagnosis and treatment planning.
- The health of the periapical osseous tissues appears to be the provital factor for tooth retention.
- A favourable outcome can only be achieved with a comprehensive treatment approach that effectively manages all local factors that are contributing to the disease process.

Keywords: bifurcation, complex radicular lingual groove, maxillary lateral incisor, spiral computed tomography.

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Introduction

Maxillary incisors are susceptible to developmental anomalies that can lead to periodontal and/or endodontic problems. One such developmental anomaly is the radicular lingual groove (RLG), which is often associated with incorrect diagnosis and subsequent treatment failure (August 1978). Radicular lingual grooves have also been termed radicular palatal grooves (Mayne & Martin 1990), cingulo-radicular distolingual grooves, palatal gingival grooves, radicular grooves (Goon *et al.* 1991) and vertical development grooves. The RLG has a funnel-like shape and typically begins on the lingual surface at the level of the cingulum extending to various lengths along the root (Lara *et al.* 2000). The groove is a locus for plaque accumulation, which destroys the sulcular epithelium and deeper parts of the periodontium, finally resulting in the formation of a severe localized periodontal defect (Lee *et al.* 1968).

The aetiology of the groove is not fully understood. Some clinicians believe that the groove originates with alteration in the growth of inner enamel epithelium and Hertwig's epithelial root sheath (Shaju 2001). According to some authors, the RLG is embryologically related to dens invaginatus (Everett & Kramer 1972). Ennes & Lara (2004) suggested that the RLG could be the result of an alteration of genetic mechanisms. Other investigators claim that this malformation results from an incomplete attempt of the tooth to form another root (Simon *et al.* 1971, Peikoff *et al.* 1985).

Goon *et al.* (1991) classified RLGs as simple and complex. The simple RLGs do not communicate with the pulp and terminate at the cemento-enamel junction. The complex RLGs are characterized by direct communication with the pulp and grooves that extend along the length of the root. In rare cases, the most complex forms occur as deeply invaginated defects that separate an accessory root from the main root trunk (Simon *et al.* 1971, Peikoff *et al.* 1985).

A complex RLG on two rooted maxillary lateral incisor presents a diagnostic and treatment planning challenge because of the combined endodontic–periodontal lesion. The use of accurate and sophisticated diagnostic aids is essential to arrive at a correct diagnosis. Conventional radiography renders three-dimensional (3-D) anatomical structures two dimensionally with inherent distortion. To overcome these problems, newer diagnostic methods such as spiral computed tomography (SCT), which can produce three-dimensional reconstructed images of individual tooth and the surrounding tissues can be used.

This report presents the successful endodontic and periodontal management of a two rooted maxillary lateral incisor tooth with a complex RLG and severe periodontal destruction using SCT as a diagnostic aid.

Case report

A 30-year-old male patient reported with a chief complaint of mobility and discharge of pus in an upper front tooth for the last ten days. There was no history of trauma and/or discolouration of the tooth. Medical history was noncontributory. An intraoral examination revealed a sinus tract on the labial gingival surface associated with tooth 22 (Fig. 1a). Tooth 22 did not respond to electric and thermal pulp testing, whereas testing of the adjacent and contralateral teeth elicited normal responses. On further clinical examination, a groove emerging from cingulum, continuing mesioapically down the lingual aspect of root was found. Periodontal examination revealed grade II mobility and 10-mm-deep periodontal pocket on the mesial aspect of the tooth (Fig. 1a).

An intraoral periapical radiograph demonstrated a lateral periodontal defect around the mesial aspect and a diffuse radiolucency at the apex of tooth 22 (Fig. 1c). The sinus tract was traced with gutta-percha cone to tooth 22 that showed an accessory root surrounded by a large radiolucent area (Fig. 1b,d). The exact spatial relationship of the accessory root with adjacent important anatomical structures and the remaining bone support around the accessory root could not be identified clearly on the intraoral periapical radiograph. In order to ascertain the complex root canal anatomy of the tooth in a 3D manner, dental imaging with the help of SCT was therefore planned. Informed consent from the patient was obtained, and a multislice SCT of the maxilla was performed (General Electric, Milwaukee, WI, USA). The involved tooth was focused, and the morphology was obtained in transverse, axial, and sagittal sections of 1 mm thickness (Fig. 2), along with 3D reconstructed images (Fig. 2).

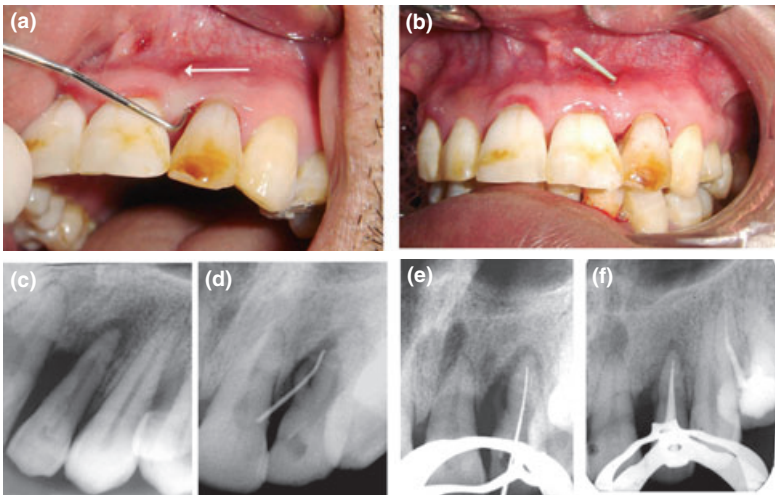

Figure 1 Tooth 22 with a complex radicular lingual groove and its management. (a) Preoperative clinical photograph showing intra-oral sinus and 10-mm-deep periodontal pocket. (b) Preoperative clinical photograph showing gutta-percha inserted into the sinus tract. (c) Preoperative radiograph revealing a lateral periodontal defect around the mesial aspect and a diffuse radiolucency at the apex of tooth 22. (d) The sinus tract was traced with gutta-percha cone to tooth 22 that showed an accessory root surrounded by a large radiolucent area. (e) Working length determination. (f) Post-obturation radiograph.

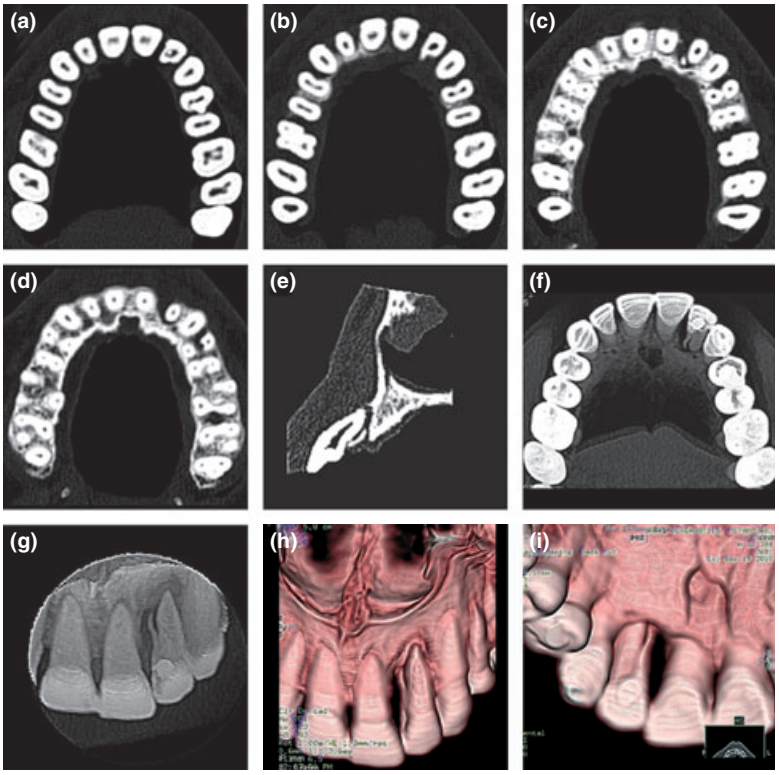

Figure 2 Spiral computed tomography images of the maxilla. (a) Axial view of the coronal third section of the crown of tooth 22. (b) Axial view of the cervical third section of the roots of tooth 22. (c) Axial view of the middle third section of the roots of tooth 22. (d) Axial view of the apical third section of the root of tooth 22. (e) Cross-sectional image. (f) Occlusal scan section. (g) Anterio–posterior view. (h,i) 3D reconstruction of the two rooted maxillary lateral incisor.

The SCT images revealed that tooth 22 had an accessory root that emerged as an extension of the cingulum on the mesiopalatal aspect. It bifurcated from the main root trunk at the junction of the cervical and middle third and terminated at the apical third (Fig. 2h,i). SCT images also revealed that there is least amount of remaining bone support around the accessory root (Fig. 2g–i). SCT axial sections and cross-sectional images showed the absence of patent root canal inside the accessory root (Fig. 2c,e). Based on the clinical, radiographic and SCT findings, a diagnosis of an endo-perio lesion with the two rooted maxillary lateral incisor associated with complex RLG was made. Treatment plan consisted of conventional root canal treatment, radiculoplasty, root resection of accessory root and surgical curettage of the periodontal defect.

Management

A decision to root fill the tooth followed by periodontal surgery was made, and informed consent was obtained from patient. After prophylaxis and removal of localized calculus, local anaesthesia was administered and a rubber dam was applied. An endodontic access cavity was prepared on the palatal surface by using a no. 2 round bur (Mani, Tochigi, Japan) and the canal orifice of the main root was found. Several attempts were made to find the orifice of the accessory root canal but without success. Working length of the main canal was determined (Fig. 1e) following which the canal was cleaned and shaped using hybrid instrumentation with gates glidden drills and NiTi hand files (Dentsply

Maillefer, Ballaigues, Switzerland). Copious irrigation with sodium hypochlorite (3%) followed by saline (0.9%) was carried out at each step of instrumentation.

The canal was dried with sterile paper points, calcium hydroxide (Ultracal XS; Ultradent, South Jordan, UT, USA) was placed in the root canal, and the access cavity was temporized with Cavit G (3M ESPE, Seefeld, Germany). The patient was recalled after 1 week and canal filling was completed with cold lateral compaction using gutta-percha and AH-plus sealer (Dentsply Maillefer) (Fig. 1f). The access cavity was restored with light cure composite resin (3M ESPE, St Paul, MN, USA).

During the periodontal surgical phase of treatment, the patient was anaesthetized with 2% lidocaine hydrochloride with 1 : 200 000 epinephrine (Astra Zeneca Pharma, Bangalore, India) and a full-thickness mucoperiosteal flap utilizing intrasulcular incisions was raised on both labial and palatal sides. The reflected flap on the labial surface revealed a bony fenestration corresponding to the location of previously existing sinus tract. On the lingual side, the RLG emerged from the cingulum, ran apically, and mesially and finally terminated in the bifurcation area giving rise to an accessory root (Fig. 3a). The accessory root was amputated (Fig. 3c), and the diseased granulation tissue was curetted out (with Gracey curette number 1, 2 and 5; Hu-friedy Manufacturing Co, Chicago, IL, USA).

After debridement of the bony defect, root planing of the main root was performed. This was followed by osteoplasty to eliminate the remaining bony deformities and to provide a biologic width for the dentogingival complex after healing (Fig. 3b). Radiculoplasty was

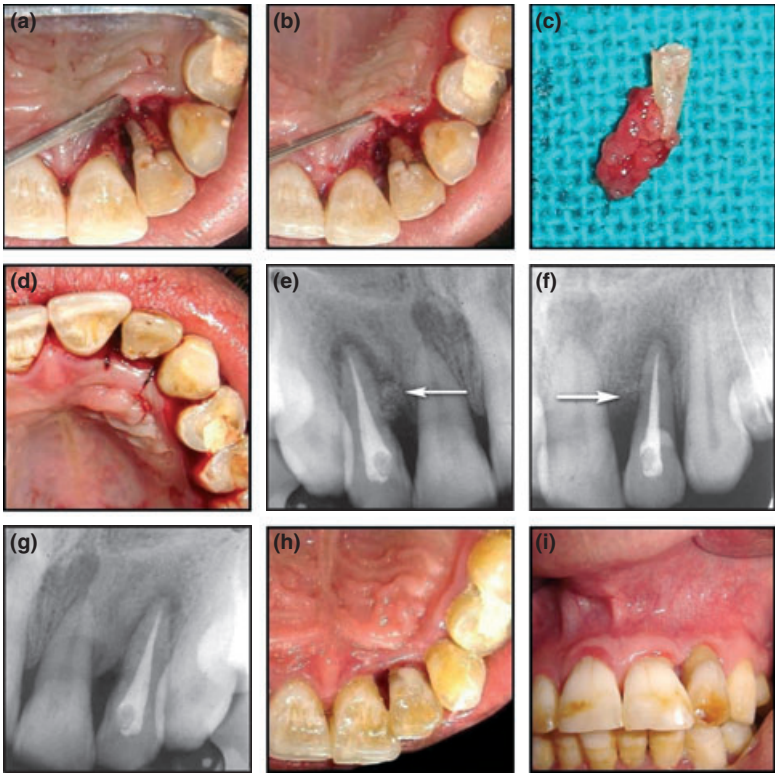

Figure 3 (a) Surgical opening of radicular lingual groove. (b) Tooth appearance after root resection. (c) Resected root along with apically attached granulation tissue. (d) Suturing. (e) Postoperative radiograph showing bone graft in place (arrow). (f) Postoperative radiograph at 3 months, the arrow points to the filling in of the lateral defect. (g) Postoperative 1-year radiograph. (h) Postoperative 1-year clinical photograph palatal view. (i) Buccal view clinical photograph showing gingival recession over the surgical area 1 year after treatment.

carried out using a round bur after which the groove was conditioned with 10% polyacrylic acid and sealed with glass ionomer cement (Fuji II; GC Corporation, Tokyo, Japan). Surgical haemostasis during setting of glass ionomer cement was achieved by using local haemostatic gelatin sponge (Pfizer Inc., New York, NY, USA).

After the cement had hardened, the bony crypt was filled with a bone graft (Ossify, Equinox medical technologies, Netherland, Holland) and the flaps were reapproximated and sutured (Fig. 3d). A postoperative intra-oral periapical radiograph was taken after bone graft placement (Fig. 3e). This was followed by coe-pak application (GC America, Alsip, IL, USA). Antibiotics, amoxicillin plus clavulanate (625 mg twice a day for 7 days), a nonsteroidal anti-inflammatory drug, voveran SR 100 mg (twice daily for 3 days) and a mouthwash containing 0.2% chlorhexidine gluconate (twice a day for 4 weeks) were prescribed postoperatively.

Healing was uneventful and sutures were removed 10 days after the surgery. At 3 months follow-up, the sinus tract had closed, probing depth was significantly reduced and bleeding on probing was not observed. A 3-months postoperative radiograph revealed increased radiodensity at the site of bony defect (Fig. 3f). At 1-year recall, the patient was asymptomatic, and a 3-mm nonbleeding pocket was present on the palatal aspect (Fig. 3h). On the buccal aspect, there was no evidence of the sinus tract; however, some gingival recession was present (Fig. 3i). Progression of hard tissue healing was observed in the periapical radiograph taken 1 year postoperatively (Fig. 3g).

Discussion

The treatment of a RLG presents a clinical challenge. A favourable outcome can be achieved only with the comprehensive treatment approach that effectively manages all local factors that are contributing to the disease process. The teeth with physiologic mobility and shallow grooves might be corrected by odontoplasty in conjunction with periodontal treatment including curettage of granulation tissue (Meister *et al.* 1983, Manoj *et al.* 2010). However, when the groove is more advanced and associated with extensive periodontal destruction, the treatment of the teeth is complex (Kanika *et al.* 2010). The ability to eradicate the inflammatory irritants by eliminating the groove and adequately treating the periodontal defect ultimately determines the prognosis of these teeth (Ballal *et al.* 2007).

Simon *et al.* (1972) described two types of endo-perio lesions in tooth involved with RLG. Primary endodontic lesion with secondary periodontal involvement and primary periodontic lesion with secondary endodontic involvement depend upon whether pulpal pathosis occurred prior to periodontal destruction or *vice versa*. The endo-perio lesion in the present case seems to be primary periodontic lesion with secondary endodontic involvement. It was because of the fact that there was no history of trauma and/or discolouration of the tooth. Moreover surgical opening of RLG did not reveal carious involvement of the groove.

The groove had a funnel-like shape and irregularities on the external surface that promoted the accumulation of bacterial plaque and calculus, resulting in the onset and progression of periodontal disease. As a result of this breach in the epithelial attachment, the progression of bacterial products through dentinal tubules could secondarily compromise the pulp tissue, causing a primary periodontic/secondary endodontic lesion which necessitated both pulpal and periodontal therapy.

The complexity of root canal system of two rooted lateral incisors made the treatment complicated (Greenfeld & Cambruzzi 1986). Pulpal-periodontal ligament communications associated with a RLG and accessory root considerably affect the management of local pathosis and the success of subsequent treatment (Peikoff *et al.* 1985). Radiculoplasty

was performed to eliminate the groove and surface irregularities which often harbour bacteria and debris leading to local inflammatory reaction (Kanika *et al.* 2010, Manoj *et al.* 2010). However, in a birooted incisor, the furcation problem will still remain even after radiculoplasty. Considering the amount of bone loss around the accessory root and difficulty in maintaining the bifurcation area plaque free, resection of the accessory root was performed. As the accessory root did not contribute significantly to the support of the tooth, resection of the accessory root and radiculoplasty was considered to be one way to eliminate the RLG and a furcation defect simultaneously (Wei *et al.* 1999, Muhammed *et al.* 2008, Venugopal & Srirekha 2010).

Several materials such as composite and amalgam have been used to fill the RLG (Friedman & Goultschin 1988). In the present case, glass ionomer cement was used for its antibacterial effect, biocompatability (Mount 1995), chemical adhesion to tooth structure (Rusz *et al.* 1992), adequate sealing ability and promotion of epithelium and connective tissue attachment (Dragoo 1997).

Traditional radiographic examinations are usually limited to two-dimensional views captured using radiographic film or digital sensors. Crucially, essential information of the three-dimensional anatomy of the teeth and adjacent structures is obscured, and even with the best intentions and paralleling techniques, distortion and superimposition of dental structures in periapical views are unavoidable. These problems are overcome by newer diagnostic techniques such as SCT and cone beam computed tomography (CBCT).

Spiral computed tomography has revolutionized maxillofacial imaging, facilitating the transition of dental diagnosis from 2D to 3D images and expanding the role of imaging from diagnosis to image guidance of operative and surgical procedures. SCT has been used successfully in clinical dentistry for the confirmatory diagnosis of morphologic aberrations in root canal anatomy (Anand *et al.* 2010, Kavita *et al.* 2010), in the treatment planning for dental implants (Butz *et al.* 2006) and management of maxillofacial trauma (Adler *et al.* 1995).

Spiral computed tomography images in the present case provided detailed information about the accessory root and its precise spatial relationship to the main root trunk. With proper knowledge of the three-dimensional interrelation of the accessory root with adjacent anatomical structures, a safer surgical intervention can be performed. Conventional radiographic approaches assessing alveolar bone structure often limits distinction between palatal or buccal structures. Bony defects on the palatal side may be supra-projected by buccal bone, hindering interpretation and adequate treatment planning. However, SCT can produce 3-D images of bone, allowing for detailed analysis of bone architecture. SCT 3D images in the present case revealed that there was least bone support around the accessory root. SCT axial scans and cross-sectional images confirmed the absence of a patent root canal inside the accessory root thus necessitating its surgical removal for the eventual success of the case.

In the present case, SCT was planned instead of CBCT because of its limited availability and high cost. Also CBCT has certain limitations when compared to SCT related to the radiation scattering caused by the absence of post-patient collimation (Mozzo *et al.* 1998), limited dynamic range of the X-ray area detectors, truncated-view artefact (Mozzo *et al.* 1998) that occurs because some of the cone-beam data penetrating portions of the object other than the region of interest are missing owing to the insufficient size of the detectors, and artefacts caused by beam hardening. These parameters create an inherent image noise that can compromise the quality of the scan and can lead to an inaccurate and false diagnosis (Sogur *et al.* 2007). Truncated-view artefact is not a problem with SCT, because the entire object is always within the field of view (FOV) of the unit. Despite these limitations, the advantage of CBCT systems is that it results in significantly less effective radiation exposure than various conventional medical CTs.

The Field of view relates to the size and shape of the reconstructed image and is usually a cylindrical volume. There is a close relationship between the FOV size and the radiation dose received by the patient, and therefore, it is important that the smallest FOV is selected for each patient whilst capturing all the required clinical information. Along with FOV other exposure parameters, i.e. operating potential, tube current, exposure time and image resolution, should be adjusted for an individual patient to obtain the highest possible quality diagnostic image consistent with the need to minimize the radiation dose.

Conclusion

Radicular lingual grooves can initiate periodontal and pulpal involvement that can be difficult to diagnose and manage. However, if clinicians are aware of the forms in which the condition may occur and can apply the correct treatment modalities, a number of teeth with RLGs may be saved. SCT as a diagnostic tool was used to great effect in understanding the complex root canal anatomy, thus helping to facilitate the successful endodontic and periodontal management of a two rooted maxillary lateral incisor associated with a complex RLG.

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