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ROOT AMPUTATION; A VIABLE ALTERNATIVE TO TOOTH EXTRACTION: A CASE SERIES
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ROOT AMPUTATION; A VIABLE ALTERNATIVE TO TOOTH EXTRACTION: A CASE SERIES

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ABSTRACT

Background: **Increased desire of patients to maintain their dentition, supported by advance in dentistry have led to treatment of teeth that once would have been extracted. To retain such teeth in whole or part, combined restorative, endodontic and periodontal treatments may be required. The terminology tooth resection refers to the excision and removal of any segment of the tooth or a root with or without its accompanying crown portion. Root amputation, hemisection, radisection and bisection are among the various tooth resection procedures described in literature. Root amputation is a procedure that involves the surgical removal of one or more roots of a multirooted tooth while other roots are retained. The Involved root (or roots) is usually separated at the junction of the root and the crown. Indications for root amputation include; untreatable roots with separated instruments, perforations, extensive caries, resorption, root fractures, calcifications and periodontal disease with associated severe bone loss.**

Objective: **To illustrate the clinical management of teeth with insurmountable impediments by root amputation procedures.**

Design: **This is a case series, illustrating the clinical management of four cases, where root amputation procedures were performed to salvage teeth that would have otherwise been extracted.**

Conclusion: **This case series presents four cases of root amputation procedures carried out on maxillary first molars with insurmountable impediments in either**

of the buccal roots. The untreatable roots were amputated salvaging the remaining portion of the strategically important teeth.

INTRODUCTION

Compromised teeth more often than not complicate the treatment plan and compromise the long-term prognosis of teeth. This oftentimes presents a significant challenge to the attending clinician, especially in an era where there is an increased desire by patients to save their natural teeth [1]. Resection is a technique that allows a portion of a diseased, injured or untreatable molar by removal to be removed. It can be achieved by sectioning the entire tooth into half followed by removal of the diseased half, a procedure referred to as hemisection. Another resection procedure is root amputation, where the involved root (or roots) is usually separated at the junction of the root and the crown. This procedure is generally performed in maxillary molars but can be performed for mandibular molars. Resection may also be achieved bisection or bicuspidization is where the type of cut is similar to that of hemisection except that the location is centered to evenly divide the crown at the furcation, the crown and root portions of both halves are retained. The furcation is converted into an interproximal whose hygiene can be maintained by the patient [1,2].

It has been reported that root amputation and hemisection are the least desired approaches by clinicians and patients because of the assumption of inferior results compared with other therapies, such as extraction followed by dental implants [3]. This assumption, however, contradicts the findings in several studies that reported high success rates when these procedures were correctly executed following proper case selection [3,4,5]. One report presented a 14- year follow- up of a maxillary right first molar in which root amputation was performed demonstrating how this procedure saved the tooth during cancer therapy [3]. Herein, four cases with untreatable roots that were amputated, enabling salvaging of teeth that would otherwise have been extracted are presented.

CASE 1

A 44-year-old female patient who presented with a chronic apical abscess following endodontic treatment. The treatment had been done two years prior to consultation. There was associated discomfort on biting. Intraoral periapical radiograph showed widened periodontal ligament space on the mesial aspect of the mesio-buccal (MB) root. The root filling with the roots appeared sufficient. A cone beam computed tomography (CBCT) image was requested for further diagnosis and treatment planning.

a) Pre-operative clinical picture

b) Pre-operative intraoral periapical radiograph

CBCT image of tooth 26

a) Axial view in the mid root region. Note strip perforation on the distal aspect of the MB root with associated

Clinical procedure; Amputation of the MB root of tooth 26

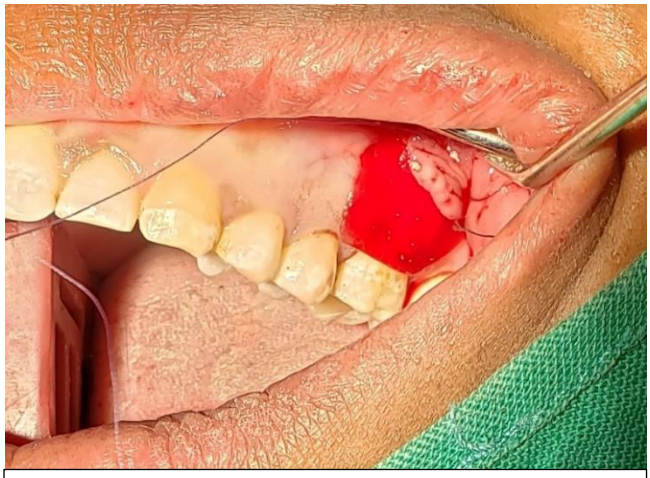
After administering local anesthesia 2 cartridges of 1.8ml lignocaine with 1:80,000 epinephrine (Lidocaine, 2% E-80, New Static, S. A, Colombia). A semilunar flap was raised. The cortical fenestration on the buccal aspect was located. Osteotomy was performed using a round surgical bur mounted on a low-speed handpiece, to expose the Mesio buccal (MB) root. The MB root was thereafter amputated, and the surgical site curated. Root end cavity preparation was done using ultrasonics and filled with mineral trioxide aggregate (Prevest DenPro Limited, India). The defect within the bone was filled with pure bone mineral of bovine origin (Cerabone ®,botiss biomaterials, GmbH Germany) and secured with a native collagen membrane made of porcine dermis (Collprotect® membrane, botiss biomaterials GmbH, German). Closure was performed using absorbable sutures (Polygalactin 910 4/0, Nantong Hope Industry &Trade Co.,Ltd, China). The patient was recalled after 1 week for review and suture removal.

a) Semilunar flap, osteotomy and exposure of MB root

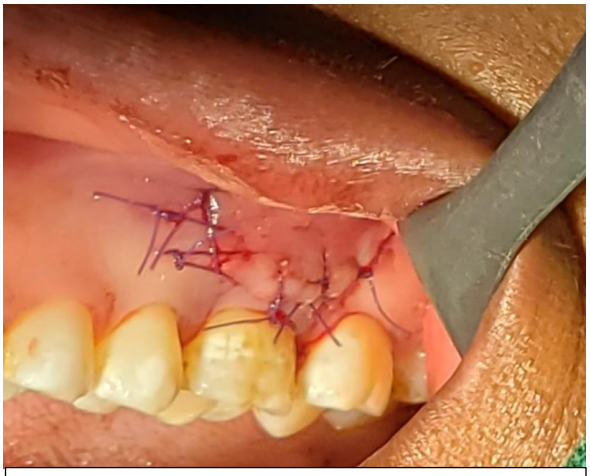
b) Surgical site after root amputation

c) Amputated MB root, gutta-percha and granulomatous tissue

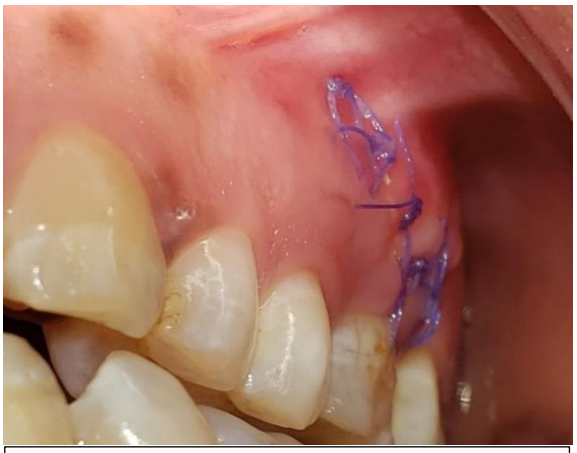
d) Placement of Cerabone ®,botiss biomaterials, GmbH Germany



e) Placement of Collprotect® membrane, botiss biomaterials GmbH, Germany



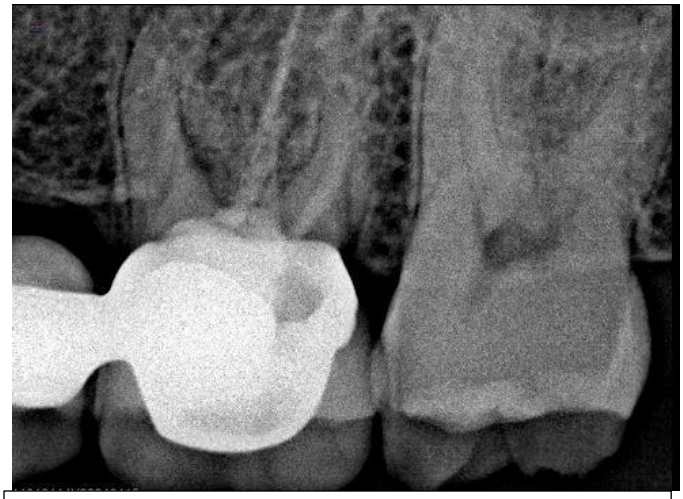
f) Closure with Polygalactin 910 4/0 Nantong Hope Industry &Trade Co.,Ltd,



g) Surgical site, 1week post-operative

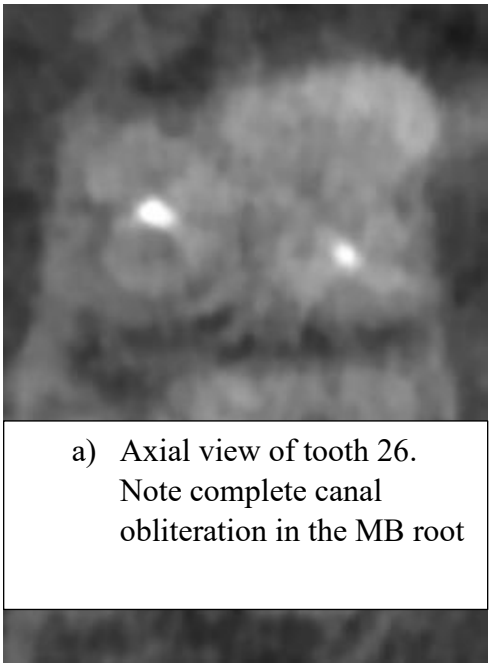
CASE 2

A 50-year-old male patient presented with pain associated with tooth 26. It had been root treated about 10 years prior to consultation. The patient reported pain associated with tooth 26, which served as an abutment for a three-unit bridge replacing tooth 25. Intraoral periapical radiograph showed widening of the periodontal ligament space around the mesial root. No root filling material was visible in the mesial root. CBCT images indicated complete obliteration of the canal space in the mesial root. A decision to amputate the MB root was made in view of the strategic importance of the tooth in the arch.



a) Intraoral periapical radiograph tooth 26

CBCT image of tooth 26

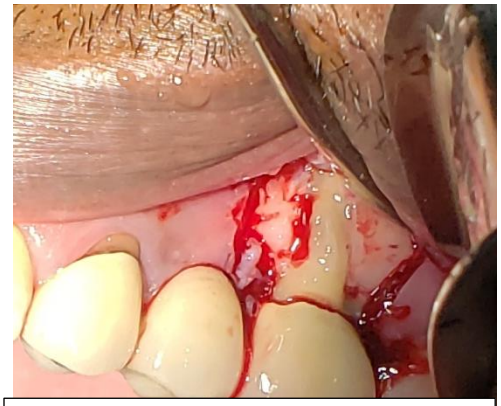


a) Axial view of tooth 26. Note complete canal obliteration in the MB root

Clinical procedure; Amputation of the MB root of tooth 26

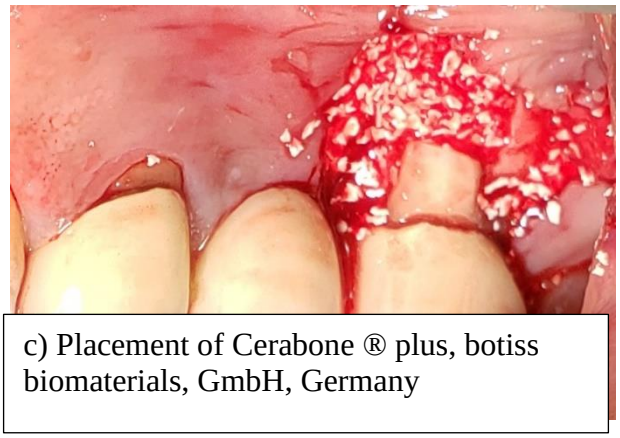
Local anesthesia, 2 cartridges of 1.8ml lignocaine with 1:80,000 epinephrine (Lidocaine, 2% E-80, New Static, S. A, Colombia) was administered. A full thickness mucoperiosteal flap was raised. Osteotomy was performed using a round surgical bur mounted on a low-speed handpiece, to expose the Mesio buccal (MB) root. The MB root was thereafter amputated and the surgical site curated. The level of root amputation was more apical. This ensured crown marginal integrity after completion of the procedure. Root end cavity preparation was done using ultrasonics and filled with mineral trioxide aggregate (Prevest DenPro Limited, India). The defect within the bone was filled with

natural bovine bone substitute mineral with hyaluronate (Cerabone ® plus ,botiss biomaterials, GmbH Germany) and secured with a native collagen membrane made of porcine dermis (Collprotect® membrane, botiss biomaterials GmbH, German). Closure was performed using absorbable sutures (Polygalactin 910 4/0, Nantong Hope Industry &Trade Co.,Ltd, China) advancing the flap coronally. The patient was recalled after 1 week for review and removal of sutures.

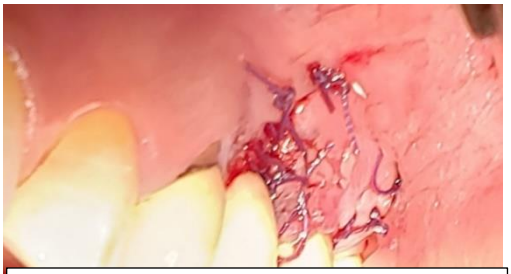


a) Full thickness mucoperiosteal flap

b) MB root amputated, root end cavity preparation with ultrasonics and filling with mineral trioxide aggregate



c) Placement of Cerabone ® plus, botiss biomaterials, GmbH, Germany



d) Closure with Polygalactin 910 4/0, Nantong Hope Industry &Trade Co.,Ltd, China

A 26-year-old female patient was referred for management of an intracanal separated instrument in the distobuccal (DB) root of tooth 16. The estimated length of the separated fragment was about 16mm, with about 7mm of the fragment extruding beyond the apical foramen. A decision to amputate the DB root and complete root filling for the mesiobuccal (MB) and palatal(P) roots was made.

a) Pre-operative intraoral periapical radiograph.

Note separated instrument fragment in the DB

Clinical procedure; Amputation of DB root of tooth 16

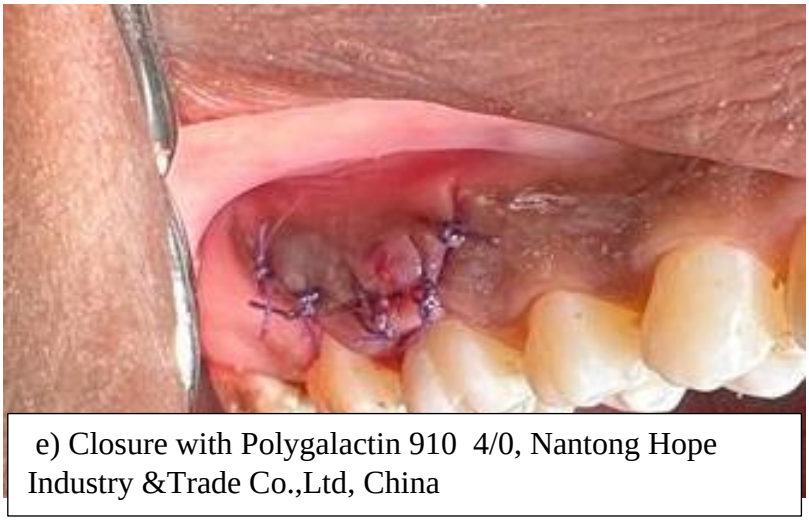
After administering local anesthesia 2 cartridges of 1.8ml lignocaine with 1:80,000 epinephrine (Lidocaine, 2% E-80, New Static, S. A, Colombia). A semilunar flap was raised. Osteotomy was performed using a round surgical bur mounted on a low-speed handpiece, to expose the Disto buccal (DB) root. The DB root was thereafter amputated, ensuring removal of the separated instrument lodged within the canal. Root end cavity preparation was done using ultrasonics and filled with mineral trioxide aggregate (Prevest DenPro Limited, India). The defect within the bone was filled with allograft bone grafting substitute with a mixture ratio of cortical powder (80%) and cancellous powder (20%) (Renew Oss™ Bone, Renew Medical Co., Ltd, Korea) and secured with a membrane (My Gis™ membrane, Renew Medical Co.,Ltd, Korea). Closure was performed using absorbable sutures (Polygalactin 910 4/0, Nantong Hope Industry &Trade Co.,Ltd, China).The patient was discharged and scheduled for review after 1 week.

a) Semilunar flap and amputation of DB root

b) Amputated DB root with separated instrument

c) Placement of Renew Oss™ Bone, Renew Medical Co., Ltd, Korea

d) My Gis™ membrane, Renew Medical Co.,Ltd, Korea, and flap repositioning

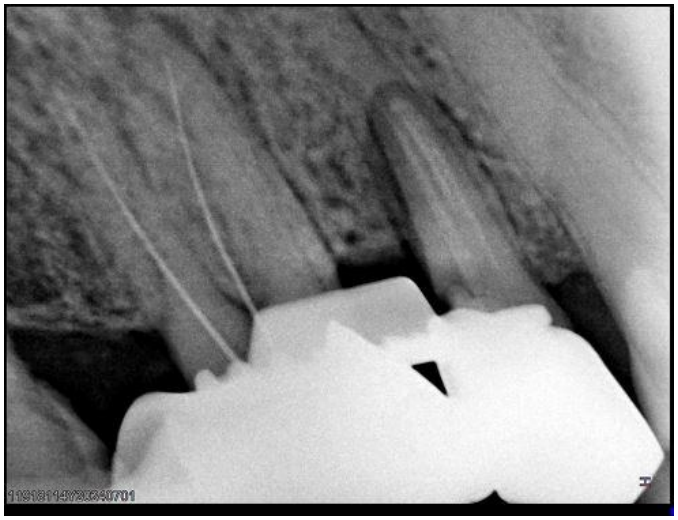


e) Closure with Polygalactin 910 4/0, Nantong Hope Industry &Trade Co.,Ltd, China

CASE 4

A 60-year-old female patient diagnosed with a necrotic pulp and chronic apical abscess associate with tooth 16. The tooth had undergone repeated extensive restorative treatment over years. A zirconia crown had been cemented 1 year prior to consultation. Intraoral periapical radiograph revealed apical lesions around the roots. The root canal space was hardly visible indicating existing calcific changes. A decision was made to perform endodontic treatment, via an access prepared through the existing zirconia crown. Patency could not be achieved for the mesiobuccal (MB) root, and thus a CBCT image was requested for treatment planning and further management.

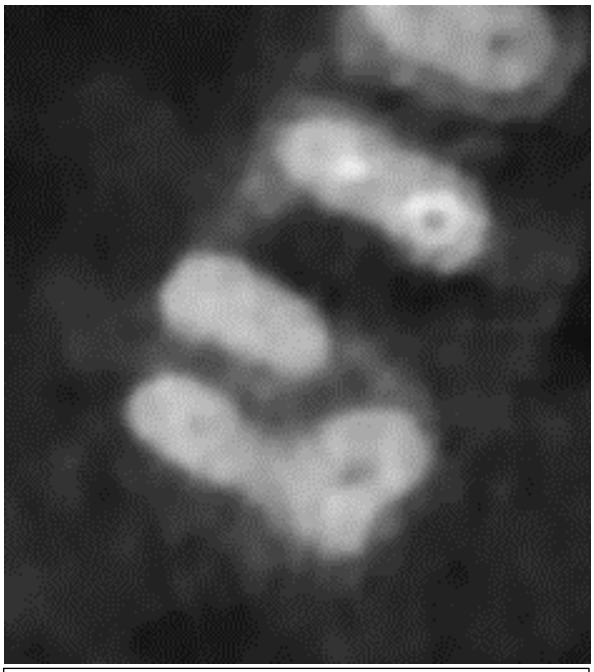
a) Pre-operative intraoral periapical radiograph



b) Working length radiograph for DB and P roots

CBCT image of tooth 16

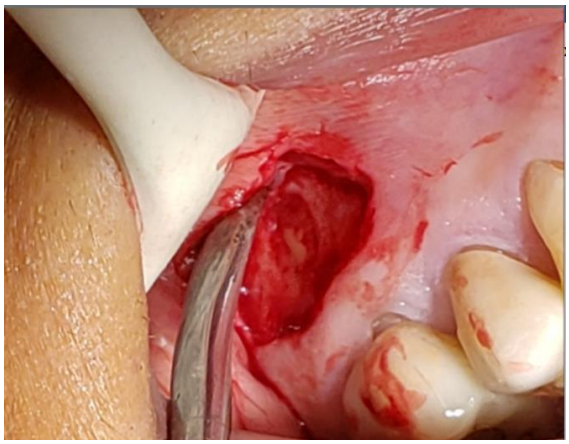
CBCT images revealed complete obliteration of the canal space in the MB root. A decision to amputate the MB root and complete endodontic treatment for the P and DB roots was made.



a) Axial view of tooth 16. Note obliteration of canal in the MB root

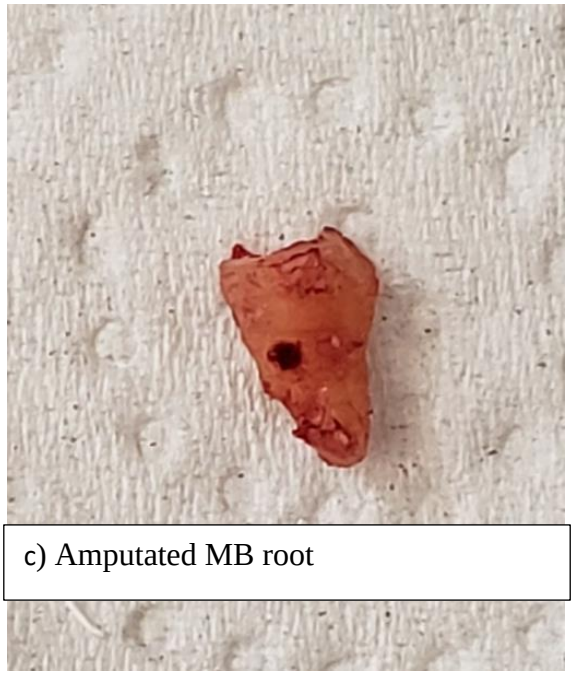
Clinical procedure; Amputation of MB root of tooth 16

After administering local anesthesia, 2 cartridges of 1.8ml lignocaine with 1:80,000 epinephrine (Lidocaine, 2% E-80, New Static, S. A, Colombia). A semilunar flap was raised. There was evident cortical fenestration around the Distobuccal (DB) root. Osteotomy was performed using a round surgical bur mounted on a low-speed handpiece, to expose the Mesio buccal (MB) root. The MB root was thereafter amputated and the surgical site curated. Root end cavity preparation was done using ultrasonics and filled with mineral trioxide aggregate (Prevest DenPro Limited, India). Closure was performed using absorbable sutures (Polygalactin 910 4/0, Nantong Hope Industry &Trade Co.,Ltd, China). The sutures were removed 1 week postoperatively. 2weeks postoperatively, the soft tissue around the surgical site had healed.



a) Semilunar flap. Note location of cortical fenestration

b) Amputation of MB root



c) Amputated MB root

d) Surgical site 2 weeks post -operative

DISCUSSION

The main purpose of root amputation therapy is to maintain a diseased tooth as an alternative to extraction and replacement. Extensive bridgework, dental implants and other forms of custom-made tooth replacements can be time-consuming and costly. In most cases root amputation followed by essential crown work can be completed in 1-3 short appointments and is less pricey [6].

In case 1, the MB root of tooth 26 had a strip perforation on the distal aspect with associated periradicular disease. The MB roots of maxillary first molars have been reported to have a danger zone thickness of 0.88mm, with the thickness decreasing when the roots have a second canal. Thus, conservative preparation must be applied during cleaning and shaping of these canals [7]. Because of its location, the strip perforation was deemed irreparable and thus root amputation was the treatment of choice over extraction and replacement with a dental implant.

Case 2 had extensive calcification leading to complete obliteration of the MB canal. At the point of the initial treatment, only the MB root and P roots were filled. The tooth remained asymptomatic until 10 years later, when periapical disease developed around the MB root. Cone-beam computed tomography (CBCT) is a three-dimensional imaging modality is useful in diagnosis and treatment planning of teeth with extensive calcification [8]. After CBCT analysis of the MB root and considering the time that had elapsed after the initial endodontic treatment, it was concluded that it was impossible to gain patency of the MB canal. Being an abutment of a three-unit bridge replacing tooth 15, extracting tooth 16 would have led to far reaching consequences prosthetic wise. Thus, amputation of the MB root was the preferred treatment modality. The level of root amputation was higher, allowing for a root end cavity to be prepared and be filled with Mineral trioxide aggregate. This allowed for the flap to be advanced coronally to ensure that the crown tooth margin related well with the gingiva after healing.

Management of intracanal separated instruments can be by bypassing the instrument fragment, removal of the fragment or leaving the instrument in situ and filling up to the level of the instrument proceeded by long term follow up [9]. However, in case 4, none of the management modalities mentioned were applicable. The separated instrument fragment had an estimated length of about 16mm, with about 7mm of its length extruding beyond the apical foramen. With the tooth becoming increasingly symptomatic a decision to amputate the DB root followed by root filling of the MB and P canals arrived at.

Similar to case 2, the MB root of tooth 16 in case 4 had complete obliteration of the canal secondary to calcification. Unlike in case 2, the canal was first explored clinically before a CBCT was requested. Upon raising the flap, a cortical fenestration was discovered around the DB root. The window within the cortical bone had to be extended mesially to allow for the amputation of the MB root. The presence and location of cortical fenestration and the volume and pattern of the periradicular lesions have been reported to have variations [10]. In view of this, clinician must be careful not to amputate the wrong root.

In cases 1, 2 and 3 presented, guided tissue regenerative (GTR) procedures were used. However, in case 4, which had a relatively smaller defect within the bone after the root amputation procedure, GTR procedures were not utilized. It has been reported that performing GTR techniques in endodontic surgery resulted in better healing rates more so for larger lesions. Smaller periradicular lesions

may be managed without GTR procedures [11]. Regarding the outcome of root resection therapy, one retrospective study reported a mean survival time of 9.1 years. In the same study, it was reported that more than 50% of teeth remained functional after 9 years of resection therapy [12]. Another study reported a weighted mean survival rate of 85.6% was for crown and root resection procedures, with individual data showing weighted mean survival rate of 87.2% for root resection procedures. The study concluded that crown and root resection procedures showed good outcome rates [13]. Root resection therapy thus remains a viable treatment option for molars with furcation defects and untreatable roots.
The cases presented will be followed up on a long-term to determine their survival.

CONCLUSION

Case selection significantly affects the long-term outcome of root amputation as a treatment of choice where endodontic or periodontal complications affect one root of multi-rooted teeth. Factors such as tooth restorability, occlusal forces and the value of the remaining roots must be examined carefully before a decision to perform root amputation is arrived at. The definite treatment plan should be discussed together with the endodontist, periodontist and the restorative dentist.

ETHICAL CONSIDERATION

Verbal consent to take clinical pictures and use them for teaching and research purposes was obtained from the patients. Confidentiality and anonymity was ensured by omitting the identities of the patients.

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