CASE REPORT

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Combined mucosal and alveolar fenestration: a clinical report and literature review

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Abstract

Background: This study reports the case of a 14-year-old girl in good state of health who presented with the apical third of the buccal root of the first upper right premolar that penetrated the alveolar buccal plate and overlying mucosa, being exposed to the oral environment. The treatment rationale is presented and compared with other therapeutic options described in the literature. *Methods*: Endodontic treatment and root end resection in association with a guided tissue regeneration protocol were recommended to preserve the tooth. *Results*: The evolution was favorable after surgery while the alveolar and mucosal defects were corrected through tissue regeneration and remodeling. A two-year follow-up period with every six months radiographic evaluation was considered. *Conclusions*: The therapeutic approach gave satisfactory results. The literature describes conservative treatment modalities in cases with mucosal fenestrations affecting permanent teeth.

Keywords: alveolar bone, pulpal-periapical pathology, endodontic treatment, guided tissue regeneration, comprehensive approach.

Introduction

Early evidence on the interest regarding the correlation between the alveolar processes morphology and the teeth dates back to 1963, when O'Connor studied the relationship of teeth with the inter-proximal bone, tooth anatomy, the presence of fenestrations and bony wedges [1]. Fenestrations and dehiscences occur in the alveolar bone, being more considered normal variations with regard to presence of the teeth, than pathologic conditions. The criteria for their identification belong to Davies RM *et al.* [2]: dehiscence is a lack of cortical bone at the level of a dental root, at least 4 mm apical to the margin of the inter-proximal bone; fenestration is a localized defect of the alveolar bone plate that exposes the root surface, usually the apical or the medium third, that does not involve the alveolar margin. Traditional textbooks of anatomy lack information on dehiscences and fenestrations, whereas famous periodontists consider them important anatomic entities when related to periodontal surgery, affecting 20% of the teeth, more commonly placed on the anterior, than on the posterior region of the jaws [3].

While dehiscences are evident due to gingival recession, fenestrations usually remain undepicted because the root is covered by gingiva or mucosa. Maybe this is the reason why dehiscences are considered more frequent than fenestrations. The potential of developing alveolar fenestrations must be taken into account when planning and performing oral surgery procedures, as their presence may complicate the outcome during the healing process [4].

A particular and rarely encountered phenomenon is when an apical fenestration is accompanied by a mucosal fenestration. In this situation, the root apex perforates both the alveolar bone plate and its overlying soft tissue, being exposed to the oral environment. Peacock ME *et al.* appreciate that mucosal fenestration "may be more common than has been reported, as lack of symptoms may inhibit patient awareness" [5].

The objective of this case report was to describe a treatment modality used to manage an apical alveolar and mucosal fenestration placed on the right first maxillary premolar buckle root.

Patient, Methods and Results

Patient evaluation

A 14-year-old girl presented to the dental office with aesthetic concerns about tooth 14. The patient was in good health (ASA 1) and experienced biting pain and while digital palpation of the tooth 14 apical area, two months ago. No pathologic signs were evident through facial inspection. Oral examination revealed the apical third of the buccal root of tooth 14 that perforated the buccal cortical plate and adjacent mucosa, being therefore exposed to the oral environment and the discolored crown of the same tooth (Figure 1).

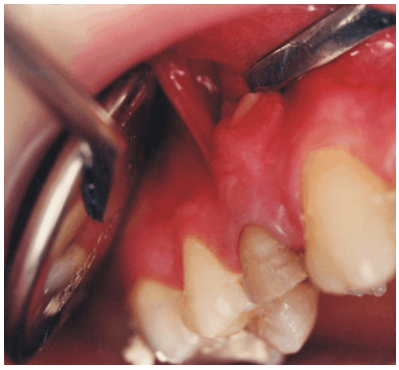

Figure 1 – ***Initial clinical situation. The apical third of the buccal root of 14th tooth is exposed through the alveolar mucosa.***

The patient confirmed a history of at least one year. The tooth responded negatively to thermal pulp testing. The diagnosis of an asymptomatic apical periodontitis on tooth 14 was made.

A CT cross section through the cervical area of the maxillary teeth pointed out the following: a thin alveolar buccal plate, fenestrated in the apical third of the first right premolar area, an eccentric position of tooth 14 in relation with the alveolar arch, and apical root protrusion from the buccal bone surface of the same tooth. Using CT, we were able to establish bone volume in the interested area, in order to find out if this evolution was a result of the endodontic pathology or if it appeared because of a structural bone deficiency background. CT confirmed the letter (Figure 2).

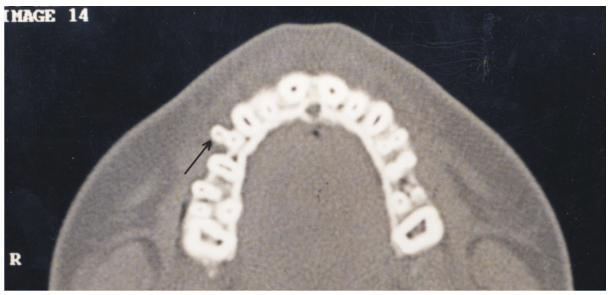

Figure 2 – ***CT: Cross section of the affected region. The arrow points out the visible fenestration.***

Treatment

Initially, working length determination was done on the palatal root of tooth 14 (Figure 3). Biomechanical root canals preparation was performed with Protaper System while abundant irrigation with sodium hypochlorite 5% was used and root canals were temporary filled with calcium hydroxide paste for 10 days. Next appointment, the calcium hydroxide paste was removed and root canal filling was performed by cold lateral condensation of gutta-percha. Follow-up was favorable, just a mild post-treatment pain was reported.

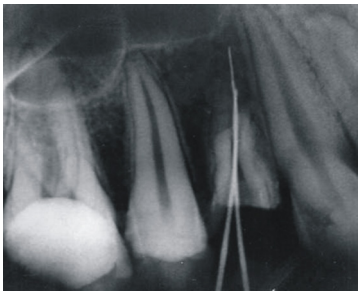

Figure 3 – ***Periapical radiograph: working length determination.***

After 14 days, a surgical procedure was performed in order to correct the aesthetic defect. A full thickness mucoperiosteal flap was raised to expose the whole alveolar defect, followed by curettage of the periapical area, resection of the apical third of the buccal root and remodeling of the apex (Figure 4). Bone graft material (inorganic bovine bone, Bio-Oss) was placed into the bone defect that resulted after periapical pathologic tissue removal and root apex resection, and it was covered with a resorbable membrane, Bio-Gide (Figures 5 and 6). The mucoperiosteal flap was coronally advanced and secured with non-absorbable sutures (Figure 7). The patient was prescribed analgesics (Acetaminophen 750 mg q.i.d.) for three days and 0.12% Chlorhexidine twice daily for four weeks.

The evolution was favorable without any local complications and the suture was removed after 10 days. Four weeks later, the patient was feeling well and free of symptoms.

Six months after the intervention the mucosa was completely healed and the region was in perfectly good shape. Periapical radiography revealed well performed endodontic treatment, the healing and remodeling of the apical area (Figure 8). As a final restoration, the tooth 14 got a zirconia-based ceramic crown (Figure 9). A two-year follow-up period with every six months radiographic evaluation was recommended.

Figure 4 – ***The buccal root apex of 14th tooth revealed during surgery.***

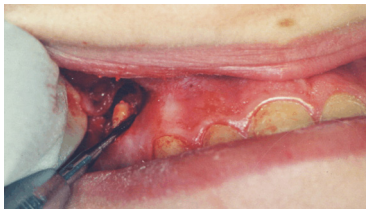

Figure 5 – ***Bone graft material placed into the bone defect.***

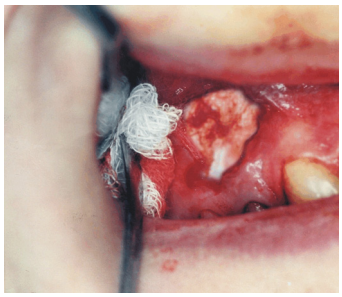

Figure 6 – ***Membrane in place.***

Figure 7 – ***Wound closure.***

Figure 8 – ***Periapical radiography six months after the intervention.***

Figure 9 – *The final result.*

Discussion

Fenestrations and dehiscences are considered non-pathological conditions; a variation within the range of periodontal normality but their undiagnosed or unexpected presence may complicate endodontic treatment, periodontal and periapical surgical procedures or require changes in implant placement protocols.

Various studies indicate that dehiscences are more often seen on mandibular teeth, while fenestrations are predominant on maxillary ones [6–8]. Rupprecht RD *et al.* found dehiscences in 40.4% of the studied skulls and in 4.1% of the examined teeth and fenestrations in 61.6% of the studied skulls and in 9% of the teeth [9].

Root prominences, tooth/jaw ratio, tooth malpositions, orthodontic tooth movement, are incriminated in the etiology of dehiscences and fenestrations. A unique dependence between the morphology of the alveolar process and the teeth exists. Some authors also consider heavy occlusal forces as an etiologic factor for the development of dehiscences and fenestrations [10], or aggravating ones [11], while others associate heavy occlusal forces with the presence of alveolar bone exostoses, as an evidence of buttressing bone formation [12].

Although symptom free, the presence of undepicted fenestrations may complicate endodontic treatment or jeopardize the functional and aesthetic outcome of periodontal surgery.

In this respect, an undepicted fenestration may give rise to pain following endodontic treatment, whose origin is sometimes difficult to determine. This is explained by irritation produced by slight projection of excess filling material to the mucosa over the apex. Pain is perceived primarily during masticatory movements or palpation [11]. The evaluation by cone-beam computed tomography (CBCT) of the periapical lesion is recommended in this situation, as CBCT can reveal defects of the cancellous bone and cortical bone separately [13, 14]. In this respect, Yoshioka T *et al.*, who classified the periapical lesions according to the characteristics of the bone defect revealed by CBCT, identified alveolar fenestrations as "type V lesions", characterized by apical root protrusion from the buccal or labial bone surface accompanied with the type II bone defect (buccal or labial bone plate defect whilst the bone plate on the opposite side remains intact). The treatment plan should be decided based on the extent of osseous defect or apical root protrusion. In cases where the protrusion is relatively small, like type V sub-category 1 (characterized by the protrusion of apical foramen only) and type V sub-category 2 (characterized by the protrusion of the apical one third of the root) surgical exposure of the apex and its remodeling to within the surrounding bone tissue are the treatment of choice [13, 15], while in cases where the whole root protrudes (type V sub-category 3) extraction is recommended [13]. Also, it is considered that these defects are associated with minimal or no intra-alveolar blood supply, as bone vascularisation derives chiefly from supraperiosteal vessels and periodontal ligament [16]. Consequently, a mucoperiosteal flap elevation during periodontal surgery will severe the supraperiosteal vessels and will further result in the loss of cortical plate or the worsening of the alveolar defect. If such defects are suspected, it is wise to leave the connective tissue covering the radicular surface. In this respect, a partial thickness flap, which preserves the supraperiosteal blood supply is recommended [16]. In order to achieve a satisfying and stable result, dentists and periodontists must be aware of the normal alveolar bone anatomy. A thorough pretreatment investigation regarding the relatively common presence of defects in the alveolar bone is advisable.

Mucosal fenestration, a pathologic condition rarely encountered in clinical practice may sometimes accompany an apical alveolar fenestration, worsening the prognosis of the affected tooth. In this case, a root apex perforates both the alveolar bone plate and its overlying soft tissue, being exposed to the oral environment, so the chief complaint is related to aesthetics. Reports with regard to mucosal fenestrations are scarce. It was first described by Menéndez OR in 1967 [17]. In 1971, Serrano J used the comprehensive term "gingivo-osseous pathologic fenestration" to describe this condition [18]. Most reports on mucosal fenestrations refer to deciduous teeth affected by traumatic intrusion, attrition, disturbed root resorbtion. Etiologic factors in relation with permanent teeth include: tooth/jaw ratio, root prominences, developmental anomalies, periodontal disease, chronic periapical pathosis, orthodontic tooth movement, trauma and strong occlusal forces [19]. No pain is described in relation with mucosal fenestrations, but they may act as plaque-retaining areas. A combined mucosal and alveolar fenestration is commonly associated with a non-vital tooth, as we found in the clinical case above. However, a minor gingival and alveolar fenestration on the disto-buccal root of a vital first maxillary molar was reported by Jhaveri HM *et al.* [19].

A peri-radicular lesion was evident on periapical radiography in the case we described, while malposition of tooth 14 in association with a thin alveolar bone plate was depicted on CT images.

A comprehensive approach was applied in this clinical case. Endodontic treatment was performed in order to eliminate the microorganisms from the root canal system, surgical procedure in order to correct the mucogingival defect and to stimulate bone healing and regeneration, while the crown was placed for aesthetic and functional reasons. The endodontic treatment was carried out four weeks prior to surgery. The surgical intervention consisted in apical root remodeling, aiming to harmonize its morphology with the alveolar housing, followed by correction of the mucosal defect.

Non-surgical root canal therapy and root end resection at different visits were also carried out by Jhaveri HM *et al.* [19], Dawes WL and Barnes IE [20], Chen G *et al.*

[21], while root canal therapy, periradicular debridement and mucosal correction were performed in the same visit by Pathak AK *et al.* [22].

The principles of guided tissue regeneration (GTR) using bone graft material in association with a resorbable membrane and coronally repositioned flap were applied in our case as an attempt to correct both the osseous defect and the mucosal one. Mucogingival approach also differs from one report to another. Use of connective tissue/periosteal graft was reported by Peacock ME *et al.* for the treatment of mucosal fenestrations [5]. Jhaveri HM *et al.* [19] used connective tissue grafts harvested from the hard palate before repositioning the mucogingival flap, while Chen G *et al.* [21] packed the bony defect with demineralized freeze-dried bone allograft and placed a connective tissue graft harvested from the hard palate before repositioning the mucogingival flap. Excision of the epithelialized margins of the mucosal defect, their reposition and suturing was the treatment performed by Dawes WL and Barnes IE for a mucosal fenestration at the level of an upper first molar [20]. Hydroxyapatite bone graft in combination with a free gingival graft harvested from the palate were used by Pathak AK *et al.* [22] in the treatment of a mandibular left central incisor with extensive alveolar and mucosal fenestration (the medium and the apical third of the root were entirely exposed to the oral environment). Tseng CC *et al.* [23] successfully treated a large endodontically induced periradicular defect and soft tissue fenestration by means of guided tissue regeneration procedure using demineralized freeze-dried bone allograft and a non-resorbable membrane. On the second stage surgery, when membrane was removed, bone regeneration and complete closure of the soft tissue fenestration were found. The guided tissue regeneration procedure using a resorbable membrane in conjunction with free connective tissue grafts was performed by Uchida A *et al.* in the treatment of a mandibular second premolar whose root apex was exposed in the oral cavity [24].

No consensus with regard the surgical treatment of mucosal fenestrations exists. Most authors apply procedures described in periodontal plastic surgery textbooks for coverage roots exposed by gingival recession, especially the subepithelial connective tissue grafts. The choice of connective tissue grafts (CTG) is supported by the establishment of a connective tissue base for migration of the epithelial cells from the margins, thus helping in "reattaching" of the soft tissue to the exposed root surface [19]. It is also appreciated that use of CTG underneath a pedicle flap creates a thicker gingival tissue compared to that achieved with GTR [19]. GTR was used in our case not only as a root coverage procedure, but also as a strategy of endodontic surgery where the ultimate goal was to regenerate the attachment apparatus: cementum, periodontal ligament, and alveolar bone. Scientific evidence indicates that principles of GTR using a resorbable barrier membrane can be successfully applied in endodontic surgery to correct alveolar bone defects confined to periapical region, even those with erosion of buccal/lingual cortex [25]. Animal histological studies showed that complete bone filling of periapical bone cavities occurred after endodontic surgery only when a barrier for guided tissue regeneration was used, whereas extensive connective tissue filling of the defects was found after conventional endodontic surgery [26]. Human prospective studies also pointed to the conclusion that use of GTR in association with bone graft materials may positively affect the healing process of through-and-through lesions [27].

Even debates with regard the treatment of mucosal fenestrations exists, the first choice should be conservative therapy. The underlying etiological factors play an important role in the establishment of the treatment plan objectives. Mucosal fenestrations are considered "an uncommon complication of pulpal-periradicular disease" [21]. Taking into consideration that teeth most affected by mucosal fenestrations coincide with the sites where "window-like" defects of alveolar bone are the most prevalent (maxillary first molar, maxillary anterior teeth, maxillary first premolar), we appreciate that alveolar defects are a prerequisite for the development of mucosal fenestrations, while pulpal-periapical pathology aggravates the conditions. Once the root canal system has been sealed, apical remodeling aims to bring the root into the alveolar bone confines, while GTR is used as an attempt to achieve regeneration of the attachment apparatus.

Conclusions

Although infrequent, the protrusion of the apical area of a dental root through the cortical plate and the overlying mucosa is an aesthetic concern for the patients and requires a comprehensive approach by the practitioner. The therapeutic protocol gave satisfactory results in this clinical case.

Contribution Note

The authors contributed equally to this paper.

References

[1] O'Connor TW, *Alveolar bony contours*, A thesis submitted to the Faculty of Baylor University Dallas, Texas, 1963.

[2] Davies RM, Downer MC, Hull PS, Lennon MA, *Alveolar defects in human skulls*, J Clin Periodontol, 1974, 1(2):107–111.

[3] Carranza FA, Bernard GW, The tooth supporting structures. In: Newman MG, Takei HH, Carranza FA (eds), *Carranza's clinical periodontology*, W.B. Saunders Co., Philadelphia, 2002, 36–57.

[4] Polimeni G, Koo KT, Qahash M, Xiropaidis AV, Albandar JM, Wikesjö UM, *Prognostic factors for alveolar regeneration: bone formation at teeth and titanium implants*, J Clin Periodontol, 2004, 31(11):927–932.

[5] Peacock ME, Mott DA, Cuenin MF, Hokett SD, Fowler EB, *Periodontal plastic surgical technique for gingival fenestration closure*, Gen Dent, 2001, 49(4):393–395; quiz 396–397.

[6] Elliot JR, Bowers GM, *Alveolar dehiscence and fenestration*, Periodontics, 1963, 1:245–248.

[7] Stahl SS, Cantor M, Zwig E, *Fenestrations of the labial alveolar plate in human skulls*, Periodontics, 1963, 1:99–102.

[8] Larato DC, *Alveolar plate fenestrations and dehiscences of human skull*, Oral Surg Oral Med Oral Pathol, 1970, 29(6): 816–819.

[9] Rupprecht RD, Horning GM, Nicoll BK, Cohen ME, *Prevalence of dehiscences and fenestrations in modern American skulls*, J Periodontol, 2001, 72(6):722–729.

[10] Agarwal V, *Fenestration and dehiscence in a non vital tooth – a case report*, Indian J Neonat Med Res, 2010, 4(4):2971–2973.

[11] Boucher Y, Sobel M, Sauveur G, *Persistent pain related to root canal filling and apical fenestration: a case report*, J Endod, 2000, 26(4):242–244.
[12] Horning GM, Cohen ME, Neils TA, *Buccal alveolar exostoses: prevalence, characteristics, and evidence for buttressing bone formation*, J Periodontol, 2000, 71(6):1032–1042.
[13] 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(3):245–252.
[14] de Paula-Silva FWG, Wu MK, Leonardo MR, da Silva LA, Wesselink PR, *Accuracy of periapical radiography and cone-beam computed tomography scans in diagnosing apical periodontitis using histopathological findings as a gold standard*, J Endod, 2009, 35(7):1009–1012.
[15] Ingle JI, Heithersay GS, Hartwell GR, Goerig AC, Marshall FJ, Krasny RM, Frank AL, Gaum C, Endodontic diagnostic procedure. In: Ingle JI, Bakland LK (eds), *Endodontics*, B.C. Decker Inc., Hamilton, 2002, 203–258.
[16] Horning GM, The periodontium. In: Vermino AR, Gray J, Hughes E (eds), The periodontic syllabus, Lippincott Williams & Wilkins, Baltimore, 2008, 1–14.
[17] Menéndez OR, *Bone fenestration by roots of deciduous teeth*, Oral Surg Oral Med Oral Pathol, 1967, 24(5):654–658.
[18] Serrano J, *Gingivo-osseous pathological fenestration*, Oral Surg Oral Med Oral Pathol, 1971, 32(5):697–700.
[19] Jhaveri HM, Amberkar S, Galav L, Deshmukh VL, Aggarwal S, *Management of mucosal fenestrations by interdisciplinary approach: a report of three cases*, J Endod, 2010, 36(1):164–168.
[20] Dawes WL, Barnes IE, *The surgical treatment of fenestrated buccal roots of an upper molar – a case report*, Int Endod J, 1983, 16(2):82–86.
[21] Chen G, Fang CT, Tong C, *The management of mucosal fenestration: a report of two cases*, Int Endod J, 2009, 42(2): 156–164.
[22] Pathak AK, Dixit J, Lal N, Verma UP, *Single step perioplastic surgical procedure for combined mucogingival, periapical and fenestration defects – a case report*, J Indian Dental Assoc, 2011, 5(9):982–984.
[23] Tseng CC, Chen YH, Huang CC, Bowers GM, *Correction of a large periradicular lesion and mucosal defect using combined endodontic and periodontal therapy: a case report*, Int J Periodontics Restorative Dent, 1995, 15(4):377–383.
[24] Uchida A, Takahashi K, Nakamura Y, Nakamura A, Suzuki K, Nishikawa H, *A case report of endodontic surgery using GTR for a mandibular second premolar tooth whose root apex was exposed in the oral cavity*, J Japan Endod Assoc, 2004, 25(1):20–26.
[25] von Arx T, Cochran DL, *Rationale for the application of the GTR principle using a barrier membrane in endodontic surgery: a proposal of classification and literature review*, Int J Periodontics Restorative Dent, 2001, 21(2):127–139.
[26] Pecora G, De Leonardis D, Ibrahim N, Bovi M, Cornelini R, *The use of calcium sulphate in the surgical treatment of a 'through and through' periradicular lesion*, Int Endod J, 2001, 34(3):189–197.
[27] Taschieri S, Del Fabbro M, Testori T, Saita M, Weinstein R, *Efficacy of guided tissue regeneration in the management of through-and-through lesions following surgical endodontics: a preliminary study*, Int J Periodontics Restorative Dent, 2008, 28(3):265–271.

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