

## **Periodontal regenerative treatment of intrabony defects associated to palatal grooves: a report of two cases**

Stefano CORBELLA, PhD, DDS <sup>1, 2, 3</sup>

Alice ALBERTI, DDS <sup>1, 2</sup>

Beatrice ZOTTI, DDS <sup>1, 2</sup>

Luca FRAN CETTI, MD, DDS <sup>1, 2</sup>

<sup>1</sup> Department of Biomedical, Surgical and Dental Sciences, Università degli Studi di Milano, Milan, Italy.

<sup>2</sup> IRCCS Istituto Ortopedico Galeazzi, Milan, Italy.

<sup>3</sup> Institute of Dentistry, I. M. Sechenov First Moscow state medical University, Moscow, Russia.

**Correspondence:** Dr. Alice Alberti

IRCCS Istituto Ortopedico Galeazzi - Dental Clinic, Via R. Galeazzi, 4, 20161 Milan - ITALY

Email: [alice.alberti3@gmail.com](mailto:alice.alberti3@gmail.com), Tel: +39 02 50319950 Fax: +39 02 50319960

### **ORCID**

Stefano CORBELLA: 0000-0001-8428-8811

Alice ALBERTI: 0000-0001-5017-1340

Luca FRAN CETTI: 0000-0001-5775-8961

### **ABSTRACT**

Palatal radicular groove (PRG) is a morphological deformity, occurring during tooth development. It is usually located on the palatal aspect of maxillary incisors, and frequently associated with periodontal or endodontic-periodontal lesions. Some treatment options were described for such lesions, including primary endodontic treatment and periodontal surgery, and extraction with intentional replantation after removal of PRG and endodontic treatment. The present paper reported two cases of PRG-associated deep intrabony defects, successfully treated with periodontal surgery with enamel matrix derivative (EMD) application and mechanical removal of PRGs, avoiding endodontic treatment or retreatment. The complexity of the diagnostic process was also discussed.

### **KEYWORDS**

Enamel matrix derivative; Intrabony defects; Palatal radicular groove; Periodontal regeneration; Periodontal surgery.

## INTRODUCTION

In scientific literature, palatal radicular grooves (PRGs) were first described by Lee and coworkers in 1968, [1] who discussed its clinical characteristics and potential etiology. [1] PRG is usually described as a kind of morphological deformity, occurring during tooth development as a failed attempt to form a new root, [2] usually located on the palatal aspect of permanent maxillary lateral incisors. [3,4] From the anatomical point of view PGR are heterogeneous, generally extending from the central fossa of the incisor, over the cingulum and down apically, on the root surface. [5,4] In some cases, the presence of one PRG was considered as an important adverse prognostic factor, because of the frequently associated wide endodontic-periodontal lesions. [6] Even though a recent classification scheme for tooth, root and canal anomalies was recently proposed, [7] the most common classification for PGR was proposed by Gu and coworkers, [8] who described three different types on the basis of its anatomical extension.

Considering that, in the past, many terms were used to describe this particular kind of deformity (such as palate-gingival groove, development radicular anatomy, disto-lingual groove, palatal-radicular groove, and radicular groove [5]), PGR incidence was described, with this limitation, to range between 2.8% and 18%, [9-11,5] and one study on a cohort of Taiwanese people found PGRs in more than 40% of subjects. [12]

With regard to the clinical features, the presence of a PRG provide an ideal pathway for oral bacteria to reach deep periodontal tissues, since it can be difficultly cleaned by standard oral hygiene maneuvers. The apical migration of bacteria could lead to the formation of intrabony pockets, which are located in correspondence of the PRG, and are usually deep and narrow. [10,13,14] In some cases, probably due to rapid progression of the infection, the lesion could reach the apical tissues, thus causing pulp necrosis and consequently an endodontic-periodontal lesion of periodontal origin [9,15,16,11,2]. In some cases, the diagnosis could be complicated by the presence of sinus tract usually on the vestibular mucosa, in correspondence of the affected tooth. [4]

The treatment options for endodontic-periodontal lesions related to presence of PRG include primary endodontic treatment [4] usually associated to periodontal surgery that was limited in the site of the defect. [9,15,5] Other authors described the extraction of the affected tooth when a complete loss of periodontal support occurred, [4] or extraction and intentional replantation after removal of PRG and extraoral endodontic treatment. [11] Ideally, a timely diagnosis could prevent the pulpal involvement, thus allowing successful treatment of the defect through a merely periodontal approach. The aim of this paper was to present two case reports of PRG-associated deep intrabony defects treated with periodontal surgery and enamel matrix derivative (EMD) application, avoiding endodontic treatment or retreatment.

## **CASE PRESENTATION**

Both subjects were treated following the principles of the Helsinki Declaration. [17] The operator (SC) informed the patients about the treatment alternatives and about the planned intervention, and both patients signed a written informed consent form before performing the treatment procedures.

### **Case report 1**

One female patient, aged 49 at the time of the first visit, without any systemic disease (ASA-1 following the classification proposed by the American Society of Anesthesiologists) presented referring an episode of acute abscess in the region of 1.1, 1.2, 1.3 that was treated with systemic administration of Amoxicillin 875 mg + Clavulanate 125 mg twice a day for six days.

The clinical examination revealed the presence of one isolated periodontal pocket (measuring 13 mm) in correspondence of the palatal aspect of 1.2, in presence of one enamel alteration (PRG) (Fig. 1). Mild pain was associated to percussion of 1.2 and the element was vital, without any caries. Full-mouth clinical evaluation excluded the presence of generalized periodontitis. Adjacent sites did not show the presence of any pathological periodontal pocket, being probing depth less than 4 mm in all sites. Radiographic examination showed a deep intrabony defect distal to 1.2 (Fig. 2).

Differential diagnosis reasonably excluded the presence of a vertical root fracture (VRF) since the tooth was vital and no history of trauma was reported. The treatment option was to elevate a palatal flap to allow the debridement of the pocket, to remove physically the etiologic factor (the PGR) maintaining tooth vitality, and to stimulate periodontal regeneration by using enamel matrix derivative (EMD).

After local anesthesia on vestibular and palatal side with Articaine 4% + epinephrine 1:100.000 a horizontal incision was performed on the palatal aspect preserving interdental papilla between 1.1 and 1.2 and between 1.3 and 1.4 (Fig. 3). The papilla between 1.2 and 1.3 was separated from the vestibular portion and reflected in order to directly visualize the PRG and the defect (Fig. 4). After the debridement of the defect, by removing the granulation tissue, the PRG was smoothed by the use of a diamond bur under abundant irrigation of sterile saline solution (Fig. 5, Fig. 6). Following the instructions provided by the manufacturer, tooth surface was conditioned using for two minutes 24% EDTA gel (Straumann® PrefGel®, Straumann AG, Basel, Switzerland) and, after its removal through copious irrigation with sterile saline solution, EMD (Straumann® Emdogain®, Straumann AG, Basel, Switzerland) was placed in the defect (Fig. 7). The flap was then sutured with single 5/0 and 6/0 sutures (ETHILON®, Ethicon, Inc, Johnson & Johnson, Piscataway, NJ, United States) (Fig. 8). The patient was advised to avoid any trauma or traction in the region of surgery and not to consume hard food during the first five days. Ibuprofen 400 mg was prescribed twice a day for three days for inflammation control and pain relief. Healing completed without any adverse event.

Clinical and radiographic examination 12 months after surgical intervention revealed a complete healing with bone regeneration in the site of the defect (Fig. 9, Fig. 10).

## **Case report 2**

One female patient, aged 36 at the time of the first visit, without any systemic disease (ASA-1 following the classification proposed by the American Society of Anesthesiologists) presented referring mild pain sensation while touching with the tongue the palatal gingival margin of 1.2.

The clinical examination revealed the presence of one deep narrow isolated periodontal pocket (PD = 10 mm) in correspondence of the palatal aspect of 1.2, in presence of bleeding on probing, no plaque accumulation and one PRG (Fig. 11). Full-mouth clinical evaluation excluded the presence of periodontitis. Radiographic examination showed no evidence of one visible intrabony defect (Fig. 12). The tooth was endodontically treated, and did not show signs and symptoms of a lesion of endodontic origin.

The treatment was by a regenerative approach, using EMD, on the palatal aspect, removing mechanically the PRG from the root (Fig. 13, Fig. 14), following the technique described in details before.

After one year from surgical intervention, clinical examination showed a physiological probing depth (less than 4 mm) in the site of the surgery, and the absence of symptoms.

## **DISCUSSION**

The described case reports showed the clinical and radiographic success of one treatment option for PGR-related intrabony lesions. The periodontal regenerative treatment resulted in the resolution of the cases, maintaining tooth vitality when present and avoiding the recurrence of symptoms.

The presented results should be considered with caution, in particular when evaluating external validity, since they are derived on just two cases not included in one clinical trial. Even considering this important limitation, some considerations could be made on the basis of the outcomes obtained.

The first issue to be discussed is about the diagnostic procedure that led to the diagnosis of PRG-related intrabony defect. Both patients referred some non-specific symptoms that could be related to various condition of periodontal or endodontic origin. In order to identify the etiologic factor, an accurate clinical examination was performed, revealing no caries, no restorations and the presence of a deep and narrow periodontal pocket on the lingual aspect of the tooth.

Purely periodontal lesions could be obviously related to the presence of periodontal disease. In the presented cases, a full-mouth examination excluded the presence of periodontitis. For this reason, we considered other factors which can be related to localized periodontal lesions, with or without acute abscess. Those include: endodontic periapical or lateral

lesions of the involved or of an adjacent tooth which find a drainage route through the periodontal ligament and the gingival sulcus, [18] vertical root fractures with or without pulpal involvement, local plaque retention factors, such as the presence of inadequate restorations, [19] developmental anomalies such as gemination, fused roots and radicular grooves, [1] and other rare conditions, such as ectopic gingival sebaceous glands. [20] All these options should be considered and tested.

Even though no caries was visible, no previous restoration was present and no dental trauma was reported by the patients, the hypothesis of a purely endodontic lesion wasn't excluded since it can also result, for example, from longitudinal tooth fractures such as split tooth or VRF, which cannot be easily detected. [21] Thus, tooth vitality was tested and a radiographic examination was performed: in both cases the involvement of a fracture was excluded.

Vertical root fractures are usually related to dental trauma and excessive occlusal forces, and they are referred to as "acute" and "chronic" or "fatigue fractures" respectively. [22] They usually occur in restored endodontically treated teeth with or without endodontic posts, even though they can be encountered in vital and non-endodontically treated teeth. [23-25] The diagnosis of VRFs can be challenging, since signs and symptoms are not specific, including pain with lateral percussion or while chewing, gingival swelling, sinus tract, periodontal defect. Only the presence of two deep and narrow periodontal pockets on the buccal and lingual sides of the tooth can be considered a pathognomonic sign of VRF. Its radiographical features are also heterogeneous, varying from vertical bone resorption, to radiographic thickening of the periodontal ligament, to the typical "halo" effect, a combined periapical and perilateral radiolucency. [26,22] Surgical exploration, consisting of direct visualization after lifting a full-thickness flap, can confirm VRFs diagnosis. In the reported cases no characteristic sign of VRF was found and no previous endodontic treatment or large restoration was present; on the other side, PRGs typically occur in maxillary lateral incisors. [3,4]

Once confirmed (through direct visualization in the presented cases) the diagnosis of PRG, some authors proposed a classification of such deformity, distinguishing three types of grooves on the basis of their depth evaluated before intervention using Cone-Beam Computed Tomography (CBCT). [4] Other classification were proposed on the basis of groove characteristics as evaluated after tooth extraction. [8]

With regard to the treatment options, a combined approach (both from the endodontic and the periodontal side) was widely described and proposed when the bony defect caused the loss of tooth vitality. [9,15,16,11,5] Schwartz and coworkers in 2006 described a combined endo-periodontal treatment that was complicated by the complex root canal anatomy. [5] Other authors proposed the extraction, endodontic treatment and sealing of the groove using composite resin or glass-ionomer cement and subsequent replantation of the affected teeth. [27,11] Al-Hezaimi and coworkers associated intentional extraction and replantation to EMD application to treat residual bone defect. [28] Cho and coworkers published

in 2017 the description of three cases treated with a combined endo-periodontal approach with odontoplasty in order to remove / flatten, after endodontic treatment, the groove from root surface. [16]

Some studies reported the results of EMD application alone for the treatment of periodontal defects associated to PGR, in teeth with preserved pulp vitality, [29,30] even though the techniques described were different from the one adopted for the described case reports. However, the use of such biomaterial found a wide justification in previously published scientific papers on the regenerative treatment of deep and narrow periodontal defects, mainly self-contained. [31]

Many reviews described the mechanisms of action of EMD in the stimulation of a number of cells (fibroblast and epithelial cells of the gingiva and of the periodontium) involved in regenerative process, by influencing cell attachment, spreading, proliferation, and, finally, bone remodeling. [32-34]

With regard to the clinical applications of EMD, since the first paper published by Heijl in 1997, the results of a number of studies confirmed the efficacy of EMD (even when used alone) in the treatment of deep intrabony defects. [35,36]

The multicentric study by Tonetti and coworkers, published in 2002, compared open flap debridement and EMD application alone in the treatment of intrabony defects. [35] The authors found that the use of EMD resulted in a mean PD reduction of  $3.9 \pm 1.7$  mm and CAL gain of  $3.1 \pm 1.5$  mm 12 months after surgery. These results were similar to those obtained in other studies comparing the same treatment options. [36,37] Our case reports confirmed that EMD alone could be successfully used for the treatment of PGR-related periodontal defects, when an adequate primary closure was obtained.

In conclusion, the two case reports described a technique that resulted in clinical and radiographic resolution of PGR-related periodontal defect by periodontal regenerative approach with application of EMD, furthermore preventing loss of tooth vitality (Case 1). Well-designed randomized controlled clinical trials with adequate sample size are needed in order to establish which treatment procedure would lead to better results. However, even considering the limitations of the present study, we can speculate that a timing and early diagnosis of PGR-related defect can modify importantly the prognosis of affected teeth.

## **ACKNOWLEDGMENTS**

No funding was received for the present study. The authors declare that they have no conflict of interest.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

## REFERENCES

1. Lee KW, Lee EC, Poon KY (1968) Palato-gingival grooves in maxillary incisors. A possible predisposing factor to localised periodontal disease. *Br Dent J* 124 (1):14-18
2. Peikoff MD, Trott JR (1977) An endodontic failure caused by an unusual anatomical anomaly. *J Endod* 3 (9):356-359. doi:10.1016/S0099-2399(77)80066-6
3. Lara VS, Consolaro A, Bruce RS (2000) Macroscopic and microscopic analysis of the palato-gingival groove. *J Endod* 26 (6):345-350. doi:10.1097/00004770-200006000-00009
4. Tan X, Zhang L, Zhou W, Li Y, Ning J, Chen X, Song D, Zhou X, Huang D (2017) Palatal Radicular Groove Morphology of the Maxillary Incisors: A Case Series Report. *J Endod* 43 (5):827-833. doi:10.1016/j.joen.2016.12.025
5. Schwartz SA, Koch MA, Deas DE, Powell CA (2006) Combined endodontic-periodontic treatment of a palatal groove: a case report. *J Endod* 32 (6):573-578. doi:10.1016/j.joen.2005.08.003
6. Simon JH, Glick DH, Frank AL (1971) Predictable endodontic and periodontic failures as a result of radicular anomalies. *Oral Surg Oral Med Oral Pathol* 31 (6):823-826
7. Ahmed HMA, Dummer PMH (2017) A new system for classifying tooth, root and canal anomalies. *Int Endod J*. doi:10.1111/iej.12867
8. Gu YC (2011) A micro-computed tomographic analysis of maxillary lateral incisors with radicular grooves. *J Endod* 37 (6):789-792. doi:10.1016/j.joen.2011.03.002
9. Attam K, Tiwary R, Talwar S, Lamba AK (2010) Palatogingival groove: endodontic-periodontal management--case report. *J Endod* 36 (10):1717-1720. doi:10.1016/j.joen.2010.06.025
10. Everett FG, Kramer GM (1972) The disto-lingual groove in the maxillary lateral incisor; a periodontal hazard. *J Periodontol* 43 (6):352-361. doi:10.1902/jop.1972.43.6.352
11. Garrido I, Abella F, Ordinola-Zapata R, Duran-Sindreu F, Roig M (2016) Combined Endodontic Therapy and Intentional Replantation for the Treatment of Palatogingival Groove. *J Endod* 42 (2):324-328. doi:10.1016/j.joen.2015.10.009
12. Hou GL, Tsai CC (1993) Relationship between palato-radicular grooves and localized periodontitis. *J Clin Periodontol* 20 (9):678-682
13. Walker RT (1976) The disto-palatal groove in maxillary incisors; a predisposing factor in periodontal disease. *J R Nav Med Serv* 62 (1):30-32
14. Withers JA, Brunsvold MA, Killoy WJ, Rahe AJ (1981) The relationship of palato-gingival grooves to localized periodontal disease. *J Periodontol* 52 (1):41-44. doi:10.1902/jop.1981.52.1.41

15. Castelo-Baz P, Ramos-Barbosa I, Martin-Biedma B, Dablanca-Blanco AB, Varela-Patino P, Blanco-Carrion J (2015) Combined Endodontic-Periodontal Treatment of a Palatogingival Groove. *J Endod* 41 (11):1918-1922. doi:10.1016/j.joen.2015.08.008
16. Cho YD, Lee JE, Chung Y, Lee WC, Seol YJ, Lee YM, Rhyu IC, Ku Y (2017) Collaborative Management of Combined Periodontal-endodontic Lesions with a Palatogingival Groove: A Case Series. *J Endod* 43 (2):332-337. doi:10.1016/j.joen.2016.10.003
17. World Medical A (2013) World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA* 310 (20):2191-2194. doi:10.1001/jama.2013.281053
18. Harrington GW, Steiner DR, Ammons WF (2002) The periodontal-endodontic controversy. *Periodontol* 2000 30:123-130
19. Halperin-Sternfeld M, Saminsky M, Machtei EE, Horwitz J (2016) The association between dental proximal restorations and periodontal disease: A retrospective 10-18 years longitudinal study. *Quintessence Int* 47 (3):249-259. doi:10.3290/j.qi.a34810
20. Cohen RE, Aguirre A, Drinnan AJ, Neiders ME, Mastroianni AJ (1990) Ectopic gingival sebaceous glands presenting as localized periodontitis. *J Periodontol* 61 (1):58-60. doi:10.1902/jop.1990.61.1.58
21. Berman LH, Kuttler S (2010) Fracture necrosis: diagnosis, prognosis assessment, and treatment recommendations. *J Endod* 36 (3):442-446. doi:10.1016/j.joen.2009.12.018
22. Tsesis I, Rosen E, Tamse A, Taschieri S, Kfir A (2010) Diagnosis of vertical root fractures in endodontically treated teeth based on clinical and radiographic indices: a systematic review. *J Endod* 36 (9):1455-1458. doi:10.1016/j.joen.2010.05.003
23. Chan CP, Lin CP, Tseng SC, Jeng JH (1999) Vertical root fracture in endodontically versus nonendodontically treated teeth: a survey of 315 cases in Chinese patients. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 87 (4):504-507
24. Yang SF, Rivera EM, Walton RE (1995) Vertical root fracture in nonendodontically treated teeth. *J Endod* 21 (6):337-339. doi:10.1016/S0099-2399(06)81013-7
25. Yeh CJ (1997) Fatigue root fracture: a spontaneous root fracture in non-endodontically treated teeth. *Br Dent J* 182 (7):261-266
26. Cohen S, Blanco L, Berman L (2003) Vertical root fractures: clinical and radiographic diagnosis. *J Am Dent Assoc* 134 (4):434-441
27. Forero-Lopez J, Gamboa-Martinez L, Pico-Porras L, Nino-Barrera JL (2015) Surgical management with intentional replantation on a tooth with palato-radicular groove. *Restor Dent Endod* 40 (2):166-171. doi:10.5395/rde.2015.40.2.166

28. Al-Hezaimi K, Naghshbandi J, Simon JH, Rotstein I (2009) Successful treatment of a radicular groove by intentional replantation and Emdogain therapy: four years follow-up. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 107 (3):e82-85. doi:10.1016/j.tripleo.2008.11.012
29. Rethman MP (2001) Treatment of a palatal-gingival groove using enamel matrix derivative. *Compend Contin Educ Dent* 22 (9):792-797
30. Zucchelli G, Mele M, Checchi L (2006) The papilla amplification flap for the treatment of a localized periodontal defect associated with a palatal groove. *J Periodontol* 77 (10):1788-1796. doi:10.1902/jop.2006.050333
31. Miron RJ, Dard M, Weinreb M (2015) Enamel matrix derivative, inflammation and soft tissue wound healing. *J Periodontol* 86 (5):555-569. doi:10.1111/jre.12245
32. Bosshardt DD (2008) Biological mediators and periodontal regeneration: a review of enamel matrix proteins at the cellular and molecular levels. *J Clin Periodontol* 35 (8 Suppl):87-105. doi:10.1111/j.1600-051X.2008.01264.x
33. Miron RJ, Wei L, Yang S, Caluseru OM, Sculean A, Zhang Y (2014) Effect of enamel matrix derivative on periodontal wound healing and regeneration in an osteoporotic model. *J Periodontol* 85 (11):1603-1611. doi:10.1902/jop.2014.130745
34. Zeichner-David M (2001) Is there more to enamel matrix proteins than biomineralization? *Matrix Biol* 20 (5-6):307-316
35. Tonetti MS, Lang NP, Cortellini P, Suvan JE, Adriaens P, Dubravec D, Fonzar A, Fourmoussis I, Mayfield L, Rossi R, Silvestri M, Tiedemann C, Topoll H, Vangsted T, Wallkamm B (2002) Enamel matrix proteins in the regenerative therapy of deep intrabony defects. *J Clin Periodontol* 29 (4):317-325
36. Francetti L, Del Fabbro M, Basso M, Testori T, Weinstein R (2004) Enamel matrix proteins in the treatment of intrabony defects. A prospective 24-month clinical trial. *J Clin Periodontol* 31 (1):52-59
37. Chambrone D, Pasin IM, Chambrone L, Pannuti CM, Conde MC, Lima LA (2010) Treatment of infrabony defects with or without enamel matrix proteins: a 24-month follow-up randomized pilot study. *Quintessence Int* 41 (2):125-134

## **FIGURE LEGENDS**

Figure 1. Clinical examination revealed the presence of a 13 mm deep periodontal pocket associated to an enamel alteration on the palatal side of 1.2.

Figure 2. An angular bone defect was also visible through intraoral radiographic examination.

Figure 3. A horizontal incision on the palatal aspect was performed, preserving the interdental papilla.

Figure 4. The reflection of the flap, including the papilla between 1.2 and 1.3, allowed a direct visualization of the intrabony defect and the radicular groove.

Figure 5. Granulation tissue was removed from the intrabony defect.

Figure 6. Using a diamond bur with copious irrigation of sterile saline solution, the enamel alteration was removed.

Figure 7. The bone substitute was placed in the osseous defect after it had been conditioned through a 24% EDTA gel and irrigated with abundant sterile saline solution.

Figure 8. Single 5/0 and 6/0 sutures were placed.

Figure 9. Clinical examination after 12 months.

Figure 10. Radiographic examination after 12 months.

Figure 11. Clinical examination: a 10 mm periodontal pocket is associated to 1.2 in correspondence of a palatal groove.

Figure 12. Radiographic examination: no bone resorption is visible in correspondence of the involved tooth.

Figure 13. After a flap was reflected and direct visualization of the defect was obtained, debridement of the periodontal lesion was performed and the radicular groove was smoothed.

Figure 14. The radicular groove was smoothed using a diamond bur.

Figure 15. Clinical examination after 12 months.

Figure 16. Radiographic examination after 12 months.