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CASE REPORT

Papillary reconstruction and guided tissue regeneration for combined periodontal–endodontic lesions caused by palatogingival groove and additional root: a case report

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Key Clinical Message

We described a combined periodontal–endodontic lesion, which was caused by a palatogingival groove and an additional root. An interdisciplinary approach involving endodontic therapy, mineral trioxide aggregate (MTA) filling, root resection, guided tissue regeneration, and papillary reconstruction was used for the case. The tooth presents morphologically and functionally normal except tooth discoloration caused by MTA.

Keywords

Additional root, combined periodontal-endodontic lesions, guided tissue regeneration, multidisciplinary approach, palatogingival groove, papillary reconstruction.

The palatogingival groove is a developmental anomaly that usually begins from the central fossa of a tooth, extends over the cingulum, and continues apically for varying distances and directions [1–3]. Different studies have reported the prevalence rate of palatogingival groove to be 2.8–8.5% [3, 4]. The incidence in Chinese people [5] revealed a higher percentage of 18%, with an important racial link [6].

The palatogingival groove is most commonly observed in the maxillary lateral incisors, unilateral or bilateral [7, 8]. It can be of various depth and complexity. The groove is predominantly located on the distolingual surface of the root [9, 10]. Nevertheless, it can also be found on the mesial or distal surface as well as the facial surface of maxillary central incisor [11]. A case report showed a tooth having two grooves, one on the facial surface and another on the palatal surface [12]. It was reported that the groove can extend through the central side of the lingual surface or mesiolingual surface [13].

The terms of this developmental anomaly were inconsistent. Over the years, it has been known as the palatogingival groove [14], radicular lingual groove [15], distolingual groove [8], palato-radicular groove [5], developmental radicular anomaly [1], radicular groove [7], and cingulo-radicular groove [16] depending on extension, location, depth, and complexity of the groove.

The exact etiology of the groove remains ambiguous. Some scholars have speculated that the palatogingival groove is a mild form of dens invaginatus [17], resulting from an infolding of enamel organ and the Hertwig's epithelial root sheath before its calcification phase [2, 8]. However, others have claimed that it is an attempt of a tooth to form another root [1, 18]. A recent morphological analysis of the palatogingival groove has suggested that

an alteration of genetic mechanisms could be the reason [19]. In addition, it was also said that an undesirable position of the lateral incisors during the period of maxilla formation causes the groove. When the maxillary lateral incisor is a germ, it is surrounded by central incisor, canine, and the first premolar. Compared with the other teeth, this germ could be highly susceptible to folding because of the late start of the crown mineralization [20].

The palatogingival groove can be a predisposing cause for the inflammatory process in the periodontal and pulp tissues. Lee et al. [2] were the first to report the association between the groove and localized periodontitis. The funnel-shaped groove promotes bacterial plaque and calculus accumulation. Since it is impossible to be cleaned by the patient himself and even by the dentist [13, 15], it destroys the sulcular epithelium and deeper parts of the periodontal ligaments, finally resulting in a severe localized periodontitis [21]. Due to frequent occurrences of periodontal pocket and bone loss, the communication between the pulp chamber and the periodontium exists, and secondary pulpal necrosis of these teeth may precipitate the combined periodontal–endodontic lesions.

In this case, an interdisciplinary approach involving endodontic therapy, guided tissue regeneration (GTR), and papillary reconstruction was done to recover fistula, to heal the periodontitis, and to regenerate gingival papilla.

Case Report

A 23-year-old male patient reported to the Community Hospital, Tianjin, China, with a chief complaint of pus discharge in the upper front tooth for 3 weeks, and received endodontic treatment. Due to the poor result, the patient was referred to our department for further treatment. The tooth had a traumatic history before 3 years.

On examination, tooth #7 had an intact crown and no discoloration. There was a fistula on the mesiolabial aspect (Fig. 1) and an access cavity on the lingual surface likely from to show cause. The palatogingival groove was located on the cervical margin of the lingual surface (Fig. 2). The tooth had no pain on percussion, but was painful on palpation at the apical area. Paralleling technique intraoral radiograph showed a widening of the apical periodontium, as well as a protruding additional root in the main root with one canal at the mesial aspect of coronal 1/3. The additional root was surrounded by a large area of radiolucency (Fig. 3).

Periodontal examination revealed that the patient had a good oral hygiene. The gingiva was slightly tough and swollen. Plaque index (PLI) = 1 ~ 3; calculus index (CI) = 0 ~ 1; bleeding index (BI) = 0 ~ 2; tooth mobility

Figure 1. The initial intraoral facial view of the fistula at the mesiolabial aspect of tooth #7.

Figure 2. An access hole could be seen in lingual fossa, likelihood of distal gouging. A palatogingival groove at the palatal surface was located on the cervical margin of the lingual surface. The probing depth at this site was 6 mm.

Figure 3. The preoperative X-ray picture showed that apical periodontal widening of tooth #7, as well as the main root had a protruding additional root with one canal on the coronal 1/3 at the mesial aspect. The additional root was surrounded by a large area of radiolucency.

was I°; no pus. The probing pocket depth was shown in Table 1. The attachment level of tooth #7 was 4 mm.

Considering our clinical tests, the concluding diagnosis of tooth #7 was combined periodontal–endodontic lesions and a palatogingival groove. A multidisciplinary approach involved root canal treatment, periodontal initial therapy, root resection, GTR, bone grafting, aesthetic papillary reconstruction, supportive periodontal therapy, and follow-up regularly.

Root canal treatment: The tooth was isolated with a rubber dam without local anesthesia; an access cavity was prepared and established a straight-line pathway to the canal. The root canal was instrumented by ProTaper system (Dentsply Maillefer, Ballaigues, Switzerland) to working length by using an F3 master apical file (Dentsply Maillefer), following the manufacturer's manual. The canal was irrigated copiously with 3% sodium hypochlorite (Septodont, Saint-Maur, France) at 60°C between each instrumentation, and agitated with EndoActivator (Dentsply Tulsa Dental Specialties, Tulsa, OK) at 10,000 cpm for 1 min. One milliliter 17% ethylenediaminetetraacetic acid (META, Chungbuk, ROK) was used as a final rinse. After preparation, the root canal was dried with sterile paper points (Dentsply Maillefer), and calcium hydroxide paste (UltraCal XS; Ultradent Products, Inc., South Jordan, UT) was used as intracanal medication between appointments. The fistula was almost healed after 1 week, and on 2-week follow-up the patient was asymptomatic. Responses to percussion and palpation were normal and the fistula was resolved. Then, the canal was downpacked apical 2/3 with thermoplasticized guttapercha (Beefill; VDW, Munich, Germany) and AH Plus sealer (DeTrey Dentsply, Konstanz, Germany) using continuous wave technique. The radiograph revealed a satisfactory obturation (Fig. 4).

A week later, mineral trioxide aggregate (MTA) (ProRoot MTA; Dentsply Tulsa Dental) was placed at the coronal 1/3 of the root and over the orifice of the additional root canal under microscope, and the tooth was restored temporarily with zinc oxide non-eugenol filling material (Coltosol F; Colt_ene/Whaledent Inc, Cuyahoga Falls, OH). The patient was then referred to the department of periodontology.

Table 1. The probing pocket depth of tooth #7 before and after the operation.

Lingual	
Post op	3 3 3
Baseline	3 6 3
	7
Buccal	
Baseline	3 2 3
Post op	3 2 3

Figure 4. Three weeks later radiographic verification of the root canal filling is satisfied.

Periodontal treatment: Minimally invasive techniques including scaling, root planning, and open flap debridement were carried out under local anesthesia. During the operation, a groove running over the cingulum toward the root was found on the mesiopalatal aspect, and had formed an additional root at 6 mm under the cementoenamel junction. The alveolar crest at the mesiofacial aspect of tooth #7 was lost, and the residual alveolar crest at the distal aspect of tooth #8 remained. A large amount of alveolar bone involved under the alveolar crest around the additional root and furcation area connecting the labial and palatal aspects was destroyed (Fig. 5). The additional root was amputated and confirmed root length was 6 mm, about 1–2 mm in diameter, and with an evident apical foramen. Approximately 5×7 mm^2 and 6×7 mm^2 resorbable bilayer membranes BioGide (Geistlich, Pharma AG, Wolhusen, Switzerland) were, respectively, placed on the labial and palatal aspect of tooth #7. Then, the mixture of bovine bone mineral particles Bio-Oss (Geistlich, Pharma AG) and periocline (Sunstar INC 3-1; Asahi-Machi, Takatsuki, Osaka, Japan) was placed between the resorbable bilayer membranes. Finally, gingival flap was replaced, and sutured and periodontal pack was set.

One week after surgery, the tooth was permanently filled with composite resin (Filtek Supreme XT; 3M ESPE, St Paul, MN). At 1-month follow-up, the mesiolabial and palatal gingival papilla was slightly swollen and radiograph showed a reduction in radiolucency around the additional root.

Figure 5. (One month later) Periodontal surgery involved deep subgingival scaling, root planing, open flap debridement. On the operation, a groove running over the cingulum toward the root was found on the palatal aspect, and it formed an additional root at 6 mm under the cementoenamel junction (green arrow). The alveolar ridge crest at the mesiofacial aspect of tooth #7 was lost, and few residual crest at the distal aspect of tooth #8 was remained (black arrow). A large of alveolar bone involving under the crest, around the additional root and furcation area connecting the labial and palatal aspects was destructed.

At 3-month follow-up, the mesiopalatal gingiva and gingival papilla were not recovered to normal. The palatogingival groove was exposed clearly, the probing depth reduced to 3 mm (Table 1). There was marked postsurgical papillary loss involving the mesiolabial gingival papilla, resulting in the appearance of black triangle disease (Fig. 6).

Aesthetic papillary reconstruction was accessed at the restorative department. The composite resin restoration was used for restoring the proximal surface contour under mesial contact zone, shaping a good transition from crown to root which induces gingival papilla formation (Fig. 7). The groove restoration extended from cingulum to the part of subgingival area and the restoration surface was explored smoothly.

After 3-years of periodontal surgery (36 months after aesthetic papillary reconstruction), radiograph indicated that the alveolar bone density had returned to normal, alveolar lamina dura was forming, and the apical periodontal widening was resolved (Fig. 8). The patient was suggested to receive crown restoration, but he refused.

Figure 6. Three months after the periodontal surgery, there was marked recession involving the mesiolabial gingival papilla, resulting in the appearance of black triangle disease.

Figure 7. Three and a half months after the periodontal surgery, aesthetic papillary reconstruction was accessed.

Figure 8. Three years after the periodontal surgery (36 months) after aesthetic papillary reconstruction) Intraoral radiograph indicated that the alveolar bone density was returned to normal gradually, alveolar lamina dura was forming, and the apical periodontal widening was resolved.

Discussion

According to the classification of Gu [22], the palatogingival groove can be divided into three types on the basis of severity: Type I, the modest form. The groove is short, not over the coronal third of the root surface. The tooth has normal root canal configuration; type II, long and shallow groove extending beyond the coronal third of the root, corresponding to a normal or simple root canal. The anatomy of this groove is relatively complex. It usually shows a V-shaped cross-sectional configuration; type III, the most complex form which is difficult to diagnose and treat. The deeply invaginated groove extends over the coronal third of the root. C-shaped canal, invagination canal, and additional root at the mesial or distal aspect can be observed. The groove combined with the supernumerary root is considered to be the more severe form. Our case belongs to type III, having an additional root with one canal at the mesiolingual aspect.

The prognosis of the palatogingival groove depends on its depth, extent, and complexity. Various therapeutic options are recommended, such as the granulation tissue curettage [23], restoration of the palatogingival groove at the coronal aspect [24], endodontic treatment as primary or secondary lesion, and surgery procedures [3]. The surgery procedures involve additional root resection, radiculoplasty, GTR, and bone grafting [25–27]. The radiculoplasty is done to remove the root surface groove and change the wrinkled root form to the relatively flat and smooth normal root morphology by using hand curettes and rotary burs [28]. Whether or not to handle the groove was a controversial issue. Numerous cases recommended grinding and flattening the groove [25, 26], but others believed that only a flap procedure with removal of the granulation tissue, careful scaling, and root planning instead of odontoplasty were necessary to achieve new attachment [5, 23]. We deliberately carried out the groove restoration using composite resin without radiculoplasty in the case presented here. Three months after surgery, the probing depth reduced from 6 to 3 mm, and sustained until 3-year follow-up. The tooth recovered both morphologically and functionally.

In the present case, several potential causes of the combined periodontal–endodontic lesions in tooth #7 might be explained as follows. First, a diminished dentin thickness in the adjacent region of groove, which was shown on the microscopic analysis could cause pulp involvement [10]. Moreover, a rupture of the cementoenamel junction where the groove originated led to a communication between the periodontal tissue and the pulp [13]. Second, some reports have verified that accessory canals were found in incisors with palatogingival groove [11, 22], resulting in association with periodontal tissue. Last but not least, the probing depth at the groove was 6 mm. During the operation, we confirmed that the alveolar bone connecting the labial and palatal aspects around the additional root was lost. The additional root was amputated and easily removed, and it was inferred that no alveolar bone existed. The amputated root had an evident round apical foramen (unfortunately we did not take a picture), which allowed the penetration of microorganisms and its byproducts between the pulp cavity and the periodontium. Our finding was supported by Ingle et al. [29], a periodontal pocket caused by localized periodontitis extended to the apex, and gave rise to retrograde apical periodontitis. In addition, the tooth had trauma 3 years before, which may have facilitated the progression of the defect.

Before the periodontal operation, there was no existence of gingival recession. It could be inferred that the gingival papilla was supported by the residual alveolar crest of tooth #8 (Figs 3 and 4) and the additional root (Fig. 5). During operation, it could be seen that the alveolar crest at the mesiofacial aspect of tooth #7 was lost. Also, a large amount of alveolar bone involved under the crest, around the additional root, and whole furcation area was absorbed. It resulted in the formation of a hollow cavity after the removal of the additional root and the curettage of granulation tissue. Moreover, due to the limited capability of alveolar bone and cementum

Figure 9. Three years after the periodontal surgery (36 months after aesthetic papillary reconstruction), the black triangle disappeared and the gingival papilla maintained the height and contour.

regeneration, the lost bone could not recover completely, even after GTR and bone grafting. Consequently, it turned out to be postsurgical papillary loss between teeth #7 and #8, resulting in black triangle disease. It appeared 3 months after the periodontal surgery (Fig. 6) and mainly caused aesthetic deformities [30].

In the described case, black triangle might be caused by several factors. First, loss of periodontal attachment resulting in recession; second, loss of height of the alveolar bone related to interproximal contact; third, the distance between alveolar crest and contact point of teeth #7 and #8 also played an important role, if the vertical distance was 5 mm or less, the papilla was present almost 100% of the time [31]; fourth, poor cervical configuration at mesial and mesiopalatal surfaces. The adjacent surface contour under the mesial contact zone of tooth #7 revealed irregularities and the cervical root under the cementoenamel junction narrowed significantly.

Surgical and nonsurgical techniques have been proposed to regenerate interdental papilla [32]. The surgical techniques aim to recontour, preserve, or reconstruct the soft tissue between teeth [33]. The nonsurgical approaches (orthodontic, prosthetic, and restorative procedures) modify the interproximal space, thereby inducing modifications to the soft tissues. Based on the several reasons mentioned previously, all etiological factors were removed. GTR and bone grafting were conducted to allow the regeneration of alveolar bone, cementum, and periodontal ligament; minimally invasive restoration with composite resin was used for restoring the proximal surface contour under mesial contact zone, and shaping a good transition from crown to root and gingival papilla dynamic changes. Nine months after the restoration, the black triangle disappeared. At 3-year follow-up, the gingival papilla maintained the height and contour (Fig. 9).

Mineral trioxide aggregate possesses excellent sealing ability [34], biocompatibility [35, 36], and antibacterial property [37], especially due to blood contamination [38]. It can also promote the regeneration of alveolar bone [39] and cementum [40, 41]. This case made use of MTA to seal the root canal orifice of the additional root to prevent infections and blood flow to the main root canal during the periodontal surgery.

In this case, crown discoloration increased gradually from 2-week to 4-month follow-up after periodontal surgery and remained after 4-month follow-up. The discoloration was mainly located in the cervical 1/3 of the crown where MTA was placed. Therefore, reasons might be associated with the white MTA, as well as Periocline. White MTA contains iron and manganese, which have been reported as responsible elements for the discoloration [42]. The minocycline in Periocline, used for bone grafting, binds to tooth calcium ions via chelation to form an insoluble complex, which causes tooth discoloration [43, 44]. For discoloration, prophylactic, bonding agent, or flowable composite were recommended to be applied on the coronal access cavity wall to coat dentinal tubules [45].

Conclusion

An interdisciplinary approach can bring hope for the maxillary lateral incisor with combined periodontal–endodontic lesions caused by palatogingival groove and additional root.

The treatment outcomes that have been achieved in this case are the probing depth reduction from 6 to 3 mm, aesthetic papillary reconstruction, and the disappearance of the radiographic radiolucency area.

Removal of all etiological factors is the key to the clinical success. A series of procedures including root canal therapy, MTA filling, root resection, GTR, bone grafting, and aesthetic papillary reconstruction were chosen to treat the right maxillary lateral incisor.

Unfortunately, the crown had discoloration.

Conflict of Interest

None declared.

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