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Management of a complex palato-gingival groove on a maxillary lateral incisors with an integrated regenerative - modified re-implantation technique: 4 year follow-up

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Abstract:
Palato gingival groove (PGG) is an extremely unusual developmental defect that is most commonly present on the palatal surface of maxillary teeth. PGG forms as the central fossa passes the cingulum and persists in an apical axis for variable distances. The flaw is hidden from cleaning attempts and provides an ideal environment for plaque or calculus to accumulate. If the issue is not addressed, it can lead to a slew of periodontal problems, including attachment loss, pocket formation, and progressive bone loss. Clinicians must choose a way to eradicate the causal pathologic cause and obtain a favourable outcome from the different therapeutic alternatives available. A unique approach for the management of PGG is described in this case report. It is a trustworthy alternative that provides proper physiology, anatomy, and quality of life while delivering satisfactory results.

Keywords: *Endodontic, Palato gingival groove, Modified reimplantation, SynOss putty*

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I. Background:

PGG emanates when the central fossa crosses the cingulum and extends in an apical direction to varying distances. Several etiologies have claimed its development, which include: (1) the infolding of oral epithelium and the epithelial root sheath of Hertwig mimicking a mild type of dens invaginatus[1], (2) an interrupted attempt at the creation of an additional root on the affected tooth, and (3) the modification of genetic mechanisms and racial relation has recently been reported[3]. Formed as a conduit, the defect is veiled from the cleaning efforts and acts as an ideal environment for plaque or calculus accumulation; which can lead into localized periodontal inflammation and progress as a pathway along the tunnel/fissure[3,4]. When the defect remains unresolved, a multitude of periodontal consequences, including attachment loss, periodontal pocket formation, and progressive bone loss, may be preceded. Besides this, the development of combined endodontic-periodontal lesions may well be predisposed to endodontic participation secondary to bacterial invasion from these attachment areas[5]. The incidence of PGG varies from 2.8% to 18%, with the aforementioned contributing to evidence of an especially high incidence in the Chinese population[6]. In 1991, Goon et al. classified PGG into broad groups, simple and complex grooves. While a simple groove partly connects the root canal with the periodontium and therefore does not extend in depth, a complex groove directly connects the root canal with the periodontium and stretches longitudinally across the root canal[7]. The outcome of a PGG tooth depends on multiple factors: groove position, magnitude of the underlying periodontal disease, proximity to the region of the defect, and groove type (shallow/deep or long/short)[8]. In 2003, Kerezoudis et al. discussed the treatment procedures needed in cases of relatively shallow PGG: (i) surgical removal of granulation tissue as well as toxic substances, (ii) gingivectomy and apical flap, (iii) surgical exposure and groove flattening by grinding, with or without the use of directed tissue regeneration techniques, (iv) restored groove positioning, (v) orthodontic extrusion of the tooth[9]. Clinicians have to select a strategy to remove the causative pathological factor and obtain a desirable outcome among the numerous proposed treatment options. Few researchers have reported good clinical results with intentional replantation for more complex cases[10]. To achieve complete removal of the groove and subsequent reimplantation, intentional removal of a defective tooth. Appropriate case selection, the pathogenesis of the infected tooth and the IR indication would also have a remarkable effect on the prognosis[11]. The additional oral time taken to repair the tooth will impact the IR prognosis directly. Manipulation and disruption to the periodontal ligament, cementum and related cells in order to maintain the cells alive should also be kept to a minimum. There are case studies of active follow-ups in the long term (as long as 15 years). It

has been shown to be more effective in the IR of teeth that are hermatically sealed with a retro or orthograde root end filling[11,12]. The purpose of the procedure is to achieve sufficient root surface sealing in order to avoid contact between the periodontium and the root canal. The purpose of this case report is to present a novel technique where the affected tooth is extracted atraumatically, granulation tissue removed and the root canal and PGG sealed using Biodentine extra orally, regenerative scaffold placement in the alveolar sockets and reimplanted at horizontal 180 degree rotation. The clinical and biological benefits of the technique are presented and discussed as well.

II. Case Description:

A 27 year old male patient reported to the Outpatient Department, with a chief complaint of intermittent pain and discharge in the left upper front teeth region for 6 months. No history of trauma was given. During the clinical examination, the left maxillary lateral incisor (#22), discolored with negative vitality testing and positive to percussion. Examination on palatal aspects revealed a palatogingival groove which was extending deep into the apical region. To confirm the groove extension, CBCT scan reports were taken and it revealed a complex groove which communicating with the root canal and periodontium and extends lengthwise through the root till its apex. Radiographically, a pear shaped radiolucency was evident in the coronal aspect with apical periodontal widening (Fig 1a,b,c,d).

Based on the clinical, radiographic and expectations of the patient, the following treatment plan was proposed: scaling and root planning to eliminate the subgingival calculus, Initial intracanal antibiotic medication to eliminate bacteria, minimally invasive extraction of upper left lateral incisor, sealing of palatogingival groove, replantation with intentional horizontal 180 degree rotation of the tooth followed by splinting. The procedures were carefully explained to the patient, who understood the benefits and risk of the proposed treatment plan.

After the oral prophylaxis, cleaning and shaping were performed using crown-down technique up to apical file size 50. Root canals were irrigated using 3% of NaOCl and 17% EDTA and calcium hydroxide dressing was given (Fig 2a,b). On the second appointment, complete extra oral and intra oral mouth disinfection was done with betadine, local anesthesia was administrated (lignocaine 2% with epinephrine 1:80,000). A minimally invasive extraction of upper left lateral incisor was performed (Fig 3a). The tooth was held firmly between thumb and index finger, 3 mm of root end was resected (Fig 3b), both the root canal and palatal gingival groove was sealed using Biodentine (Fig 3c,d). Inorder to have the cells viable, the tooth was placed in a preserving medium intermittently for an interval of 5s (Fig 3e). The granulation tissues were removed and the alveolar sockets were cleaned using betadine and saline. The SynoOss putty was mixed with patient blood and used as a scaffold in the alveolar socket towards the affected defective region (Fig 4a). The tooth which remained outside of the socket for 8 minutes, was then replanted with a 180 degree rotation using mild digital pressure (Fig 4b). A composite wire splinting was given on the palatal aspect of maxillary anterior teeth for a period of 6 month (Fig 4c). Follow-up examination done in an interval of 2 months period of time. Splinting was removed after 6 month, upon clinical examination Grade 1 mobility was present. The splinting continued for another 2 month and it remained stable and he was asymptomatic postoperatively after its removal. The patient was instructed to use 0.12% chlorhexidine post surgically twice a day for 5 weeks. Oral prophylaxis was performed every months for 1 year. Post operative CBCT scan was performed to assess the status of the teeth. It showed reduction in the size of the lesion surrounding the teeth, remodeling of bone was evident (Fig 5a). This case was followed for 4 years and the teeth was functional and patient was asymptomatic (Fig 5b,c).

III. Discussion:

The rationale behind the selected treatment plan was the following:

1. To prevent bacterial colonization and plaque accumulation on the palato-gingival groove and its subsequent complications.
2. Other treatment options such as following:

a) The non-surgical root canal treatment cannot be performed in this case since the groove has a direct communication with periodontal tissue, canal debridement was not feasible.

b) Second treatment option was surgically reflecting the flap. It was a complex groove that communicates the root canal with the periodontium directly and extends lengthwise through the root. Reflecting the palatal flap till the end of the root could leads to violation of periodontal supporting tissue.

3. A Minimally invasive extraction followed by apicectomy, sealing of both groove and root canal with biomineralizing material such as Biodentine was performed.
4. SynOss putty mixed with patient blood and used as a scaffold in the alveolar socket to promote tissue formation and mineralization.
5. A 180 degree horizontal rotation technique was used to reimplant the teeth which was performed to keep the healthy side of the tooth in contact with the bone defect.

Palatogingival groove is a morphological aberration known to frequently affect maxillary incisor teeth with a rate of affliction seen to be higher in lateral incisors (4.4-5.6%) compared to central incisors (0.28-3.4%). Severity and complexity of the pathology developing secondary to the groove is greatly dictated by its depth, extent, and tortuousness.[13] Goon et al. have classified palatogingival grooves as simple and complicated. Simple grooves are less likely to cause severe destruction as they do not communicate with the pulp and represent only a minor infolding of the Hertwig's epithelial root sheath. On the contrary, complicated grooves communicate with the pulp cavity either laterally or apically owing to their severe depth and extent on the root. They are more likely to precipitate complex endo-perio lesions, have guarded prognosis, and management in most cases demands an interdisciplinary approach.[7] In our case, palatogingival groove existing on the lateral incisor was classed as complicated/Type III[14] since it was judged to extend more than two-thirds the length of the root. This was apparent on radiographic and CBCT examination. Pulp in the affected lateral incisor in our case was necrotic; hence there was a need to institute endodontic treatment. The current philosophy for PGG treatment is based on surgical procedures that allow defect sealing either by performing an intentional replantation and repairing the defect of the extracted tooth or by a decision made during the surgical procedure and repairing under direct observation.[15]After taking informed consent from the patient a minimally invasive extraction has been performed. The advantage is that the clinician can debride the morbid parts of the root thoroughly by performing extraorally and under direct vision.[16] Biodentine was used to obturate the root canal and to seal the groove, since it has proven bioactive properties, is known to promote hard tissue regeneration and is biocompatible. In addition to documented uses of biodentine in diverse clinical applications like orthograde and retrograde filling material, perforation repair, pulp capping and pulpotomy; our case also shows successful application of Biodentine in management of complicated palato gingival groove similar to reported cases by Johns et al. and Liji and Rameshkumar.[17,18] SynOss putty was mixed with patient blood and used as a scaffold in the alveolar socket to promote tissue formation and mineralization. This material was recently introduced as a scaffold in clinical use for RET. It is a Food and Drug Administration–approved substance (https://www.accessdata. fda.gov/cdrh_docs/pdf7/K072397.pdf) with a base of bovine type 1 collagen combined with calcium phosphate–based mineral particles within a carbonate apatite structure. Collagen-based scaffolds similar to SynOss were used to revitalize pulpless teeth and to induce root development in monkeys and humans.[19,20] In a case series study, Nevins and Cymerman showed successful results using SynOss Putty as a scaffold in RET of immature teeth with pulp necrosis. Nosrat et al showed predictable tissue formation and mineralization using SynOss Putty mixed with blood in RET in noninfected human teeth with open apices.. The results were showed the formation of intracanal mineralized tissue with a histologic structure like bone.[19,20]

The biological rationale behind the 180 degree rotation we performed is that the repaired PGG was put in direct contact with the healthy bony wall that had not been affected by the periodontal defect, which aided in bone growth at the contact area between the bone defect from the PGG and the unaffected radicular wall. By rotating the tooth, the remnants of the healthy PDL on the root faced the connective tissue in the alveolus at the sites that were initially compromised, which effectively reduced the defective diseased area by half. Based on the literature, we expected expedited reattachment of the tissues during the early stage of the healing process after the replantation.[21] In 2001 Sugaya et al. and Kawanami et al. successfully demonstrated the reliability of the intentional replantation of a rotated tooth for the treatment of endo-periodontal explained that rapid reinsertion achieved inhibition of the formation of the long junctional epithelium and its subsequent periodontal pocket when the tooth is rotated. This tissue exhibited adequate bone healing with recovery of the alveolar bone height due to the absence of bacteria.[22,23]By doing this rotating replantation, the remaining healthy periodontal ligament (PDL) approximated the alveolus with connective tissue at the site where periodontal breakdown took place. The biological result was that prompt attachment of the tissues occurred, preventing apical migration of the gingival epithelium during the early stage of healing.

Factors that encourage healing include reduction in extra oral time, atraumatic extraction/re-insertion, prevention of damage to tooth roots, adequate apical seal incases of depth, material compaction and characteristics aswell as suitable case selection. It is essential for periradicular healing process and prevention of resorptive process such as replacement resorption, ankylosis, internal and external root resorptions.[24] Biomaterials may help to make IR a more standard form of therapy, in the right hands. If the long term prognosis of this treatment proves to be high, it may rival success rates of other treatment modalities and possibly be offered as routine treatment.

In the present case success can be related to bacterial elimination, Minimally invasive extraction of teeth, sealing of groove with biodentine, placement of SynoOss putty regenerative scaffold material in the alveolar socket and reimplantation at 180 degree horizontal rotation technique.

IV. Conclusion:

With careful case selection and suitable training, IR can have a high success rate with bioregenerative material and be far less expense than other treatment options and an interdisciplinary approach combining endodontic treatment and surgical therapy most often needs to be instituted when managing such type of complex cases.

Clinical significance: This new technique represent a reliable alternative for the management of PGG showing satisfactory results by providing adequate physiology, anatomy and quality of life. If the long term prognosis of this treatment proves to be high, it may rival success rates of other treatment modalities and possibly be offered as routine treatment.

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Figures

Figure 1a,b,c,d

Figure 1a,b:Pre-operative x-ray, 1c,d:CBCT images at coronal 3rd,apical 3rd cross section

Figure 2 a,b

Figure 2a:bleeding from periodontal tissues, 2b:PGG

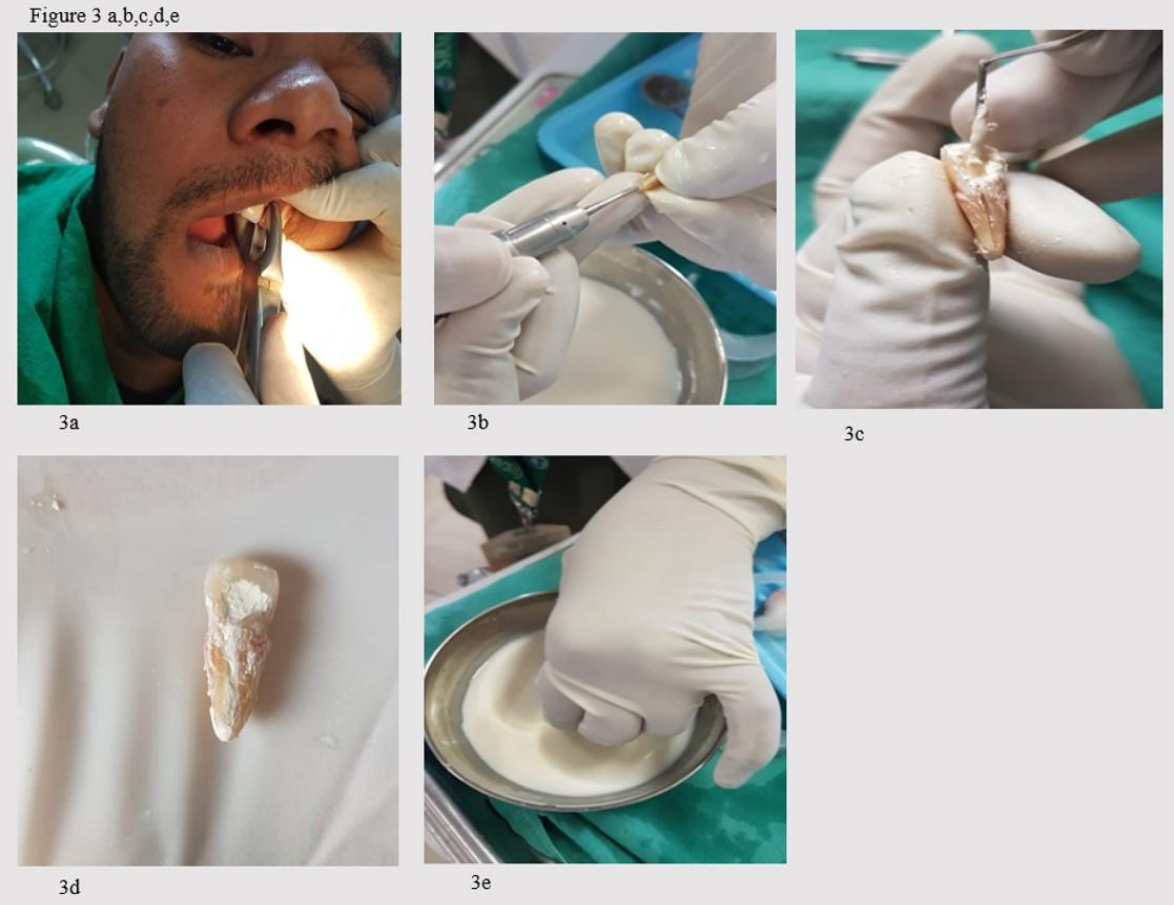

Figure 3a,b,c:Minimally invasive extraction, apicectomy, root canal is filled, 3d,e: Retrograde filling done with biodentine, teeth is placed in a medium

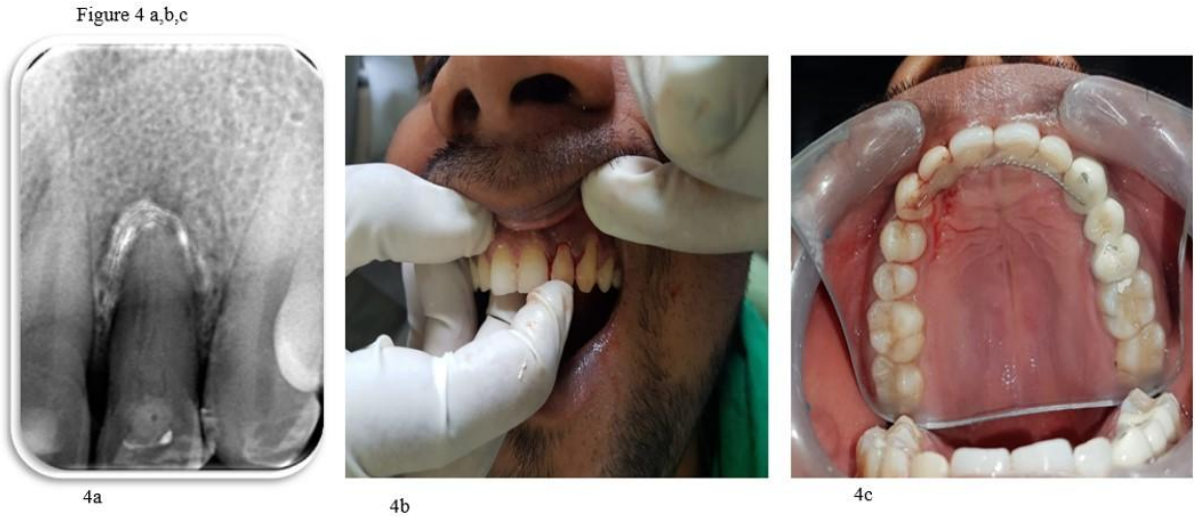

Figure 4a,b: SynOss putty placed, teeth is re-implanted at 180 degree rotation, 4c:composite splinting given

Figure 5a,b,c

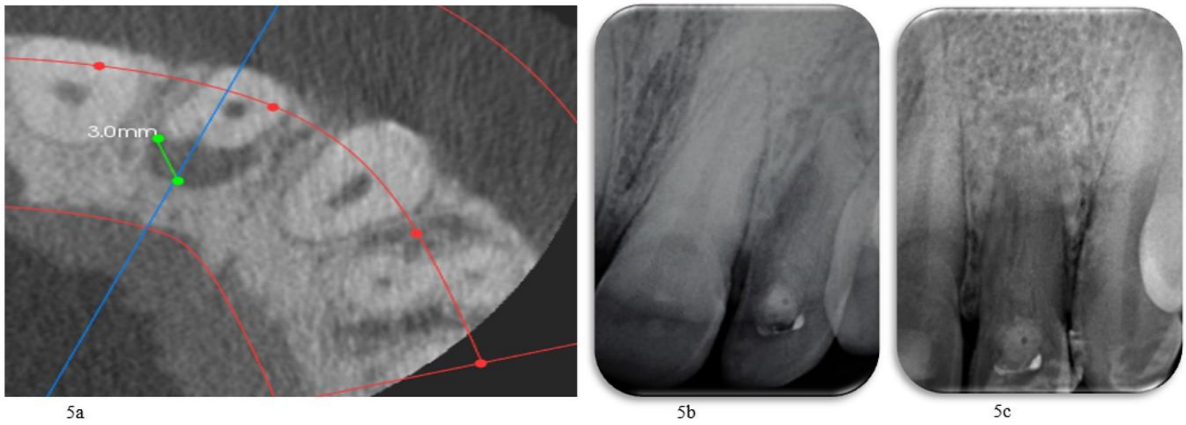

Figure 5a:size of the lesion after 6 month, 5b,c:after 4 year

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