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CASE REPORT

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CBCT Diagnosis of Palatogingival Groove in the Maxillary Central Incisor: A Case-Based Review

Diagnóstico por CBCT de surco palatogingival en el incisivo central maxilar: una revisión basada en casos

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ABSTRACT: The palato-gingival groove (PGG) is a variation of normality characterized by a fissure along the root of the anterior-superior teeth, in which late detection could result in clinical-related complications. A 16-year-old female underwent a cone-beam computed tomography (CBCT) for an orthodontic evaluation to assess the presence and position of impacted maxillary canines. CBCT revealed the presence of a PGG in the upper right central incisor. Clinically, a sulcus was detected in the cingulum region, accompanied by gingival inflammation. In tomographic sections, the extension of the sulcus from the cingulum to the apical third was observed. A periodontal approach was performed, followed by an 18-month follow-up. At this follow-up, no clinical evidence of gingival inflammation was observed, characterizing a favourable prognosis. PGG is an unusual variation that affects maxillary anterior incisors. The early detection of this sulcus, performed only by CBCT, is associated with a favourable prognosis.

KEYWORDS: Cone-Beam computed tomography; Tooth abnormalities; Anatomy.

RESUMEN: El surco palato-gingival (SPG) es una variación de la normalidad caracterizada por una fisura a lo largo de la raíz de los dientes anterosuperiores, cuya detección tardía podría dar lugar a complicaciones clínicas. Una joven de 16 años se sometió a una tomografía computarizada de haz cónico (TCHC) para una evaluación ortodóncica con el fin de evaluar la presencia y posición de caninos maxilares impactados. La TCHC reveló la presencia de un SPG en el incisivo central superior derecho. Clínicamente, se detectó un surco en la región del cíngulo, acompañado de inflamación gingival. En los cortes tomográficos se observó la extensión del surco desde el cíngulo hasta el tercio apical. Se realizó un abordaje periodontal, seguido de un seguimiento de 18 meses. En este seguimiento, no se observaron evidencias clínicas de inflamación gingival, lo que caracteriza un pronóstico favorable. El SPG es una variante inusual que afecta a los incisivos anteriores maxilares. La detección precoz de este surco, realizada únicamente mediante TCHC, se asocia a un pronóstico favorable.

PALABRAS CLAVE: Tomografía computarizada de haz cónico; Anomalías dentarias; Anatomía.

INTRODUCTION

Dental anomalies of permanent dentition are changes that occur during tooth development and are usually associated with environmental and genetic factors (1). Shape variations are most prevalent in maxillary incisors, including peg shape, dens invaginatus, gemination, fusion, accessory root, and presence of a palato-gingival groove (2).

The palato-gingival groove (PGG) is a dental shape variation initially described by Black in 1908 as a root groove that begins in the central fossa of the palatal root, extends over the cingulum and continues apically across the root surface (3). Although reports of PGG in molar teeth are scarce, studies suggest a higher prevalence in upper incisors (2). The overall prevalence of PGG varies from 2% to 10% in the literature (4-6). In this context, PGG is more prevalent in lateral incisors (4.4%-5.6%) than in central upper incisors (0.28-3.4%), regardless of race and sex (2). The classification of the location and extent of PGG has been previously reported in the literature (3,7). PGG is classified according to clinical location (distal, mesial, or central), complexity (mild, moderate, or complex), and depth of the groove (shallow, deep, or closed tube). Furthermore, the PGG degree of severity is tomographically classified as short (type I), long but shallow (type II), or long and deep (type III) (7). In this context, the early detection of PGG has a strong impact on the prognosis of this condition, especially regarding susceptibility to endodontic and periodontal disorders (2,8).

The prognosis for PGG is determined by the clinical complications associated with groove extension (9). Endodontic and periodontal diseases may develop due to the accumulation of plaque and microorganisms in the groove. The microorganisms inside the groove are well-characterized as a polymicrobial community (10), and can lead to pulpal necrosis, periapical lesions, periodontal pockets, and sinus tracts, causing unfavorable clinical outcomes (7). In this context, management depends on the PGG stage observed during clinical and imaging examinations. These exami-

nations guide clinicians in choosing the best treatment approach.

The use of two-dimensional imaging examinations, such as intraoral radiographs, is important in determining the location, size, extent, and depth of the PGG. However, these examinations produce poorly detailed, overlapping images, which can compromise the detection and analysis of these structures. In this context, three-dimensional images obtained by cone beam computed tomography (CBCT) are more accurate and detailed, allowing precise assessment, diagnosis, and follow-up (7). Indeed, previous studies have used CBCT for the classification and diagnosis of PGG (11-13). However, there are a few published studies that reported the use of CBCT in PGG examination. Therefore, this study reports a clinical case of PGG located in the maxillary central incisor that was diagnosed by CBCT and reviews the literature on the clinical and radiographic features and treatment strategies for PGG.

CASE REPORT

A 16-year-old female patient was referred for dental care with indications for orthodontic treatment and the presence of impacted maxillary canines. During anamneses, the patient reported no systemic diseases. The patient had no deleterious habits in her dental history, such as bruxism. The intraoral examination confirmed the absence of maxillary canines (Figure 1. A). Moreover, a fissure was observed on the cingulum of the maxillary central incisor, accompanied by gingival inflammation on the palatal aspect (Figure 1. B). Pulpal vitality of the maxillary central incisor was positive, without the presence of mobility and pain on the percussion test.

A CBCT scan was requested to evaluate the possibility of traction of the maxillary canines. The exam was performed with the following acquisition parameters: FOV: 5X5, kVp: 85.0, mA: 08.0, and resolution of 75 micrometers using Eagle 3D equipment (Dabi Atlante, São Paulo, Brazil). A CBCT scan revealed the presence of PGG in the upper right central incisor, which was classified as type III (Figure 2). The sulcus was observed from the cingulum extending vertically toward the apical third of the medial-palatal surface (Figure 3). No communication of the sulcus with the root canal and adjacent bone was detected, Hypodense periapical or bone defects were not present.

Considering the increased susceptibility to periodontal complications from PGG, a basic periodontal approach (dental prophylaxis) was performed, followed by orientation on the possible retention of biofilm in the PGG region. It was recommended that the patient perform hygienic procedures more carefully in this region. At the 9-month follow-up, no clinical signs of gingival inflammation were observed. Likewise, no gingival changes or other PGG-related complications were observed at the 18-month follow-up.

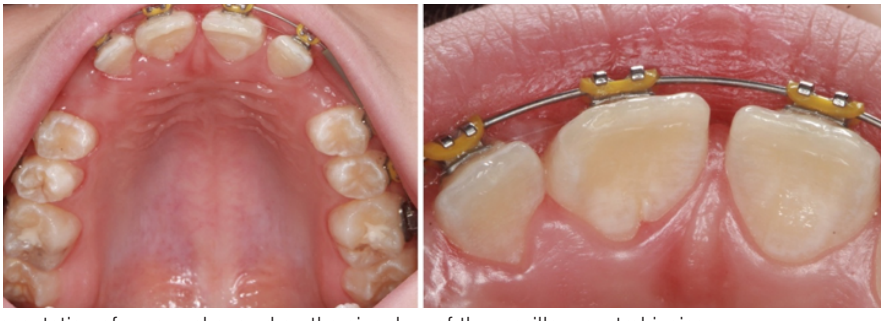

Figure 1. Clinical presentation of groove observed on the cingulum of the maxillary central incisor.

Figure 2. Adjusted and enlarged axial sections of cone-beam tomography involving (a) cervical, (b) medium, and (c) apical third.

Figure 3. Three-dimensional representation of palatogingival groove extending vertically toward the apical third.

LITERATURE REVIEW

A structured electronic search was performed on 7th May 2022 to assess the PGG features reported in the literature. The search encompassed articles in English without a timeline limitation in the following databases: MEDLINE/PubMed, Scopus, Embase, and Google Scholar. The search strategy was similarly reproduced and adapted in four databases, including the following terms: "palato-gingival groove" OR "palato radicular groove" OR "disto lingual groove" OR "corono radicular groove" OR "radiculo lingual groove". We selected only case reports or case series that described demographic characteristics, clinical and radiographical features, treatment modality, and follow-up. Reviews, book chapters, abstracts, clinical and observational studies, and studies for which the full text could not be found were excluded. Rayyan® software was used for the exclusion of duplicates and article screening.

DISCUSSION

After the literature screening process (Figure 4), 40 studies were included reporting a total of 58 cases (Table 1). The literature search suggested that this is the sixth reported case of PGG diagnosed with CBTC and the twelfth reported case involving the maxillary central incisor. The prevalence

of PGG in maxillary central incisors varies from 1.6% to 3.4% and is considered a rare condition (2). Our case demonstrated a PGG located in the mild palatal site extending from the cingulum to the apical third. The PGG features observed in this case were consistent with prior evidence from the literature. A previous study supported these characteristics, reporting that 50% of PGGs are located in the midpalatal region (12). In addition, most patients affected by PGG were female with ages ranging from 8 to 55 years, consistent with our case. The indication of CBCT imaging for PGG detection remains poorly reported in the literature. Rather, most prior cases were diagnosed using periapical radiographs, potentially impacting a precise diagnosis and classification of PGG.

Two-dimensional imaging could help the initial diagnosis of PGG; however, CBTC is preferred due to the three-dimensional images provided, which allow for evaluation of the relationships between the tooth anatomy, groove, and adjacent structures (11). Due to the lack of internal/external tooth anatomy and geometric distortion provided by periapical radiography, two-dimensional imaging approaches are less accurate for diagnosis (12). In the present case, the PGG visualized by CBTC scans revealed a groove that originated in the central fossa and continued distally to the apex, interrupting the margin and the tubercle, and possibly extending beyond the cementoenamel junction to reach the apex. Only CBTC imaging can classify PGG according to its degree of severity (14). In this context, based on CBTC imaging features, our case illustrated a long and deep extension of the groove classified as type III. In contrast, previous studies more commonly reported type I severity in PGG cases (12,15,16,17). Type III represents a greater diagnostic and therapeutic complexity of PGG (11); however, our case suggests that early detection could improve overall prognosis. Although PGG is a rare condition, CBTC helps to identify the shapes and sizes of PGGs, and it is important to emphasize management by a dental professional to decrease clinical-related complications of PGG.

The differences in PGG shapes and sizes are directly related to clinical complications. The numerous clinical characteristics of late PGG often lead to endodontic and periodontal disease. In this context, clinicians should understand the clinical features of PGG to ensure prompt diagnosis (18). Depending on the PGG extension and depth, communication with the root canal may lead to endodontic complications, such as pulp diseases and periapical inflammation. Furthermore, PGG is considered a predisposing factor for localized periodontal breakdown (12). The relevant clinical sign exhibited in this case was mild inflammation of the palatal gingiva of the maxillary central incisor. Our literature search identified frequent reports of clinical PGG-related complications, such as the presence of enamel discoloration, gingival inflammation, periodontal pockets, pulp necrosis, and tooth mobility. Furthermore, the sinus tract may be present in advanced cases due to root canal and bone infection. Consequently, in advanced cases, the tooth may require extraction due to severe bone loss. PGG can hinder local hygiene, leading to the development of an inflammatory process in periodontal tissue, and can be considered a predisposing factor for periodontal disease (12). In this context, patients diagnosed with PGG should be educated on the importance of good oral hygiene practices and periodic dental visits for the prevention of periodontal disease.

PGG treatment depends on the groove stage, extension of bone defects, and associated periodontal/endodontic diseases (12). In most PGG cases, management comprises multimodal therapy to extend tooth life (19). Management aims to reduce microorganisms, seal the groove, and improve periodontal regeneration (7). A basic periodontal approach (prophylaxis and root planning) is recommended in cases where only gingival inflammation is present. Initial PGG cases (mild complexity), as

in our case, have a good prognosis with a positive response to basic periodontal approaches. Our patient followed the hygiene recommendations and was aware of the clinical complications that could arise from the deleterious morphological defect. In this context, our proposed treatment controlled the progression of the disease.

Moderate and advanced PGG cases can present with tooth mobility and deep grooves. The management of PGG presents a clinical challenge that requires a multidisciplinary approach to treatment. Therapeutic options for moderate PGG cases include scraping the affected tissues, rounding the site in cases of shallower grooves, sealing the groove using a variety of materials, and primary or secondary endodontic therapy. For advanced cases, management involves surgical procedures such as flap periodontal surgery or tooth extraction in cases of unsuccessful treatment. In addition, intentional implantation has been reported in several advanced cases with good results (20,21,22). However, intentional implantation is generally not a good therapeutic approach because these can fail and leave a pathway for bacterial infection (23). Although advanced cases have a poor prognosis, a multidisciplinary approach to treatment can achieve bone regeneration and establish favorable clinical conditions to maintain the tooth without any signs of the periodontal pocket and tooth mobility.

Although rare, dentist clinicians should be aware of the occurrence of PGG in the maxillary central incisor. Early detection is determined by an association between clinical examination and CBTC analysis. CBTC is the only imaging examination capable of detecting PGG and providing information on the precise location, extension, and depth features of the defect. The use of CBTC can guide professionals in choosing the best therapeutic approach for a favorable tooth prognosis.

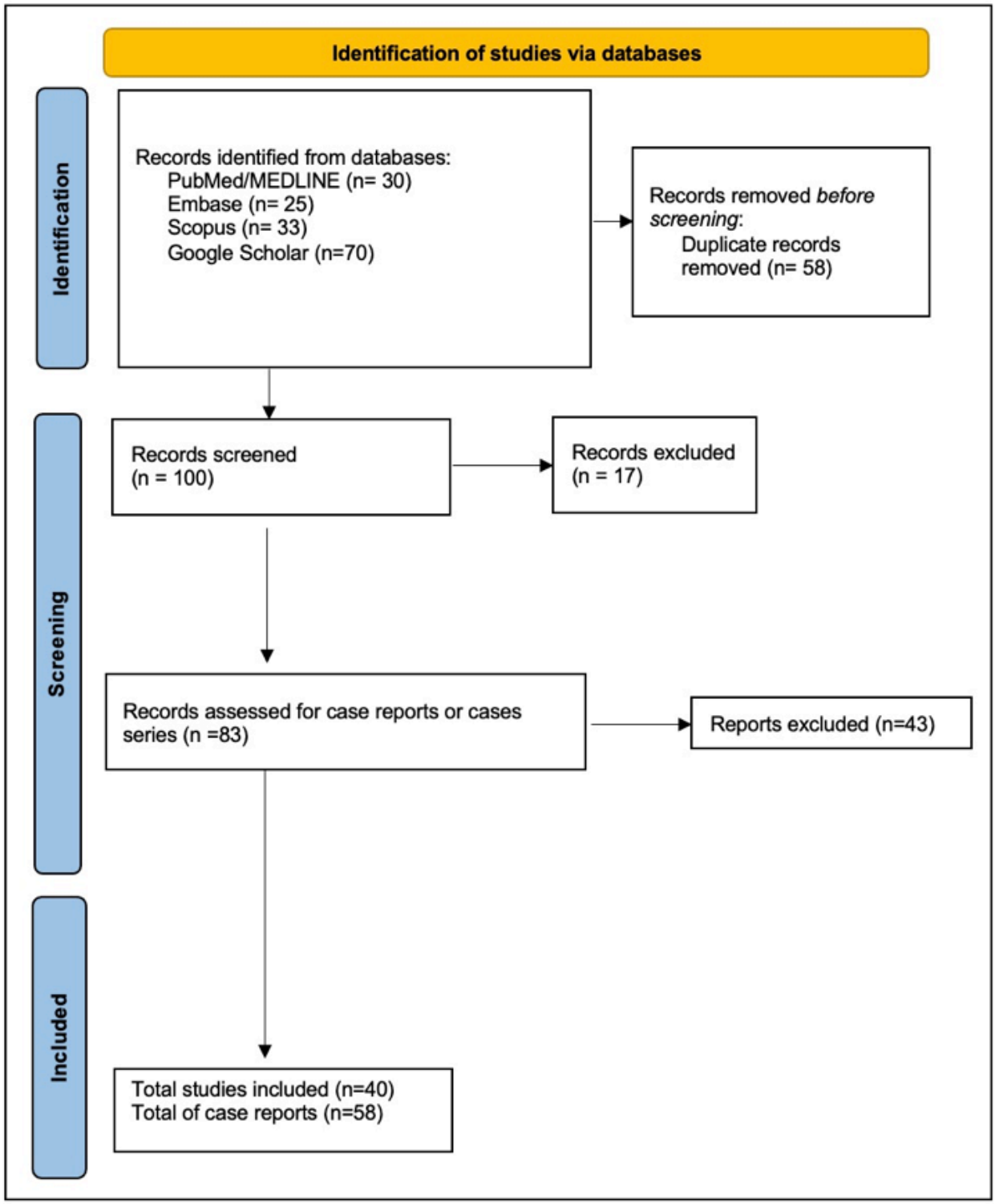

Figure 4. Schematic representation of structured review flowchart.

Table 1. Clinical and radiographic features of PGG according with included case reports (n= 58 cases).

	N (%)
Age M±SD (R)	31.2±7.7 (8-55)
Gender	
Female	31 (53.4)
Male	26 (44.8)
NI	1 (1.7)
Maxillary anterior incisor	
Maxillary central	11 (18.9)
Maxillary lateral	47 (81)
Clinical features of PGG	
Location	
At coronal third	3 (5.1)
At mild-palatal	4 (6.8)
At disto-palatal	3 (5.1)
PGG with intact crown without clinical related complications	7 (12)
Extension	
Extending from cingulum to the apical third	16 (27.5)
Extending from cingulum to mid-root third	4 (6.8)
Extending from CEM to the apical third	2 (3.4)
NI	19 (32.7)
Clinical-related complications	
Periodontal pocket (mm) (M.SD)	7.9 3.9
Gingival inflammation	22 (37.9)
Pulp necrosis	33 (56.8)
Tooth mobility	18 (31)
Grade I	9 (50)
Grade II	8 (44.4)
Grade III	1 (5.5)
Enamel discoloration	5 (8.6)
Pain associated with percussion test	2 (3.4)
Sinus tract	19 (32.7)
Imaging examination	
Periapical radiograph	46 (79.3)
CBTC	5 (8.6)
Spiral-CT	1 (1.7)
NI	6 (10.3)
Radiographic description of PGG	
Parapulpal radiolucent line	14 (24.1)
Radiopaque line	1 (1.7)
NI	43 (74.1)

Radiographic complications	
Vertical bone loss	10 (17.2)
Radiolucent area tooth-associated	28 (48.2)
Periapical	23 (82.1)
Distal	4 (14.2)
Mesial	1 (3.5)
Treatment modality	
Tooth extraction	3 (5.1)
Only endodontic therapy	2 (3.4)
Only periodontal surgery	13 (22.4)
Endodontic and Periodontal surgery associated	40 (68.9)
Follow-up (months) (M±SD)	16±22

PGG, palato-gingival groove; R, range years; NI, not informed; CBTC, cone beam computed tomographic.

CONCLUSION

Our case-based review illustrated the ongoing challenges of diagnosing PGG, especially in choosing the method of imaging examination. Although PGG can be detected in two-dimensional imaging, CBTC is more precise in diagnosis, staging, and characterization of the groove in the maxillary anterior incisor. Clinicians should request this exam to improve the diagnosis, treatment, and prognosis of the patient.

AUTHOR CONTRIBUTION STATEMENT

Conceptualization and design: G.C.N.F., M.C. and A.R.F.
Literature review: A.R.F., C.M.P., N.M.R., F.B.O. and L.B.Z.
Formal analysis: A.R.F., C.M.P., N.M.R. and F.B.O.
Investigation and data collection: A.R.F., C.M.P., N.M.R. and F.B.O.
Resources: A.R.F., C.M.P., N.M.R. and F.B.O.
Data analysis and interpretation: A.R.F., C.M.P., N.M.R. and F.B.O.
Writing-original draft preparation: A.R.F., C.M.P., N.M.R. and F.B.O.
Writing-review & editing: M.C. and G.C.N.F.
Supervision: M.C. and G.C.N.F.
Project administration: M.C. and G.C.N.F.

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