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Radicular grooves of maxillary anterior teeth in a Turkish population: A cone-beam computed tomographic study

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ABSTRACT

Objective: There is limited data on the use of cone-beam computed tomography (CBCT) scanning in examining radicular groove (RG). This study aims to investigate the presence of RG in maxillary anterior teeth in a Turkish Population using CBCT scanning and to correlate the findings with the tooth type, and patient's gender.

Design: A total of 1969 CBCT images of maxillary anterior teeth obtained from 342 patients were included in the study. Patients' age and gender, the tooth type (central/lateral incisor, canine), and the presence/absence, bilateral/unilateral diversity, and type of RG were recorded. The RG type was categorized using Gu's classification. Statistical analysis was carried out to correlate the findings with tooth type, and gender using the χ^2 test ($p = 0.05$).

Results: RGs were detected in 4 (0.6%) central incisors, 15 (2.3%) lateral incisors, and 0 canines. The frequency of RGs in males was higher than in females. There were statistically significant differences among the different tooth types in terms of the presence of RGs ($p < 0.001$). Statistical analysis also revealed a significant difference between the males and females in terms of the presence of RGs ($p = 0.003$).

Conclusions: The prevalence of RGs was statistically higher in males than in females and in lateral incisors compared to central incisors. CBCT may be recommended as an effective diagnostic device to identify RGs.

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1. Introduction

The radicular groove (RG), first described by Black in 1908, is a developmental malformation that occurs near the cingulum of a tooth and extends along the root to varying lengths.[1] Although the exact aetiology of the RG remains unclear, alteration of genetic mechanisms, enfolding of the enamel organ and Hertwig's epithelial root sheath, and the effort required to form another root are considered as causal elements for RG.[1–5] Synonyms of this malformation include the palatogingival groove,[6] the palatal groove,[7] the radicular lingual groove,[8] the distolingual groove,[2] the vertical developmental RG,[8] the cinguloradicular groove,[9] a developmental radicular anomaly,[4] the interruption groove,[10] and the coronoradicular groove.[11] RGs usually present in the maxillary lateral incisors and less frequently in the central incisors.[2,12] They normally initiate in the central fossa, pass the cingulum, and spread through the root in different directions and distances.[13]

Different classifications of RGs have been suggested; Bacic et al.[7] classified RGs according to their location (mesial, distal or mid palatal). Kogon[13] classified RGs according to their location, origin (lingual fossa, cingulum, cementoenamel junction or root) and termination (cingulum, cementoenamel junction or root). Recently, Gu[3] classified RGs into three types according to the degree of severity based on micro-computed tomography studies, as follows: type I, the groove is short (not beyond the coronal third of the root); type II, the groove is long (beyond the coronal third of the root) but shallow, corresponding to a normal or simple root canal; type III, the groove is long (beyond the coronal third of the root) and deep, corresponding to a complex root canal system.

RGs may be asymptomatic until their presentation as advanced periodontal pathosis or with secondary pulpal involvement.[14] Clinically, the coronal part of the RG could be visible. The affected tooth has a radiographic laterally localized periodontal defect almost reaching the apical portion of the root, but it cannot be diagnosed using radiography. An accessory root could be a sign of a RG.[15] Although RGs can be detected by probing associated teeth, this is sometimes difficult. If the pulp is primarily infected, a teardrop-like radiolucency can be observed in a radiograph, indicating a possible fracture. Simon et al.[16] reported that such a situation could be diagnosed only after surgical procedures.

RGs are clinically significant because they allow for the accumulation of bacterial plaque and calculus, and help to cause localized periodontitis.[1] In such a situation, long RGs, which reach the apical foramen, can cause a secondary pulp infection followed by a possible periapical lesion.[14] Deep grooves can also connect with the pulp cavity, resulting in a pulp infection.[17,18] The pulp infection could be primary, followed by an endodontic lesion advancing through the RG.[16] The main accessory canals form the link between the pulp and the RG.[14]

The clinical management of RGs may be difficult; case reports have described several treatment modalities to eliminate RGs, such as odontoplasty, resection of accessory roots, intentional replantation, periodontal regeneration, and extraction.[15,19–22] Other studies used restorative materials, such as amalgam, glass ionomer cement, and composites, to fill the RG.[14,23,24] The treatment options vary according to the presence and the depth of the pulp cavity. If the pulp is infected, root canal treatment should be initiated.

The prevalence of RGs ranges from 1.01% to 18%.[2,7,13,25,26] A study by Bacic et al.[7] indicated that 1.01% of the extracted maxillary incisors investigated presented with a RG, whereas Kogon[13] reported a prevalence of 4.6% and Pecora et al.[12] showed it to be 3.9%. The researchers did not mention the racial origin of the extracted teeth. The incidence may vary in different ethnic groups, and previous studies showed the highest frequencies were in Sino-Americans, and the low frequency groups were Sub-Saharan Africans and Sahul-Pacific people.[27]

The region around the maxillary lateral incisor is an area of embryologic hazard.[2] A great number of malformations occur in this region, namely, globulo-maxillary cysts,[28] cleft palate,[29] congenital absence,[30] supernumerary,[31] dens invaginatus,[32] or peg-shaped lateral incisors.[33] The prevalence of RGs in maxillary lateral incisors is higher than in maxillary central incisors.[7,13] Case reports have presented maxillary lateral incisors with RGs that needed endodontic and periodontal management.[14,34]

In vivo and *in vitro* studies and case reports have evaluated RGs. Visual examination, including periodontal probing, has been performed to confirm RGs.[2,7,12–14,35] Although radiographs were used in some studies, Kozlovsky et al.[35] reported that RGs could not be detected using radiography. According to Gu,[3] *in vivo* studies might miss detailed information under the gingival tissue and alveolar bone and, therefore, three-dimensional imaging techniques could be useful in detecting RGs. Cone-beam computed tomography (CBCT) provides a practical tool for non-invasive and three-dimensional reconstruction imaging by clinicians in endodontic applications and morphological analyses. A review of the literature using PubMed Database (National Library of Medicine) with the keywords 'radicular groove' and 'cone-beam computed tomography' revealed no previous studies. Thus, this retrospective study aims to assess the prevalence of RG in maxillary anterior teeth in a Turkish population using CBCT, and to statistically analyse the findings according to the tooth type, and the patient's gender.

2. Materials and methods

We selected 657 previously obtained CBCT images from the archive of the Oral and Maxillofacial Radiology Departments of Izmir Katip Celebi University, Izmir, and Erciyes University, Kayseri, in Turkey. All the images were obtained with a NewTom 5G CBCT machine (NewTom 5G®, QR, Verona, Italy) from patients with different dentomaxillofacial complications, between October 2012 and April 2013. The voxel size was 0.15 mm and the slice thickness was 1.0 mm. The acquisition process was performed by an experienced radiologist according to the manufacturer's recommended protocol, with the minimum exposure time necessary for adequate image quality.

Inclusion criteria were the presence of high-quality CBCT images of maxillary incisors and canines. Exclusion criteria