

Evaluation of the Retromolar Canal and Foramina of the Mandible with Cone-Beam Computed Tomography

Mandibuler Retromolar Kanal ve Foramenin Konik Işınli Bilgisayarlı Tomografi ile Değerlendirilmesi

Nihat LAÇIN¹ , Birkan TATAR¹ , İlknur VELİ² , Emre AYTUĞAR³ 

1 İzmir Katip Celebi University, Faculty of Dentistry, Department of Oral and Maxillofacial Surgery, İzmir, Turkey

2 İzmir Katip Celebi University, Faculty of Dentistry, Department of Orthodontics, İzmir, Turkey

3 İzmir Katip Celebi University, Faculty of Dentistry, Department of Oral and Maxillofacial Radiology, İzmir, Turkey

Abstract

Background: The goal of this study was to investigate the occurrence of retromolar canal (RMC) and retromolar foramen (RMF) using cone-beam computed tomography (CBCT) in a Turkish subpopulation.

Methods: This study included high-resolution CBCT images from 177 male and 173 female, totally 350, with average age of 31.9 years (18 to 70 years). The RMC was defined as an independent accessory canal or arising from the mandibular canal continuous with a foramen on the retromolar fossa. The RMCs were analyzed by considering sex and side. Independent samples statistically analyzed with *chi-square test*. $P < 0.05$ was considered statistically significant.

Results: The RMC was detected in 11.42% of patients. Of these, 11 patients (3.14%) had bilateral RMC, while 29 patients (8.28%) had a unilateral RMC. There were no differences between left and right sides or between genders ($P > 0.05$).

Conclusions: RMC is an anatomic variation that performers of oral surgery should be aware of. It could potentially cause hypoesthesia and unnecessary discomfort of patient when injured. CBCT is a useful device to reveal anatomic features of the retromolar foramen and canal.

Keywords: Mandible, Anatomic Variation, Cone-Beam Computed Tomography

Öz.

Amaç: Bu çalışmanın amacı, bir Türk popülasyonunda konik-ışınli bilgisayarlı tomografi (KIBT) kullanılarak retromolar kanal (RMK) ve retromolar foramen (RMF) oluşumunun değerlendirilmesidir.

Materyal ve Metod: Çalışmaya 350 hastanın (177 erkek, 173 kadın, ortalama yaş 31.9, 18-70 yıl arasında değişen) KIBT görüntüleri dahil edildi. RMK, mandibular kanaldan bağımsız olarak ramusta bulunan veya retromolar fossa üzerinde bir foramen ile devamlılık gösteren ve mandibular kanaldan kaynak alan bir aksesuar kanal olarak tanımlandı. RMK'lar cinsiyet ve taraf dikkate alınarak analiz edildi. İstatistiksel değerlendirmede, bağımsız örnekleri analiz etmek için ki-kare testi kullanıldı. $P < 0.05$ istatistiksel olarak anlamlı kabul edildi.

Bulgular: RMK, hastaların% 11.42'sinde tespit edildi. Bunlardan 11'inde (% 3,14) bilateral, 29'unda unilateral RMK (% 8,28) saptandı. Sağ ve sol taraflar arasında veya cinsiyetler arasında anlamlı bir istatistiksel fark bulunmadı ($P > 0.05$).

Sonuç: RMK, oral cerrahi uygulayıcılarının bilmesi gereken anatomik bir varyasyondur. Hasarlandığında hipoesteziye ve hastanın gereksiz rahatsızlığına neden olabilir. KIBT, retromolar foramen ve kanalın anatomik özelliklerini ortaya çıkarmak için yararlı bir araçtır.

Anahtar Kelimeler: Mandibula, Anatomik Varyasyon, Konik ışınli bilgisayarlı tomografi

Sorumlu Yazar / Corresponding Author

Dr. Nihat Laçın

Aydinlikevler mah. Cemil Meric Cad.
İzmir Katip Celebi Üniversitesi Dis
Hek. Fak. Ağız, Dis ve Cene
Cerrahisi 35640 Cigli, İzmir, TURKEY

Tel: +90 536 403 47 01

E-mail: nihat.lacin@hotmail.com

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Introduction

The retromolar foramen (RMF) is a rare anatomical variation found in the alveolar surface of the molar triangle of the posterior mandible, directly drain to the retromolar canal (RMC), which usually split from the mandibular canal (MC) (1).

The frequency of the RMC based on previous reports ranges from 8.5 to 28.1% per patient and from 8.5 to 75.4% in CBCT studies (2). Nevertheless, the first particular study about the RMC was conducted by Schejtman et al. with anatomical dissection on 25 Argentinian cadavers in 1967 which reported an accessory canal in 72% of the specimens suggesting that the RMC originates from neurovascular pile of the lower jaw before the entrance of MC and ends in the RMF or in surrounding foramina (3). The components found most frequently are the neurovascular bundle such as a myelinated sensory nerve or arterioles and venules with a decreasing order (4). The RMC mostly arises from the MC posterior to the 3rd molar or distal to the 2nd molar if the wisdom tooth is missing and passes towards to retromolar fossa (RF) (5).

The content of the RMC is clinically critical for surgeries involving the retromolar area of posterior mandible. Bleeding of the vascular contents of this canal could reduce the vision of the surgical field or neural injury during ramus osteotomies, surgical extraction of the impacted wisdom teeth or various surgical interventions could adversely affect outcome (2,6). This anatomic variation is also relevant for bone harvesting in ramus and retromolar areas, removal of cystic or tumoral pathologies as well as for routine intraoral dental anesthesia (7-10). It is important to evaluate and detect the course of the RMC with the location of the RMF prior to such surgical procedures in this area.

RMC is relatively a very narrow structure that is inconvenient to detect on panoramic radiographs. Therefore, it is hard to differentiate status of the RMC in detail on wide-view radiographs. The high-resolution CBCT images are very convenient to confirm the mini structures in the jaw bones that could not be observed on panoramic radiographs (1).

In this article, we aimed to investigate the occurrence of RMC using high-resolution CBCT images in a Turkish subpopulation.

Materials and Methods

CBCT images from patients with written informed consent obtained seen in the Oral and Maxillofacial Radiology Department of the Izmir Katip Celebi University was used to conduct this retrospective study.

Healthy patients older than 18 years without cystectomy or resection history with high quality mandibular CBCT

images and were included in the study. The CBCT images had already been chosen for diagnostic aims; mostly with a view to comprehensively evaluate implant surgery, dental trauma, orthognathic surgery, endodontic purposes or impacted tooth surgery. Radiographies that were not convenient for the study of the posterior mandible, notably due to the presence of artifacts in retromolar area, as well as those patients who had skeletal diseases and syndromes or already undergone head and neck surgery as well as those with trauma history of the lower jaw were excluded from the study.

A total of 350 patients who had a CBCT examination between January 2013 and December 2018 were included. There were 177 (50.57 %) male and 173 (49.43%) female, with a mean age of 31.9 years, ranging from 18 to 70 years.

All scans were obtained using a NewTom 5G CBCT machine (QR srl, Verona, Italy), operating at standard resolution mode (0.2mm voxel size), 1-20 mA, with a 12×15 field of view at 110 kVp in supine position.

The presence of RMCs were detected on NNT station (QR srl, Verona, Italy) with a RadiForce MX270W display (27-inch and 2560 x 1440 resolution) by an experienced observer. The RMC was defined as an independent accessory canal or arising from the mandibular canal continuous with a foramen on the retromolar fossa. (Figure 1). The RMCs were analyzed by considering gender and side.

Statistical Analysis

The statistical analyze of all data was carried out using *chi-square* (χ^2) test to compare the frequency of presence of the RMCs between sexes and sides using SigmaStat (version 3.5; Systat Software, San Jose, Calif) program. Based on the 95% confidence interval, statistical significance $p < 0.05$ was determined.

Results

In the CBCT sections, the RMC was found in 11.42% (40/350) of patients. Of these, 11 patients (3.14%) had bilateral RMC, while 29 patients had a unilateral RMC (8.28%) (Table 1). RMC was observed in images of 21 males (11.86%) and 19 females (10.98%) (Table 2, 3). 15 patients had a RMC on the right, 14 patients on the left side (Table 1). Significant differences were found between right and left sides regardless of sex ($P < 0.0001$) (Table 1) and statistically significance was found in side comparison in each gender ($P \leq 0.0001$) (Table 1).

Discussion

The frequency of the RMC have reported in previous

clinical studies using CBCT from ranges 8.5 to 75.4% (5,11). While the cadaveric studies using CBCT reported RMCs are between 8.3 and 52% (12,13). Studies using panoramic images (PAN) have reported less frequent results between 0% and 16.9% (2,14). Therefore, it may be caused by RMCs are not rare anatomic variations, but PAN is not sufficient enough to observe them and CBCT is necessary to provide reliable data.

Table 1. Incidence of the retromolar canal

LEFT	RIGHT		TOTAL
	-	B	
-	310	15	325 (92,9%)
B	14	11	25 (7,1%)
TOTAL	324(92,6%)	26(7,4%)	350

Chi-square = 46,793 ; p<0,0001

Table 2. Incidence of the retromolar canal in males

LEFT	RIGHT		TOTAL
	-	B	
-	156	8	164 (92,7%)
B	8	5	13 (7,3%)
TOTAL	164(92,7%)	13(7,3%)	177

Chi-square = 15,333 ; p=0,0001

Table 3. Incidence of the retromolar canal in females

LEFT	RIGHT		TOTAL
	-	B	
-	154	7	161 (93,1%)
B	6	6	12 (6,9%)
TOTAL	160(92,5%)	13(7,5%)	173

Chi-square = 27,243 ; p<0,0001

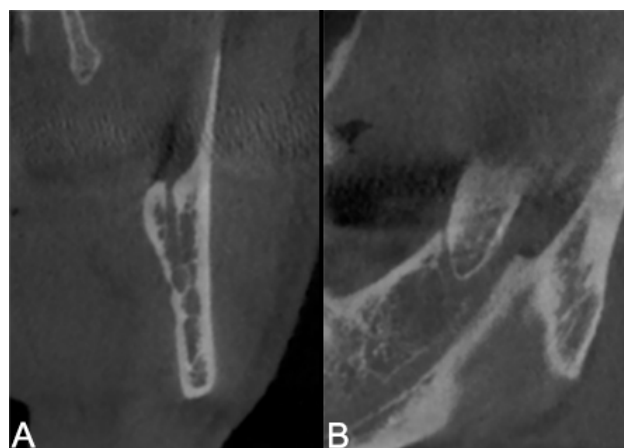


Figure 1. CBCT sections of a retromolar canal and foramen. A. Coronal view B. Sagittal view

The RMC has been described in various types and courses. As a branch from the MC behind molars and courses superiorly to the retromolar fossa in a straight direction with or without an anterior branch to the molars, as a branch from MC behind the molars continues anteriorly, and then curves posteriorly and superiorly to the retromolar fossa, as a higher diverging branch from mandibular foramen continues anteriorly in a horizontal direction or as a branch originating from retromolar fossa downwards but not from mandibular canal. Narayana et al. and von Arx et al. suggested that a straight upward canal to be the most frequent trajectory (15, 9). On the other hand Patil et al. suggested that a RMC descending from retromolar fossa to radicular portion of wisdom teeth was the most frequent type (5).

Location of RMF is reported related to second and third molar teeth in various studies. Von Arx et al. reported the distance to distal aspect of 2nd molar as 15.2 ± 2.39 mm and a significantly longer horizontal distance compared to older individuals was found (9). Similarly, Patil et al. found reported the distance to distal aspect of 2nd molar as 11.9–15.2 mm (5). Filo et al. that the mean distance from the RMF to the second molar is longer in patients with third molars absent (15.4 mm) then patients with the wisdom teeth present (15.1 mm), but the difference was not statistically significant (16).

Ossenberg reported that the prevalence and types of RMC differ among populations and the frequency in the North America being lower than in the Northeast Asia, Europe, and Africa (17). Bilecenoglu et al. was conducted an anatomical study on 40 Turkish dry mandibles and reported that the approximate location of the RMF from the distal edges of the second molars was 11.9 and third molars was 4.23 mm and the incidence of RMF as 25% (18). Accordingly, Orhan et al. found the frequency of RMC 23.1% in their study using bilateral CBCT images of 242 Turkish adults (19).

The RMC as an anatomic variation of clinical significance for many surgical procedures such as extraction of impacted teeth, osteotomies, bone harvesting in retromolar area, cyst enucleations and tumor resections as well as for routine dental anesthesia. Some reports emphasized the risk and results of damage to the neural and vascular content emerging from the RMC. Singh reported a case of paresthesia of the intraoral soft tissue extending from the retromolar to the canine area after a third molar surgical removal (20). Jablonski et al., Kodera and Hashimoto also reported an atypical branch of the long buccal nerve emerged from the RMC (21,22). Variations in MCs may also be related with increased difficulty in obtaining anesthesia in the posterior mandible (23). Gow Gates mandibular block anesthesia or infiltration of additional local anesthesia in the RMC is suggested by various authors (24,25). CBCT examination is a convenient imaging

method to determine bone structures in high resolution for a delicate operation (26).

Conclusion

In summary, RMC is an anatomic variation that oral surgeons should be aware of. Although the injury of the RMC did not lead severe bleeding complications, it could potentially cause hyposthesia and unnecessary discomfort of patient. CBCT is a useful tool to evaluate anatomical structure of the mandible including retromolar foramina and canal that must be taken into account during presurgical planning.

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