Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 07, pp.55309-55315, July, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

RADIOGRAPHIC EVALUATION OF RETROMOLAR CANALS AND JUXTA APICAL RADIOLUCENCY ON CONE BEAM COMPUTED TOMOGRAPHY

***Dr. Someshwari S. Salunkhe, Dr. Manjushri Waingade, Dr. Daya K. Jangam and Dr. Namrata Khandare**

Sinhgad Dental College and Hospital, Pune, India

ARTICLE INFO

Article History:
Received 10th April, 2017
Received in revised form
18th May, 2017
Accepted 19th June, 2017
Published online 31st July, 2017

Key words:

Retromolar canal,
Juxta-apical radiolucency,
Cone beam computed tomography.

ABSTRACT

Objectives: To evaluate prevalence and location of retromolar canals and juxta-apical radiolucency using mandibular scans of cone beam computed tomography.

Methods: An observational study was carried out on 70 CBCT scans to evaluate the prevalence and location of Retromolar canals and juxta-apical radiolucency on axial and coronal sections and also the number and type of retromolar canals. Assessment of Juxta-apical radiolucency was made in relation to third molar root to find out its location.

Results: The prevalence of RMC and JAR was found to be 67.14% and 45.71% respectively. Unilaterally 30% (n=21) and bilaterally 37.1% (n=26) scans showed presence of RMC. Unilaterally 20% (n=14) and bilaterally 25.7% (n=18) scans showed presence of JAR. There was statistically non-significant difference seen between retromolar canal and juxta-apical radiolucency when compared with age and gender. Type A canal was most prevalent (25%) followed by type B (7.8%) and type C (5.7%).

Conclusion: Retromolar canals and juxta-apical radiolucency must be taken in to considerations before any surgical procedures in retromolar region to avoid the post-operative complications. CBCT can be a best diagnostic tool for analysis of such anatomic variations.

Citation: *Dr. Someshwari S. Salunkhe, Dr. Manjushri Waingade, Dr. Daya K. Jangam and Dr. Namrata Khandare, 2017. "Radiographic evaluation of retromolar canals and juxta apical radiolucency on cone beam computed tomography", *International Journal of Current Research*, 9, (07), 55309-55315.

INTRODUCTION

Cone beam computed tomography (CBCT) technology has a substantial impact on maxillofacial imaging that has been used in several areas of dentistry because it shows 3D images of dental structures in addition to providing clear structural images with high contrast. (Neves *et al*., 2012) It's high-resolution three-dimensional images reveal anatomic structures more clearly. (Muinelo-Lorenzo *et al*., 2014) The retromolar canal (RMC)is a rare anatomic variation found in the retromolar triangle, a small triangular-shaped region posterior to the third molar in the mandible. (Sekerci *et al*., 2013; Cennet and Levent, 2015; Athavale *et al*., 2013) The juxta-apical radiolucency (JAR) has been seen on tomography in close approximation to the roots of third molar and has been shown to be more predictive of nerve injuries. This new radiographic sign is a well-circumscribed radiolucent area lateral to the root rather than at the apex. (Kapila *et al*., 2014) Identifying the position and configuration of these anatomic structures has important clinical implications.Various surgical procedures may occur in the retromolar area, such as extraction of an impacted third molar and sagittal split ramus osteotomy; damage to the vessels and nerves in this region could cause unexpected bleeding or paresthesia, sensory disturbances or traumatic neuromas. (Muinelo-Lorenzo *et al*., 2014; Sekerci *et al*., 2013; Cennet and Levent, 2015; Patil *et al*., 2013) The impingement of the neurovascular bundle in the retromolar fossa from prosthetic appliances in the elderly due to the resorption of alveolar bone may result in patient discomfort. (Sekerci *et al*., 2013) Moreover, proper identification may help adequate planning of anaesthesia. (Muinelo-Lorenzo *et al*., 2014; Kapila *et al*., 2014; Alves and Deana, 2015) CBCT has enabled us to better visualize the anatomy of the RMCs and JAR. The study is significant as both the RMCs and JAR are seen in the same region which is combined in this study for the first time in literature.

MATERIALS AND METHODS

A retrospective observational study was undertaken using 70 CBCT scans from the archives of Departmentof Oral Medicine and Radiology, Sinhgad Dental College and Hospital, Pune to determine the prevalence and location of RMC and JAR and also the number and type ofRMC. Patients who had been referred for CBCT scan were consecutively enrolled in the

Corresponding author:* **Dr. Someshwari Salunkhe

study. Because of the retrospective nature of the present analysis, the study was exempted from formal approval by the ethical committee. The images were acquired with the PlanmecaProMax 3D Mid CBCT machine. The tube voltage was set at 90 kVp, the tube current at 8 mA and the exposure time was 13.8 s. The height of the field of view (FOV) was 20 cm and the diameter was 17 cm. The voxel size was 0.4 mm. The sagittal, coronal and axial images, which were reconstructed from the projection data, were used for assessing the RMC and JAR. The CBCT scans of medium or full FOV covering the retromolar region with presence of third molar erupted or impacted bilaterally were included. Each scan was opened in the respective software viewer. All RMC evident on CBCT images irrespective of their diameter were included in the study. Three types of RMCs were detected based on their course and have been referred to as types A, B, and C (Figure 1). In type A, the RMC branched off the mandibular canal distal to the third molar and coursed superiorly to open into the retromolar fossa. The canals in the Type B category coursed between the retromolar fossa and the radicular portion of third molar. The connectivity of these canals with the mandibular canal was not evident on the CBCT images. The type C canal originated from the mandibular foramen in the ramus, it coursed antero-inferiorly and then antero-superiorly to open into the retromolar fossa.

Juxta apical radiolucency is classified depending upon the location in relation to root of third molar as JAR in relation to apical third, middle third and cervical third of 3rd molar root.

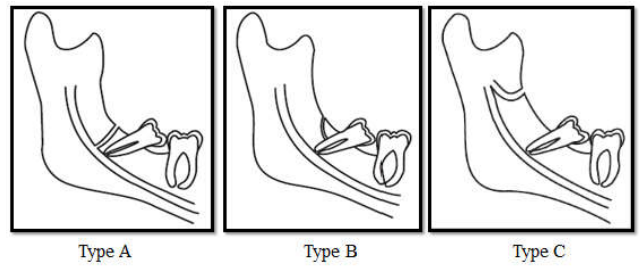


Figure 1. **Classification of retromolar canal**

RESULTS

Data obtained was compiled on a MS Office Excel Sheet (v 2010). Data was subject to statistical analysis using Statistical package for social sciences (SPSS v 21.0, IBM).Frequency (n) and percentage (%) of RMC (retromolar canal) & JAR (juxta-apical radiolucency) on both left and right sides have been calculated. Association of gender & age group with various variables like RMC on right & left side, its type, JAR on right & left side and its location has been done using chi square test.

Table 1. Comparison of distribution of presence of unilateral & bilateral RMC with age and gender

		RMC			
		Absent	Unilateral presence	Bilateral presence	p value of chi square test
AGE CODED	20-29	7	6	7	0.720#
	30-39	8	11	11	
	40-49	8	3	7	
	>50	0	1	1	
Gender	M	14	13	15	0.953#
	F	9	8	11	

RMC: Retromolar canal

Table 2. Comparison of distribution of presence of unilateral &bilateral JAR with age and gender

		JAR			
		Absent	Unilateral presence	Bilateral presence	p value of chi square test
AGE CODED	20-29	12	2	6	0.200#
	30-39	12	8	10	
	40-49	13	4	1	
	>50	1	0	1	
Gender	M	25	6	11	0.324#
	F	13	8	7	

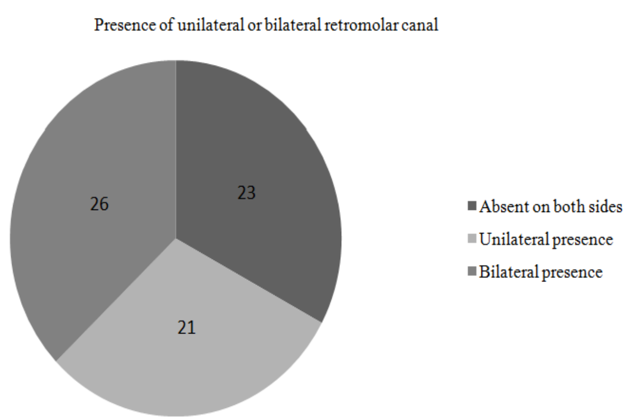
JAR: Juxta-apical radiolucency

Table 3. Frequencies of number and type of RMC

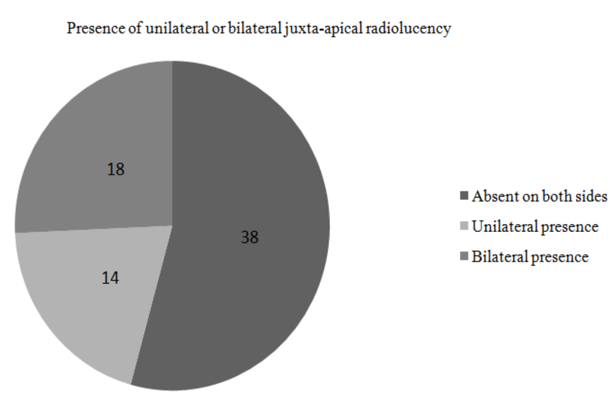
	Number	Types	Frequency	Percent
RIGHT SIDE	0	0	32	45.7
	1	Type A	16	22.9
	2	Type A+ Type A	1	1.4
	4	Type A+ Type A +Type B+ Type C	1	1.4
	3	Type A+ Type A + Type C	3	4.3
	2	Type A + Type B	3	4.3
	2	Type A + Type C	2	2.9
	1	Type B	6	8.6
	1	Type C	6	8.6
LEFT SIDE	0	0	36	51.4
	1	Type A	19	27.1
	2	Type A+ Type A	2	2.9
	3	Type A+ Type A+ Type A	1	1.4
	2	Type A + Type B	2	2.9
	2	Type A+ Type C	2	2.9
	3	Type A+ Type C + Type C	1	1.4
	1	Type B	5	7.1
	1	Type C	2	2.9

For all the statistical tests, $p<0.05$ was considered to be statistically significant, keeping α error at 5% and β error at 20%, thus giving a power to the study as 80%. In the present study, 70 CBCT scans were examinedwhich included 42 males (60%) males and 28 females (40%). The mean age of the population included in the study was 34.79 +/- 7.16. The prevalence of RMC and JAR was found to be 67.14% and 45.71% respectively. Unilaterally 30% (n=21) and bilaterally 37.1% (n=26) scans showed presence of RMC (Graph 1). When distribution of presence of unilateral & bilateral RMC was done with age and gender, there was a statistically non-significant difference seen (almost equal distribution among both males and females (p=0.95) in all the age groups (p=0.72)) (Table 1).

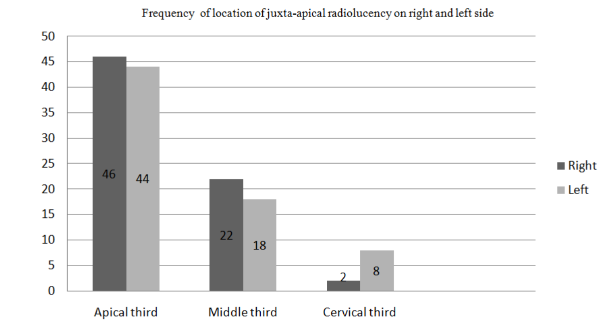
Unilaterally 20% (n=14) and bilaterally 25.7% (n=18) scans showed presence of JAR (Graph 2). When distribution of presence of unilateral & bilateral JAR was done with age and gender, there was a statistically non-significant difference seen (almost equal distribution among males and females (p=0.34) in all the age groups (p=0.2) (Table 2). TypeA canal was most prevalent amongst all followed by Type B and Type C. It was found that 51.42% scans showed multiple RMC on single retromolar area, of which two canals seen more frequently followed by three and four canals at one site. Frequencies of number and types of RMC on right and left side are described in Table 3. JAR was seen most commonly located at the apical third in 65.7% scans and 11.4% at cervical third of third molar root (Graph 3).



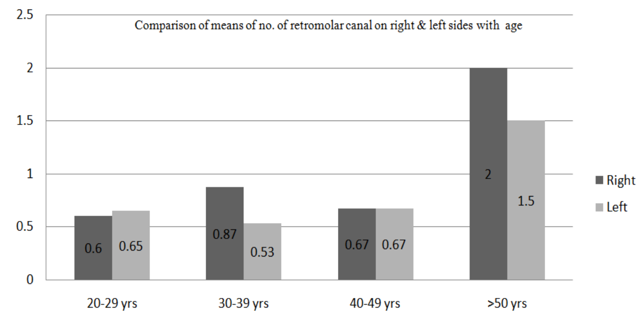
Graph 1.



Graph 2.



Graph 3.



Graph 4.

Correlation of number of RMC on both sides with age has been done using Pearson's correlation coefficient and we have obtained a positive relationship between the age and number of RMC i.e. more number of RMC were appreciated at one site in older age groups but this association has negligible relationship & slight correlation (Table 4). Comparison of number of RMC on right & left sides with age and gender has been done using t-test (P=0.873, P=0.281) & One way ANOVA (P=0.172 & P=0.379) and there was a statistically non-significant difference seen with intergroup comparison of variables (Table 5 & Graph 4). There was a statistically non-significant difference seen when gender was compared using Chi-square test with variables like presence or absence of RMC & JAR on right & left sides, type of RMC and location of JAR on right & left sides.On age wise comparison of variables, there was statistically non-significant difference seen between all the variables like presence or absence of RMC & JAR on right & left side, type of RMC on right side and location of JAR on left side. Except for variable like type of RMC on left side where majority of type 1 was found in age group of 20-29 years (P<0.05) Majority of subjects had absence of JAR on right side in the age group of 40-49 years as compared to the majority of subjects who had presence of JAR on right side in the age group of 30-39 years (P<0.05).

DISCUSSION

The retromolar fossa, located between the anterior border of the mandibular ramus and the temporal crest, may have one or more inconstant foramen called retromolar foramen (Figure 2), which permits the passage of vascular-nerve bundles that contribute to nutrition and innervation of the pulp and periodontium of molars. (Sicher, 1960; Sawyer and Kiely, 1991; Bilecenoglu and Tuncer, 2006; Rossi *et al*., 2012; Kumar Potu *et al*., 2013; Han *et al*., 2014) Carter *et al*. demonstrated inferior alveolar nerve (IAN) or from the retromolar branch that travels through the RMC. (Carter and Keen, 1971) However, Jablonski *et al*.have shown an aberrant buccal nerve originating from the IAN within the ramus of the mandible, traversing through the RMC, emerging through the RMF and then passing forward and upward to penetrate the buccinator muscle. (Sekerci *et al*., 2013; Cennet and Levent, 2015; Jablonski *et al*., 1985) The frequency of RMC has been found to be varying among different populations worldwide ranging from 3.2-72%. (Jablonski *et al*., 1985; Ossenberg, 1987; Narayana *et al*., 2002; Schejtman *et al*., 1967; Lizio *et al*., 2013; Orhan *et al*., 2011; Kawai *et al*., 2012; Von *et al*., 2011; Sisman *et al*., 2015; Priya *et al*., 2005; Motta-Junior *et al*., 2012) We found the prevalence of 67.14% which is in accordance to the study conducted by Patil *et al*. (65%). (Patil *et al*., 2013) Ossenberg states that the percentage of RMF alters between different populations; however we observed that the literature reports great variation in the prevalence of RMF in a single ethnic group, e.g. Japanese, with 3.2% being the lowest value found and 75.4% the highest. In South-Americans the prevalence varies between 12.9% and 26.58%, in Indians between 12.2% and 21.9%, and in Europeans between 8.1% and 25. Based on the data reported in the literature, we believe that the prevalence of this anatomical variation is not related to population. (Alves and Deana, 2015; Ossenberg, 1987) There was no difference in the occurrence of RMCs with regard to gender. Most of the studies have found no gender predilection but few studies showed higher female predilection but was not statistically significant. (Sekerci *et al*., 2013; Alves and Deana, 2015; Von Arx *et al*., 2011) Ossenberg[18]reported a slightly greater incidence of the retromolar foramen in males, but without reaching statistical significance. Also Pyle *et al*. found a higher occurrence rate of the retromolar foramen in male skulls (9.6%) than in female skulls (6.1%). (Pyle *et al*., 1999) There was no side preference for RMC in our study, just as was reported by Patil *et al*, Sawyer and KielyBilecenogluand Tuncer, von Arx *et al* and Suazo *et al*. (Patil *et al*., 2013; Sawyer and Kiely, 1991; Bilecenoglu and Tuncer, 2006; Von Arx *et al*., 2011; Suazo *et al*., 2008) however the studies of Sekerci et al., Han and Hwang, Narayana *et al*, Capote *et al*. (Sekerci *et al*., 2013; Han *et al*., 2014; Narayana *et al*., 2002; Capote *et al*., 2015) reported greater frequency on the right side, while Motta-Junior *et al* and Priya *et al* reported greater frequency on the left side. (Priya *et al*., 2005; Motta-Junior *et al*., 2012)

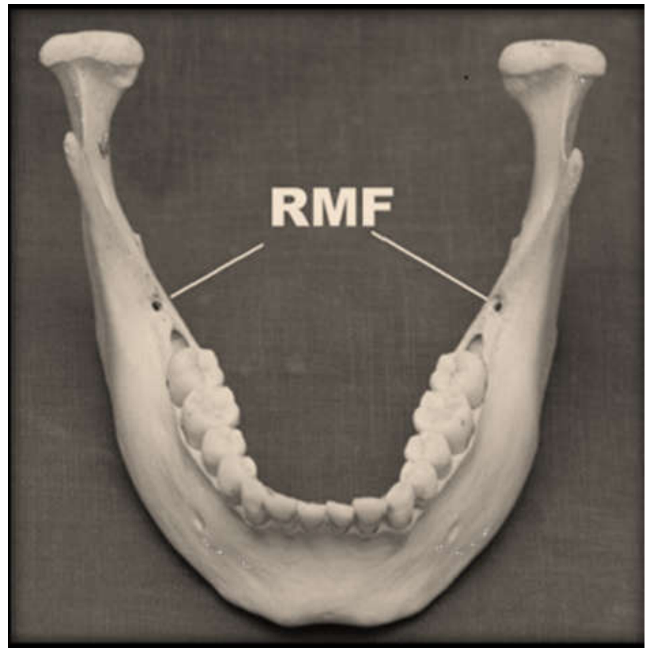


Figure 2. **Anatomic location of retromolar foramen**

Most of the studies in literature have reported that RMCs commonly occur unilaterally. (Bilecenoglu and Tuncer, 2006; Rossi, 2012; Narayana *et al*., 2002; Priya *et al*., 2005; Suazo *et al*., 2008) In our study we found bilateral occurrence of RMC which is in accordance to a study by Sagne *et al*. (1977) Concerning occurrence of the retromolar foramen and age, Pyle *et al*. (1999) noticed no statistically significant difference between age groups in a sample of 475 dry cadaver skulls. In contrast, Ossenberg reported a peak incidence of the retromolar foramen in the adolescent cohort. The author speculated that this might reflect increased neurovascular requirements related to the adolescent growth spurt and eruption of the wisdom teeth. (Ossenberg, 1987)

Table 4. Correlation of age with number of RMC

		NO. OF RMC RIGHT	NO. OF RMC LEFT
AGE	Pearson Correlation	.095	.020
	Sig. (2-tailed)	.433	.872
	N	70	70

RMC: Retromolar canal

Interpretation of "r"

<0.2	Slight correlation; negligible relationship
0.2-0.4	Low correlation; weak relationship
0.4-0.7	Moderate correlation; substantial relationship
0.7-0.9	High correlation; marked relationship

Table 5. Comparison of means of number of RMC on right & left sides with gender

	Gender	N	Std. Deviation	p value of t test
NO. RMC R	M	42	.951	.873#
	F	28	.844	
NO. RMC L	M	42	.705	.281#
	F	28	.844	

* * = Statistically highly significant difference (p<0.01)
* = Statistically significant difference (p<0.05)
# = statistically non-significant difference (p>0.05)

In our study, we found a statistically non-significant difference between the presence of RMC and age. The majority of RMCin the present study belonged to type A category (Figure 3), followed by type B (Figure 4) and type C canal (Figure 5), which is similar to the study conducted by Von Arx *et al*. (Von Arx *et al*., 2011)

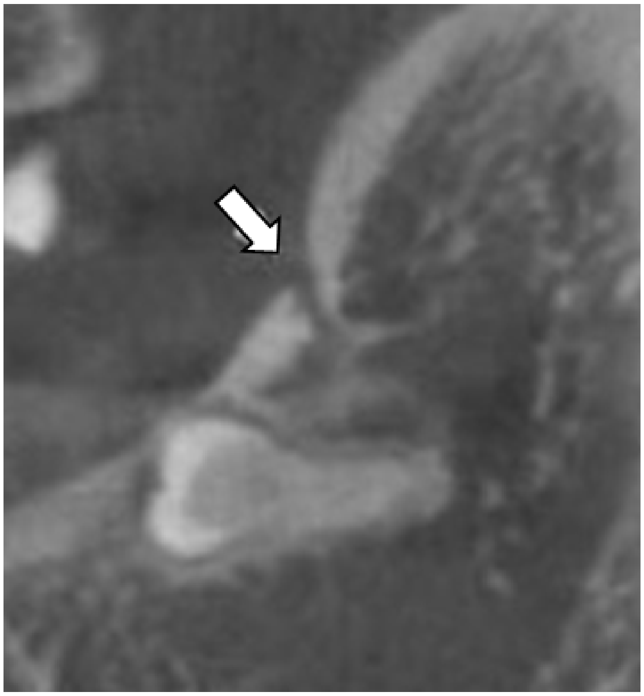


Figure 3. **Sagittal section of CBCT showing retromolar canal type A**

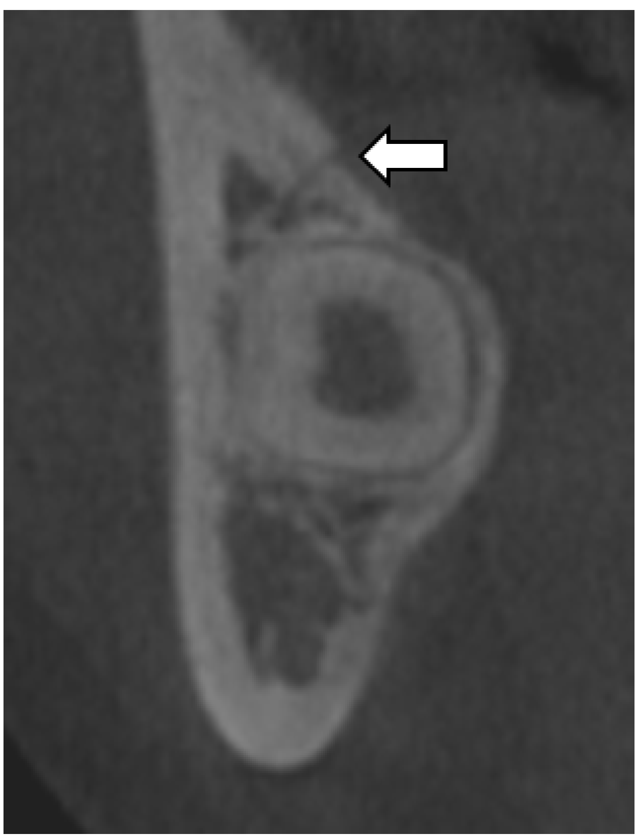


Figure 4. Sagittal section of CBCT showing retromolar canal type B

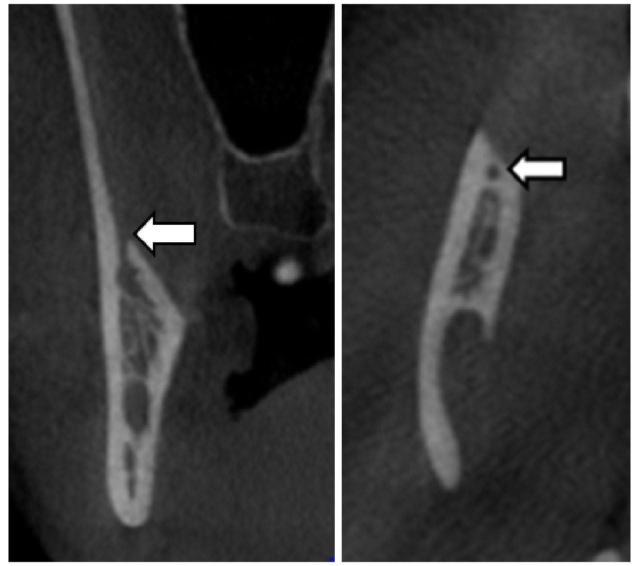


Figure 5. **Sagittal and axial sections of CBCT showing retromolar canal type C**

Figure 6. **Axial section of CBCT showing juxta-apical radiolucency located at middle third of root**

In astudy by Patil etal, type Bwas found to be to be commonly occurringfollowed by Type A an no canal of Type C was found. (Patil *et al*., 2013) Most of the sites presented with the single canal and Maximum number of canals found were 4. The contents of the RMC have been reported to consist of branches of inferior alveolar vessels and nerves. Myelinated nerve fibers associated with numerous venules and an artery. (Kumar *et al*., 2013) Anderson *et al*. reported that myelinated buccinator muscle, the most posterior part of the alveolar processes called the retromolar trigon and the pulp of the third molar tooth. (Anderson *et al*., 1991) A number of radiographic signs have been studied that indicate a possible injury during extraction of the mandibular third molar. Recently a new radiographic sign, called juxta-apical radiolucency has been associated with paresthesia after mandibular third molar removal. (Kapila *et al*., 2014; Kapila *et al*., 2014) Conflicting results have been reported in literature, regarding the predictive risk of JAR to the injury to mandibular canal. In a randomized clinical trial, the presence of JARwas found to be associated with injury to the IAN. (Renton, 2010) However; another study found juxta-apical areas to be large cancellous bony spaces rather than pathology and not a sign of increased risk. (Umar *et al*., 2010)

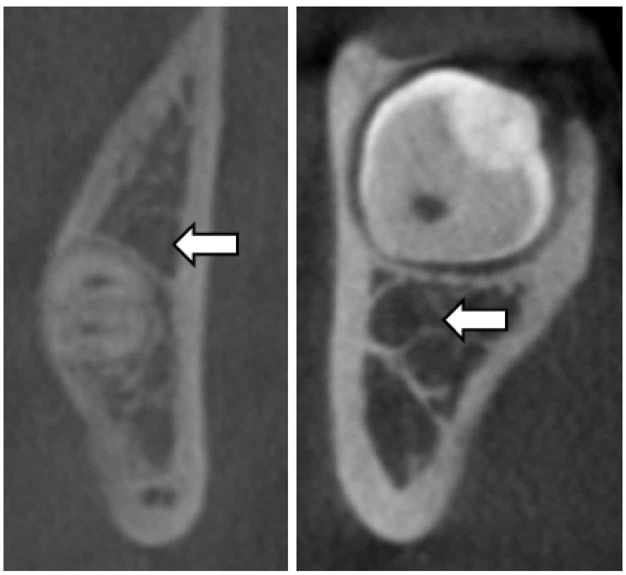


Figure 7. Sagittal section of CBCT showing juxta-apical radiolucency located at apical and cervical third of root of impacted third molar

The prevalence of JAR was 45.71% in the present study. In the literature there are only two studies, which have assessed the relationship of JAR with adjacent anatomic landmarks viz. Mandibular canals (Kapila *et al*., 2014; Kapila *et al*., 2014) and found that there is no intimate relationship of JAR with mandibular canals. In the present study, we assessedthe location of JARwith third molar which is not done in the previous studies and found that the JAR was most commonly located at the apical third of third molar root. In conclusion, our results show that RMC & JAR are reasonably frequent anatomic variations, the knowledge of which is important for planning surgical procedures. Surgeons should have knowledge about the anatomy and variations of this area for performing surgical investigation safely and for ensuring no complications due to surgery.Failure to take aberrant nerves and canals into account can affect postoperative success and lead to complications. This study establishes the occurrence and importance of RMC and JAR. However future studies are warranted that uses a larger sample size to validate the results of this study.

Acknowledgements: None

REFERENCES

Alves N, Deana NF. 2015. Anatomical and radiographical study of the retromolar canal and retromolar foramen in

Anderson LC, Kosinski TF, Mentag PJ. 1991. A review of the intraosseous course of the nerves of the mandible. *J Oral Implantol*; 17:394-403.

AthavaleSA,VijaywargiaM,DeopujariR,Kotgirwar S. 2013. Bony and Cadaveric Study of Retromolar Region. *People's J Sci Res*; 6(2):14-18.

Bilecenoglu B, Tuncer N. Clinical and anatomical study of retromolar foramen and canal. *J Oral MaxillofacSurg* 2006; 64:1493-7.

Capote TO, Gonçalves MA, Campos JA. 2015. Retromolar Canal Associated with Age, Side, Sex, Bifid Mandibular Canal, and Accessory Mental Foramen in Panoramic Radiographs of Brazilians. *Anat Res Int*; 1-8.

Carter RB, Keen EN. 1971. The intramandibular course of the inferior alveolar nerve. *J Anat*; 108:433-40.

Cennet NE, Levent C. 2015. Case Report: Aberrant buccal nerve in the retromolar canal. *Ind J Basic and Applied Medi Res*; 4(4):239-241.

Han S-S, Hwang J-J,ParkC-S. 2014. The anomalous canal between two accessory foramina on the mandibular ramus: the temporal crest canal. *DentomaxillofacRadiol;* 43: 20140115.

Jablonski NG, Cheng CM, Cheng LC, Cheung HM. 1985.Unusual origins of the buccal and mylohyoid nerves. *Oral Surg Oral Med Oral Pathol*; 60:487-8.

Kapila R, Harada N, Araki K, Sano T, Goto TK. Relationships between third molar juxta-apical radiolucencies and mandibular canals in panoramic and cone beam compute tomography images. Oral Surg Oral Med Oral Pathol Oral Radiol. 2014; 117:640-44.

Kapila R, Nana Harada N, Araki K, Tsukasa Sano T and Goto TK. 2014. Relationships between third-molar juxta-apical radiolucencies and mandibular canals in panoramic and cone beam computed tomography images. *Oral MaxillofacRadiol*; 117: 640-44.

Kawai T, Asaumi R, Sato I, Kumazawa Y, Yosue T. 2012. Observation of the retromolar foramen and canal of the mandible: A CBCT and macroscopic study. *Oral Radiol*; 28:10-4.

Kumar Potu B, JagadeesanS,Bhat K,Sirasanagandla R. 2013. Retromolar foramen and canal: A comprehensive review on its anatomy and clinical applications. *Morphologie*; 1-7.

Lizio G, Pelliccioni GA, Ghigi G, Fanelli A, Marchetti C. 2013. Radiographic assessment of the mandibular retromolar canal using cone-beam computed tomography. *ActaOdontolScand*; 71:650-5.

Motta-Junior J, Ferreira ML, Matheus RA, Stabile GAV. 2012. Forame retromolar: suarepercussãoclínica e avaliação de 35 mandíbulassecas. *Rev Odontol UNESP*; 41:164–168.

Muinelo-LorenzoJ, Su´arez-QuintanillaJA, Fern´andez-AlonsoA, MarsillasRascado S, Su´arez-Cunqueiro MM. 2014. Descriptive study of the bifid mandibular canals and retromolar foramina: cone beam CT vs panoramic radiography. *DentomaxillofacRadiol*; 43: 20140090:1-8.

Narayana, K, Nayak U. A, Ahmed, W. N, Bhat, J. G. &Devaiah, B. A. 2002. The retromolar foramen and canal in South Indian dry mandibles. *Eur. J. Anat*; 6(3):141-6.

Neves FS, Souza TC, Almeida SM, Haiter-Neto F, Freitas DQ, Bóscolo FN. 2012. Correlation of panoramic radiography and cone beam CT findings in the assessment of the relationship between impacted mandibular third molars and the mandibular canal. *DentomaxillofacRadiol*; 41:553-7.

Orhan K, Aksoy S, Bilecenoglu B, Sakul BU, Paksoy CS. 2011. Evaluation of bifid mandibular canals with cone-beam computed tomography in a Turkish adult population: a retrospective study. *SurgRadiolAnat*; 33: 501–7.

Ossenberg NS. 1987. Retromolar foramen of the human mandible. *Am J PhysAnthropol*; 73:119-28.

Patil S, Matsuda Y, Nakajima K, Araki K, Okano T. 2013. Retromolar canals as observed on cone-beam computed tomography: Their incidence, course, and characteristics. *Oral Surg Oral Med Oral Pathol Oral Radiol*; 115:692-9.

Priya R, Manjunath KY, Balasubramanyam V. Retromolar foramen. Indian J Dent Res 2005; 16:15-6.

Pyle MA, Jasinevicius TR, Lalumandier JA, Kohrs KJ, Sawyer DR. 1999. Prevalence and implications of accessory retromolar foramina in clinical dentistry. *Gen Dent*; 47:500-3.

Renton T. 2010. Prevention of iatrogenic inferior alveolar nerve injuries in relation to dental procedures. *Dent Update*; 37: 350–63.

Rossi AC, Freire AR, Prado GB, Prado FB, Botacin PR, Caria PHF. 2012. Incidence of retromolar foramen in human mandibles: ethnic and clinical aspects. *Int J Morphol*; 30: 1074-1078.

Sagne S, Olsson G, Hollender L. 1977. Retromolar foramina and canals in the human mandible. Studies in a medieval skull material. *DentomaxillofacRadiol*; 6:41-5.

Sawyer DR, Kiely ML. 1991. Retromolar foramen: A mandibular variant important to dentistry. *Ann Dent*; 50: 16-8.

Schejtman R, Devoto FC, Arias NH. 1967. The origin and distribution of the elements of the human mandibular retromolar canal. *Arch Oral Biol*; 12:1261-8.

Sekerci AE, Sisman Y, Payveren MA. 2013. Retromolar canal as observed on cone-beam computed tomography: Report of two cases with clinical importance. *J Oral MaxillofacRadiol*; 1:86-9.

Sicher, H. 1960. Oral Anatomy. 3rd ed. St. Louis, MO, Mosby.

Sisman, Y., A. Ercan-Sekerci, M. Payveren-Arıkan, and H. Sahman. 2015. Diagnostic accuracy of cone-beam CT compared with panoramic images in predicting retromolar canal during extraction of impacted mandibular third molars. *Medicina Oral Patologia Oral CirugiaBucal*; 20:74–81.

Suazo GI, Zavando MD, Cantín LM. 2008. Retromolar canal and foramen prevalence in dried mandibles and clinical implications. *Int J Odontostomatol*; 2: 183-187.

Umar G, Bryant C, Obisesan O, Rood JP. 2010. Correlation of the radiological predictive factors of inferior alveolar nerve injury with cone beam computed tomography findings. *Oral Surgery*; 3: 72–82.

Von Arx T, Hänni A, Sendi P, Buser D, Bornstein MM. 2011. Radiographic study of the mandibular retromolar canal: An anatomic structure with clinical importance. *J Endod*; 37:1630-5.

****