

**A MORPHOLOGICAL STUDY OF RETROMOLAR FORAMEN AND CANAL IN INDIAN DRIED MANDIBLES**

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**ABSTRACT: BACKGROUND:** The retromolar fossa, a small triangular area posterolateral to third molar in mandible, contains the retromolar foramen (RMF) and retromolar canal (RMC), as an anatomical variation. When the foramen present, the foramen is connected with mandibular canal through another canal known as retromolar canal and it contain neurovascular bundles, which gives additional supplies to mandible. The detailed knowledge of this anatomical variation is important in surgical procedures involving the retromolar area to protect the patient from complications such as unexpected bleeding or nerve damage & better understanding about failed inferior alveolar nerve block, spread of infection & metastasis in case of carcinoma. **AIMS & OBJECTIVES:** To study the possible variations in position of retromolar foramen (or canal) i.e. distance of RMF (or RMC) from the posterior border of 3rd molar socket, anterior border of the ramus & lingula and document its incidence in Indian population. **MATERIALS & METHODS:** 224 (Male-134, Female-90) dried fully ossified adult human mandibles are examined for the presence of retromolar foramen and canal. The retromolar foramen are observed and its distance from the posterior border of 3rd molar socket, anterior border of the ramus, and lingula are measured. **RESULTS:** The retromolar foramen and canal are found in 33 among 224 mandibles (14.7%) of which 11 on the right side (4.9%), 7 on the left side (3.1%) and 15 bilaterally (6.7%) (Table I). The RMF is found on 14 (6.2%) mandibles of male and 19 (8.5%) of female. The observed distance of RMF from posterior border of 3rd molar socket, anterior border of the ramus, and lingula varies between 3 to 10 mm, 4 to 11 mm & 3 to 9 mm respectively in right side and 5 to 12 mm, 3 to 11 mm, and 2 to 8 mm respectively in left side. **CONCLUSION:** The incidence of RMF in our study suggest that RMF or RMC is not a rare anatomical structure. So, every anesthetist and dental surgeon should confirm the location of RMF prior to performing any anesthetic and surgical procedure involving the retromolar area. The percentage of occurrence of RMF is more common in females as compared to males. It is more common in right side of mandible. The bilateral presence of RMF also found to be higher in females. The position of RMF is nearer to third molar in right side in comparison to left side.

**KEYWORDS:** Mandible, retromolar fossa, retromolar triangle, retromolar foramen, retromolar canal.

**INTRODUCTION:** The retromolar fossa, a triangular area present posterolateral to the 3rd lower molar contains retromolar foramen (RMF) and retromolar canal (RMC), as an anatomical variation in the mandible.<sup>[1]</sup> The boundary of retromolar fossa is formed medially by temporal crest & laterally by the anterior border of ramus.<sup>[2]</sup> The cribose triangular surface just posterior to lower 3rd molar is known as retromolar triangle. The retromolar canal normally arises from the mandibular canal, behind the third molar tooth.

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Neurovascular structures passes through this canal gives additional supply to mandibular molars and buccal area. Extraction of lower 3rd molar, which is commonly known as Wisdom teeth, is a common dental procedure. A complete knowledge of the region around 3rd molar is necessary to minimize complications like unexpected bleeding, hematoma formation etc. The neurovascular bundles may get damage during placement of osteointegrated implant, endodontic treatment, sagittal split osteotomy & bone harvesting as a donor site for bone graft surgery.<sup>[3]</sup>

Since most of the anatomical textbooks and dental literatures do not mention about this foramen or canal and very few studies have been conducted on Indian populations. Hence, we study the possible variations in position of retromolar foramen (or canal) i.e. distance of RMF (or RMC) from the posterior border of 3rd molar socket, anterior border of the ramus & lingula and document its incidence in Indian population.

**MATERIALS AND METHODS:** The present study has been carried out on 224 dried fully ossified adult human mandibles, which are obtained from Department of Anatomy of Indira Gandhi Institute of Medical Sciences (Patna, Bihar, India), Maitri College of Dentistry & Research Centre (Durg, Chattishgarh, India), Lord Buddha Koshi Medical College (Saharsa, Bihar, India), F. I. Maulana Ali Mian Medical College (Unnao, Uttar Pradesh, India) & Patna Medical College (Patna, Bihar, India) by the consents and permission from heads of the institutes and anatomy department. These 224 mandibles are segregated into male and female mandibles on the basis of following criteria:

1. **In males:** The angle of mandible is everted.
2. **In females:** The angle of mandible is inverted.

Finally, these are segregated as 134 male and 90 female mandibles. Mandibles having marked deformities and fractured mandibles are excluded from the study. Each mandible are observed carefully for presence of retromolar foramen and retromolar canal. Wherever foramina are noticed, the distance of foramina from posterior border of 3rd molar socket, anterior border of the ramus and lingula are measured, using a vernier caliper. The mean, range and standard deviation of all the measurement are statistically analyzed.

**RESULT:** The retromolar foramen and canal (Fig. 2 & 3) are found in 33 among 224 mandibles (14.7%) of which 11 on the right side (4.9%), 7 on the left side (3.1%) and 15 bilaterally (6.7%) (Table 1 & Figure 1). It is seen that the distance of RMF from posterior border of 3rd molar socket, anterior border of the ramus, and lingula (Fig. 4, 5 & 6) varies between 3 to 10 mm, 4 to 11 mm & 3 to 9 mm respectively in right side and 5 to 12 mm, 3 to 11 mm, & 2 to 8 mm respectively in left side (Table-2 & 3).

From the above observations, it is found that the occurrence of RMF is more common in females as compared to males. It is more common in right side of mandible. The bilateral occurrence of RMF is found to be also higher in females. The position of RMF is nearer to third molar in right side in comparison to left side.

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Sex	Right side (%)	Left side (%)	Bilateral (%)	Total (%)
Male	5(2.2%)	3(1.3%)	6(2.7%)	14(6.2%)
Female	6(2.7%)	4(1.8%)	9(4%)	19(8.5%)
Total	11(4.9%)	7(3.1%)	15(6.7%)	33(14.7%)

Table 1: Distribution of Retromolar foramen

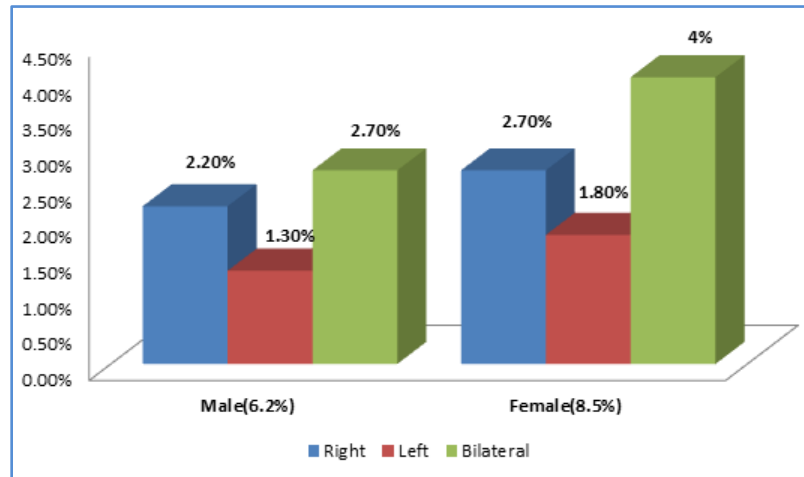


Fig. 1: Distribution of Retromolar foramen in male and female

Mandible Number	Side in which RMF found	Distance between the retromolar foramen and		
		3 <sup>rd</sup> molar socket (mm)	Ant. Border of ramus (mm)	Lingula (mm)
7	Right	3	11	7
11	Right	4	4	8
21	Right	6	8	7
25	Right	3	9	6
32	Right	4	4	4
37	Right	7	8	7
39	Right	3	9	6
43	Right	9	4	4
57	Right	8	5	8
63	Right	3	7	6
71	Right	7	6	9
75	Right	5	7	7
79	Right	3	5	5
81	Right	8	6	5
84	Right	4	10	6
109	Right	5	8	4

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135	Right	8	5	7
147	Right	3	9	8
150	Right	9	4	4
172	Right	7	4	8
189	Right	10	9	4
192	Right	8	10	6
203	Right	5	9	8
217	Right	7	8	6
221	Right	8	4	3
224	Right	6	6	5
Mean±SD		5.88±2.25	6.88±2.25	6.08±1.62
Min-Max		3-10	4-11	3-9

**Table 2: Distance of retromolar foramen from posterior border of socket for third molar, anterior border of the ramus, and lingual respectively of Right side**

Mandible Number	Side in which RMF found	Distance between the retromolar foramen and		
		3 <sup>rd</sup> molar socket (mm)	Ant. Border of ramus (mm)	Lingula (mm)
11	Left	6	7	5
17	Left	8	5	4
21	Left	7	7	6
32	Left	9	6	8
39	Left	5	10	6
41	left	11	5	2
43	Left	9	3	4
63	Left	11	9	5
75	Left	5	4	3
81	Left	5	9	2
95	Left	7	7	6
109	Left	9	9	3
143	Left	8	7	2
147	Left	9	11	5
167	Left	11	9	7
172	Left	6	11	6
192	Left	12	6	8
197	Left	8	4	4
203	Left	11	7	8
213	Left	9	6	6
217	Left	7	5	2
224	Left	10	8	8
Mean±SD		8.32±2.15	7.04±2.26	5±2.09

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Min-Max	5-12	3-11	2-8
<b>Table 3: Distance of retromolar foramen from posterior border of socket for third molar, anterior border of the ramus, and lingual respectively of Left side</b>			

**DISCUSSION:** The incidence of RMF, located in the retromolar triangle, in our study is 14.7%, which is lesser than incidence of Park MK et al<sup>[4]</sup> (93.5%), followed by incidence of Schejtman et al<sup>[5]</sup> (72%), Kawai et al<sup>[6]</sup> (52%), Rossi et al<sup>[7]</sup> (26.6%), Von Arx et al<sup>[8]</sup> (25.6%), Bilecenoglu and Tuncer<sup>[9]</sup> (25%), Kodera and Hashimoto<sup>[10]</sup> (20%) followed by Lagrana et al<sup>[11]</sup> (18%). The highest incidence of retromolar foramen is found in Korean population.<sup>[4]</sup> An our incidence (14.7%) is greater than incidence of Sawyer and Kiely<sup>[12]</sup> (7.7%), Pyle et al<sup>[13]</sup> (7.8%), Ossenberg<sup>[14]</sup> (8.2%) followed by Suazo et al<sup>[15]</sup> (12.9%).

The incidence of the RMF in our study is also compared with the studies of different authors on different races of world (Table-4). Percentage presence of RMF in our study falls somewhere within the range reported from study of Athavale et al<sup>[16]</sup> (14.1%) and Gupta et al<sup>[17]</sup> (18%), which were done on Indian population. The incidences reported from Indian population<sup>[16-19]</sup> are varying from 7.8 to 21.9%. The differences in the incidence of the RMF in these studies may be due to differential origins in Indian population.

Our findings show that the distance between the third molar and RMF is within the short range of 3 to 10 mm in right side and 5 to 12 mm in left side which is comparable with the recent study published in the literature.<sup>[16,18,19]</sup> This close relation of RMF with 3rd molar may damage the structures passing through RMF during 3rd molar extraction and causes postoperative hematomas due to rupturing of the blood vessels.

Pinsolle et al<sup>[20]</sup> found in his study that the RMF contain blood vessels, so this may be a cause of the spread of infection and metastasis from oral cavity to the blood circulation. Ossenberg NS<sup>[14]</sup> did not found any difference in incidence of RMF in male and female. But in our study, incidence is more common in female. He also found a positive intertrait relationship between presence of RMF and presence of accessory mandibular foramen & mental foramen.

Sawyer DR & Kiely ML<sup>[12]</sup> also did not found any difference in incidence of RMF between right and left side & between sexes. In our study, it is more common in female and right side of mandible. Park MK et al<sup>[4]</sup> classified the retromolar triangle according to its shape into three types: triangular, drop and tapering shape, in which triangular was most common. On Japanese cadavers, Kodera & Hashimoto<sup>[10]</sup> studied during dissection that a branch from the inferior alveolar artery originated and passed through RMC.

When this branch ran forward get joined with branches of buccal and facial artery. They also found that the nerve in RMC originated from inferior alveolar nerve. Anderson et al<sup>[21]</sup> studied the components of RMF & RMC and found that these contained nerve fibres, which supplied the 3<sup>rd</sup> molar pulp, retromolar area, temporalis and buccinator. So, damage of nerve fibres in RMC leads to alteration in function of temporalis and buccinator. Carter et al<sup>[22]</sup> also found in his study that nerve fibres which supplied the lower molar, arises from the inferior alveolar nerve or from the retromolar branch that passes through the RMC.

The course of neurovascular structures originating from the retromolar foramen was also studied by Schejtman et al<sup>[4]</sup> during dissection. He found that after leaving the foramen, these fibres were distributed mostly to temporalis tendon, buccinator, most posterior part of alveolar process and

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lower 3rd molar. They also studied under microscope & observed that the most constant element in RMC was a myelinated nerve. The branches of mandibular division of inferior alveolar nerve may arise high in the infratemporal fossa as explained by Ikeda et al<sup>[23]</sup> in his study.

These fibres extend to the base of coronoid process & enter the mandible in retromolar fossa and innervates the lower molar. Sutton<sup>[24]</sup> first of all explained additional sensory nerve fibres in RMF. He explained the relationship between the presence of this foramen and the failure of obtaining analgesia using classical anesthetic techniques. The bone surrounding the retromolar triangle is heavier as compared to cortical plate over triangle & cortical plate is more cancellous.<sup>[25]</sup> During routine anesthetic, surgical and implantation procedure of mandible, its cancellous nature always kept in mind to prevent damage of neurovascular bundles in RMF.

Sr. No.	Population	Author (year of study)	No. of mandible studied	Incidence (%)
1.	Argentine aborigines	Schejtman et al. <sup>[5]</sup> (1967)	18	13 (72%)
2.	Eskimos	Ossenberg <sup>[14]</sup> (1987)	485	40(8.2%)
3.	American	Sawyer and Kiely <sup>[12]</sup> (1991)	234	18(7.7%)
4.	Japanese	Kodera and Hashimoto <sup>[10]</sup> (1991)	41	8 (20%)
5.	Caucasian (n=226) Afro-American (n=249)	Pyle et al. <sup>[13]</sup> (1999)	475	37 (7.8%)
6.	Argentinean	Lagrana et al. <sup>[11]</sup> (2006)	50	9 (18%)
7.	Turkish	Bilecenoglu and Tuncer <sup>[9]</sup> (2006)	40	10 (25%)
8.	Brazilian	Suazo et al. <sup>[15]</sup> (2008)	294	38 (12.9%)
9.	Swiss	Von Arx et al. <sup>[8]</sup> (2011)	121	31 (25.6%)
10.	Japanese	Kawai et al. <sup>[6]</sup> (2012)	46	24 (52%)
11.	Brazilian	Rossi et al. <sup>[7]</sup> (2012)	222	59 (26.6%)
12.	Turkish	Orphan et al. <sup>[26]</sup> (2013)	126	14 (11.1%)
13.	Korean	Park MK et al. <sup>[4]</sup> (2014)	154	144 (93.5%)
14.	Indian	Narayana et al. <sup>[18]</sup> (2002)	242	53 (21.9%)
		Priya et al. <sup>[19]</sup> (1999)	475	37 (7.8%)
		Athavale et al. <sup>[16]</sup> (2013)	71	10 (14.1%)
		Gupta et al. <sup>[17]</sup> (2013)	50	9 (18%)
15.	Indian	OUR STUDY (2014)	224	33(14.7%)

**Table 4: Incidence of retromolar foramen and canal in different population studied by different authors**

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**CONCLUSION:** In this study, we report the incidence of retromolar foramen and its distance from the posterior border of 3rd molar socket, anterior border of the ramus, and lingula in Indian population, it is helpful in better understanding of clinical and surgical practice in this region. There is still possibility to study of this canal in living subjects by introducing the dye into the inferior alveolar artery. This may provide more information about this canal. It remains unknown, how the retromolar canal develops in the mandible, so there is need of further studies on large population across the world to understand its origin and evolutionary importance.

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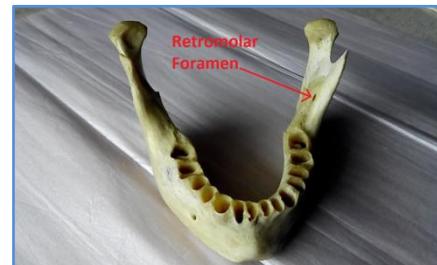


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**Fig. 2: Photograph showing retromolar foramen in right side**



**Fig. 3: Photograph showing retromolar foramen in left side**



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**Fig. 4: Photograph showing the measurement of distance between 3<sup>rd</sup> molar socket and RMF**



**Fig. 5: Photograph showing the measurement of distance between lingula and RMF**



**Fig. 5: Photograph showing the measurement of distance between anterior border of ramus and RMF**

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