Assessing the Incidence and Course of Mandibular Retromolar Canal Using Cone Beam Computed Tomography in Indian Sub-Population- A Retrospective Study

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Abstract

Aim: The purpose of the study to assess the incidence of retromolar canals and provide information with regard to their course in Indian subpopulation.

Methodology: The cone-beam computed tomography images of 150 subjects were retrospectively evaluated for the incidence and pattern of occurrence of retromolar canals.

Result: A total of 150 CBCT scans comprising 300 mandibular sides were evaluated. A total of 58 RMCs (19.33%) were found. We found that the type B1 of the RMC occurred most frequently (37.9%), followed by types A1 (20.7%), C (19%), B2 (13.8%) and C (8.6%) out of 58 RMC identified in our study.

Conclusion: The findings of this study suggests that the RMC isn’t a rare anatomical structure. When carrying out surgical interventions with retromolar access, the treating dentist should take into account the possible presence of this anatomical variant in order to be able to spare it in view of potential complications such as bleeding or dysesthesia. CBCT is well suited for the preoperative diagnostics of the RMC.

Keywords: Retromolar Canal; Retromolar Foramen; Variation of Mandibular Canal; Cone Beam Computed Tomography

Introduction

Retromolar fossa housing the retromolar canal that holds great importance in the planning of surgical procedures at the angle of the mandible. The retromolar canal (RMC) is an anatomical variant of the mandibular canal (MC), which has gained only occasional attention in the literature and is not described in most anatomical textbooks [1]. The RMC originates from the MC distal of the third molar, runs in an anteroposterior direction and exits the bone through the retromolar foramen (RMF) in the area of the retromolar fossa or retromolar trigone. The clinical significance of the RMC on the one hand is accounted for by the fact that apart from a molar branch of the inferior alveolar nerve (IAN) providing the sensory nerve supply of the mandibular molars, the RMC can also contain a so-called retromolar branch. These canals need consideration in surgical procedures involving the retromolar areas such as third molar impaction, osteotomy, bony harvesting procedures, planning a prosthetic appliance in old patients. Complications such as sensory deficits, hemorrhage and traumatic neuroma may arise in the absence of these variants [2]. Knowledge of the RMC is crucial for the clinician attempting to surgery in the mandibular third molar region because it has been reported in the literature that in about 10 - 20% of cases, this anatomical variant can entail the risk of failure of mandibular block anaesthesia.

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Since the discovery of X-rays more than a century ago, a magical eye has been opened for clinicians and surgeons to get an in-depth perception of the area of interest in the human body. Radiographic examination is an essential component of surgical planning. Panoramic radiographs are relied upon by most surgeons operating the mandibular anterior region or mandibular third molar region. By the virtue of it being a 2D imaging modality, the third dimensions of visualization are lost. At the same time, the panoramic image fails to exhibit minor vital anatomical structures due to lesser resolution and higher magnification. The advent of Cone Beam Computed Tomography (CBCT) has added the third dimension to visualize this anatomy precisely.

Materials and Methods

This study was conducted on 150 CBCT scans of Indian subpopulation to explore the capability of the CBCT to assess the incidence of retromolar canals and provide information with regard to their course. Scanning of the patients was accomplished by using a Kodak CS 9300 imaging machine using the following imaging protocols-field of view- 5 x 10 cm, voxel size - 0.18 mm, kilovoltage: 80 - 90 kv and milliampere: 5 - 10 mA. All reconstructions and measurements were accomplished using the CS imaging software program. A single observer viewed the images using a Sony Viao laptop (Intel Core i3 processor, 1.90 GHz, 4GB Ram memory, Intel HD Graphics; 15.6 HD LED LCD monitor, Windows 10 operating system). The images were analyzed and the measurements were done using the tools given in the proprietary software.

The retromolar canal was analyzed on CBCT scans on the right and the left side to assess the incidence and clinical course. Using the nerve tracing tool, the inferior alveolar canal was marked. The panoramic and sagittal sections were most appropriate sections for this assessment. A RMC was only considered as present if a distinct origin from the MC, a clear course within the image layers. Cases of canal-like structures in which neither an origin from the MC nor a comprehensible course was detected, were not considered in the study.

Based on the course and morphology using the Thomax von Arx, et al. classification [1] the recorded RMC’s were classified into five types.

- Vertical course of retromolar canal (Type A1) (Figure 1).
- Vertical course of retromolar canal with horizontal branch (Type A2) (Figure 1).
- Curved course of retromolar canal (Type B1) (Figure 1).
- Curved course of retromolar canal with additional horizontal branch. (Type B2) (Figure 1).
- Horizontal course of retromolar canal (Type C) (Figure 1).

![Figure 1: Types of retromolar canals.](image-url)
Results

300 Sides (150 Right + 150 left) in 150 CBCT scans were used to assess the incidence and clinical course of retromolar canals.

Incidence of RMC (Table 1 and Graph 1)

<table>
<thead>
<tr>
<th>Side</th>
<th>Unilateral</th>
<th>Bilateral</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right</td>
<td>Left</td>
<td>Right</td>
</tr>
<tr>
<td>RMCs Identified</td>
<td>30</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>Number of scans in which RMC was identified</td>
<td>144</td>
<td>6</td>
<td>150</td>
</tr>
</tbody>
</table>

*Table 1: Unilateral and bilateral appearance of retromolar canal.*

Out of 150 CBCT scans, 52 (34.66%) scans showed the occurrence of RMC. 30 (57.70%) scans showed the presence of RMC on the right side and 16 (30.76%) scans showed the presence of RMC on the left side. 6 (11.54%) scans showed the presence of RMC on both right and left sides. In total, 58 RMCs were found in the 300 mandibular sides, corresponding to a frequency of 19.33%.

Types of Retromolar canal (Table 2 and Graph 2)

<table>
<thead>
<tr>
<th>Sides</th>
<th>No of sides in which RMC was seen</th>
<th>A1</th>
<th>A2</th>
<th>B1</th>
<th>B2</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right side</td>
<td>36</td>
<td>8</td>
<td>2</td>
<td>13</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Left side</td>
<td>22</td>
<td>4</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>58</td>
<td>12</td>
<td>5</td>
<td>22</td>
<td>8</td>
<td>11</td>
</tr>
</tbody>
</table>

*Table 2: Side distribution showing types of RMC.*

Out of 150 CBCT scans, 58 RMC's were identified. All the unilateral and bilateral identified RMC's were grouped. The identified RMC's were classified into 5 types as per given classification by Thomas Von Arx (2001). Out of the 58 RMC's, 12 (20.7%) corresponded to type A1, 5 (8.6%) to type A2, 22 (37.9%) to type B1, 8 (13.8%) to type B2, and 11 (19%) to type C.

Discussion

The RMC is an anatomic variant, which arises from the mandibular canal behind the third molar and travels anterosuperiorly to the retromolar foramen (RMF), which is located in the retromolar fossa [3]. However, Jablonski., et al. have shown an aberrant buccal nerve may originate from the IAN within the ramus of the mandible, traversing through the RMC [4]. Two-dimensional radiographs are routinely used but the ability to detect a RMC with panoramic radiography is limited. For this reason, CBCT assume an increasingly important role in identification of very finer anatomical structures. Thus, CBCT can act as a valuable tool in assessing in the identification of retromolar canals. Various studies on different subpopulation have shown varying incidences of RMF. Ossenberg reported a higher incidence in Americans than in Japanese, Indians and Africans. This difference has been attributed to heredity, ethnic race and environmental influences such as nutrition, stress etc [5]. In the present study, 150 CBCT scans were analyzed on the right and left side to assess the incidence and course of the retromolar canal on both sides.

In the present study, 58 RMCs were found in 300 sides, corresponding to a frequency of 19.33%. Other CBCT-based studies using markedly lower number of cases partly arrived at deviating values: 14.6% in 233 sides evaluated [6], 25.6% in 121 sides [1], 37% in 90 sides [7], 65.3% in 254 sides [2]. Differences in various studies can be attributed to deviating sizes of the study populations, varying definitions of the RMC, different methods of measurement and deviating interpretations of the images on CBCT. Hence, a direct comparison of the findings was not possible. The panoramic radiographs though diagnostic of macro-anatomical structures, due to distortion and magnification may fail to show smaller anatomical variants such as RMC. On the other hand, CBCT, using lower doses of radiation is capable of giving more life size imaging of the smallest of anatomical variant to their true size. Sisman., et al. [8] compared CBCT and OPG images and found a total of 253 RMCs (144 left, 109 right) were detected with CBCT images (26.7%). Only 29 of these canals were also seen on the corresponding panoramic radiographs. Thomas Von Arx [1] also compared panoramic and CBCT images and found that the CBCT images had a higher sensitivity in exhibiting RMC than OPG. His study revealed RMC in 25.6% of the examined sides on CBCT, whereas using OPG, the respective value amounted to only 5.8%.

Different authors have defined specific anatomical courses to predict the course of RMC mentioning specific classification with regard to canal morphology. They have varied classification, but similar in structure. Ossenberg gave the first description of the type of retromolar canals based on their course and described in three patterns [5]. In our study, we have used the classification mentioned by Von Arx., et al. for identifying the course of RMC. We found that the type B1 of the RMC occurred most frequently (37.9%), followed by types A1 (20.7%), C (19%), B2 (13.8%) and C (8.6%) out of 58 RMC identified. Thomas Von Arx [1] found that most retromolar canals had a vertical course (type A1, 41.9%) or were slightly curved (type B1, 29.0%). Type C, a horizontal course, was never identified.

Katharina Filo., et al. [3] found 86 (39.82%) corresponding to type A1, 41 (18.98%) to type A2, 52 (24.07%) to type B1, 24 (11.11%) to type B2, and 13 (6.02%) to type C out of 216 RMC using Von Arx classification. The occurrence of RMC in previous osseous studies

**Graph 2:** Relative frequency of canal types (n = 58).
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[1,5,9-11] has almost always shown a unilateral occurrence. An osseous study by Sagne., et al. [12] found a high frequency of RMC occurring bilaterally. In our study only 6 scans showed the occurrence of RMC bilaterally. Theoretically, isotropic voxels should yield more accurate measurements in all dimensions [13]. The influence of voxel edge length on the frequency of RMCs is unclear. In our study using a voxel size of 0.18 mm revealed a frequency of 19.33% in analyzing the RMC. Two studies carried CBCT scans out at high resolution (0.08 mm voxel edge length) showed differing frequencies of 25.6% [1] and 65.3% [2]. Using a resolution (voxel edge length of 0.125 mm), Lizio., et al. [6] found a lower frequency (14.6%) of RMC. The sample size was different in all these studies and hence the voxel size may not be a determining factor for occurrence of RMC based on the frequency found in these studies. Studies carried out by different observers using different voxel edge lengths (0.08 mm - 0.4 mm), have shown differing range of frequencies (5.8% - 65.3%) [1,2,6-8,14,15] of the occurrence of RMC. This discrepancy may also be explained by the fact that these studies have been conducted on different subpopulations in the world and are thus influenced by the ethnic race, nutrition and growth morphology. When carrying out surgical interventions with retromolar access, the treating dentist should take into account the possible presence of this anatomical variant in order to be able to spare it in view of potential complications such as bleeding or dysesthesia.

Conclusion

Current knowledge of the retromolar canal is mainly based on cadaver studies and few case reports, most of them addressing the retromolar foramen rather than the canal. Very few CBCT studies on RMC have been reported so far. This is the first study to report the incidence of retromolar canal by CBCT in Indian subpopulation. The interesting and clinically relevant aspect of the retromolar canal is the fact that it conveys accessory innervation to the most posterior region of the alveolar process, including the mandibular molars, but it might also contain an aberrant buccal nerve. The incidence of curved course of retromolar canal was high in many of the studies making it the most common pattern. The detection of the presence of the RMC using CBCT may be crucial for extraction of mandibular third molar determined to be extremely close to the mandibular canal on panoramic radiographs. It is therefore important to confirm the course of the RMC and the location of the retromolar foramen prior to these surgical procedures.

Bibliography


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