Research Article

Prevalence And Characterisation Of Anterior Loop, Lateral Lingual Foramen And Accessory Mental Foramen In Gujrati Population By Using CBCT

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ABSTRACT

Introduction: The presence of an anterior loop (AL), accessory mental foramen (AMF), or lateral lingual foramen (LLF) adds complexity to the mental foraminal region, and implant placement in this region can damage the nerves and blood vessels if the structures are not carefully identified.

Aims and objective: The purpose of this retrospective study was to evaluate the prevalence and characteristics of the AL, AMF, and LLF to prevent complication while operating in the mandibular mental foraminal region.

Method: This retrospective study is carried out by studying 100 CBCT scans retrieved from records of CBCT centres in Gujarat. The prevalence and length of the AL was measured. The prevalence and location of the AMF as related to the mental foramen. The prevalence and location of the LLF were evaluated. Descriptive and analytical tests were performed.

Result: The prevalence of anterior loop of the inferior alveolar nerve was found to be 46%, ranging from 0.8 to 4.2 mm. The prevalence of AL length is more in male compare to female and more on left side compare to right side. The prevalence of LLF is 5%. The prevalence of AMF was 0%.

Conclusion: Anterior loop is very prevalent in gujrati population. Identifying the presence of Al and LLF is important before surgery in mental foramen region to prevent complications during surgery. These study suggested to place dental implant at least 5mm anterior to mental foramen.

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INTRODUCTION:
The mental foramen is important anatomic landmark situated bilaterally between the interproximal region of first and second premolar region. The location and number of foramina are important to consider before the placement of dental implants or other surgical procedures in the mental foraminal region.[1]

The mental branch turns upward and backward to finally exit the mandible via the mental foramen, while forming an anterior loop (AL) in this process.[2] An anterior loop is defined as the portion of the inferior alveolar nerve which extends beyond the mental foramen.[3] If the anterior loop is damaged, sensory disturbance and altered sensation would occur around the lower lip and gingival tissue between the mandibular central incisor and second premolar.[4]

On the buccal side of the mandible, additional buccal foramina, other than the mental foramen, may be found with continuity with the mandibular canal. They are defined as accessory mental foramina (AMFs). Those with no connection to the mandibular canal are identified as a nutrient foramen.[5] Local anaesthesia failure can be associated with AMFs with a complex neurovascular bundle, an accessory mental nerve (AMN). Therefore, overlooking an AMF can cause postoperative complications, such as paraesthesia or hemorrhage.[6]

The small foramens are observed in some patients in the lingual side of mandible, mostly in the mandibular incisor and premolar region.[7] According to the location, they can be classified into medial lingual foramina (either in or near the midline) and lateral lingual foramina (LLFs) (lateral to the midline).[8] Severe bleeding and hematoma formations on the mouth floor during implant surgery have been reported because of injury to the arteries entering these foramina.[9]

In the past, we generally considered that the surgery in mandibular interforaminal region is safe without severe complications. However, many studies have reported different types of complications during or after the surgery in mandibular interforaminal region, such as excessive bleeding, the loss of sensation, and fatal sublingual haematoma.[10] Information on the prevalence and morphological characteristics of ALs, AMFs, and LLFs is lacking. Before performing dental surgeries involving the mental foraminal region, a comprehensive knowledge of these anatomic variants is essential to reduce surgical complications. However, no such data have been reported in a Gujarati population. Therefore, the purpose of the present study was to investigate the characteristics of ALs, AMFs, and LLFs using CBCT images of a Gujarati population to categorize the anatomic complexity of the mental foraminal region.

AIMS AND OBJECTIVES:
The purpose of this retrospective study was to evaluate the prevalence and characteristics of the AL, AMF, and LLF in population of Gujarat to prevent complication while operating in the mandibular mental foraminal region.

MATERIAL AND METHODS:
A simple random sampling was used to select CBCT images of patients referred to the karnavati school of dentistry, for radiographic diagnosis or surgical treatment. The exclusion criteria were mandibles with pathological or developmental conditions like cysts, tumors, fractures, or malformations; partially erupted or unerupted teeth; scans that did not reveal the inferior border of the mandible; and artifacts or low image quality. Images were obtained from a CBCT scanner (DCTPRO; VATECH Corp). The field of view was 16×10 cm with a voxel size of 0.2 to 0.3 mm. A standard setting of 90 kV and 9 mA with a scanning time of 24 seconds was used for all scans. All images were analyzed by using a software program (CS 3D imaging).

The basal bone undergoes less resorption than the alveolar ridge so the plane of the basal bone was chosen as the reference plane. Parallel to the inferior edge of the mandible, the axial slices were reconstructed. On the appropriate axial slice, the mental foramen's most anterior location was marked. (Fig:1) On the sagittal slice, the area of the anterior loop with the highest curvature of the nerve was marked. From the anterior loop's most anterior point to the mesial edge of the mental foramen, the anterior loop's extension was now measured. If an AMF was
identified, the horizontal and vertical diameters of the AMF and distance from the inferior border of the mandible to that of the AMF were measured. If an LLF was identified, its location, vertical diameters, and vertical distance from the inferior mandibular border (IMB) were measured (Fig:2). Data was collected and statistical analysis was done. Chi-square tests were used to examine differences in the prevalence of the AMF and AL by side, sex, or age. 2-sample t tests were used to examine differences in the mean anterior loop length, LLF height and LLF to IMB distance by sex or side.

**RESULTS:**

A total of 100 CBCT scans were studied, with 53 men and 47 women. A total of 200 hemimandibles were evaluated in 100 patients, and the anterior loop was identified in 92 hemimandibles which was 46%. The average anterior loop length (ALL) was $2.4 \pm 1.1$ mm (range: 0.8 mm to 4.1 mm). (Table 1)(Fig: 3)

However, the prevalence of an anterior loop in men was statistically higher than that in women. ALL was also significantly longer in men ($P=.006$) and was statistically longer on the left side ($P=.004$). (Table 1)

A total of 5 LLFs were detected; 5% of patients. Most LLFs were located in the premolar region and were found at an average distance of $5.6 \pm 1.7$ mm superior to the mandibular inferior border, with the distance being significantly higher in men than in women. The mean vertical diameter of the LLFs was $1.1 \pm 0.4$ mm (range: 0.5 mm to 1.7 mm). Of the 5 LLFs detected, 60% were greater than 1 mm and 40% were less than or equal to 1 mm. (Table 2)
Table 1: Length of anterior loop categorized by side and sex.

<table>
<thead>
<tr>
<th>Group</th>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left (n=54)</td>
<td>0.8-4.1</td>
<td>2.53</td>
<td>1.3</td>
<td>.004</td>
</tr>
<tr>
<td>Right (n=38)</td>
<td>1.2-3.8</td>
<td>2.31</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (n=52)</td>
<td>1.2-4.1</td>
<td>2.42</td>
<td>1.1</td>
<td>.006</td>
</tr>
<tr>
<td>Female (n=40)</td>
<td>0.8-3.8</td>
<td>2.33</td>
<td>1.2</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Measurement of lateral lingual foramen compared between sex.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Male</th>
<th>Female</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>1.2±0.3</td>
<td>0.9±0.3</td>
<td>.04</td>
</tr>
<tr>
<td>Ibm-LLF</td>
<td>6.3±3.3</td>
<td>6.4±1.7</td>
<td>.08</td>
</tr>
</tbody>
</table>

DISCUSSION

This retrospective CBCT based study revealed the anatomic complexities of mental foramen region by evaluating characteristics of anterior loop and lateral lingual foramen. Such anatomical variances can be detected and required alterations can be performed during the presurgical phase of implant placement to prevent complication during surgery. The success of these surgical procedures and implants depends upon diagnostic tools used for accurate identification of various anatomic structures which needs to be preserved.

The present study evaluate the prevalence and characteristics of anterior loop, accessory mental foramen and lateral lingual foramen in Gujarati population.

In this study prevalence of anterior loop of mental foramen found to be 42%. In literature wide range of prevalence of anterior loop found between 0% to 88% [11] in India and outside of India. In previous CBCT based studies, Puri et al [10] observed a frequency of 53 percent in western India, 56 percent in north India, and similar findings by sitaraman [12] et al in south India, very little prevalence was found in east India is 9.7% by Sinha et al [13]. These variation in prevalence might be caused by difference in geographic areas, failure in diagnosis of anterior loop accurately, failure to use advanced diagnostic techniques for identification, lack of training of investigator.

In implant dentistry, it was usually recommended to place the most distal implant close to the mental foramen to obtain the longer distal extension of the cantilever while treating patients with 4–5 dental implants. When inserting implants mesially to the mental foramen, it is also necessary to determine a safety margin to avoid violating the anterior loop. Authors had suggested a safety margin of 2 mm to 5 mm from most distal implant to anterior loop to avoid violating the anterior loop during implant placement [14]. The average length of anterior loop was found in this study was 0.8mm to 4.2mm. The longest loop in the literature was reported by Neiva et al [15] in American population being 11 mm, followed by Uchida et al in Japanese population with a length of 9 mm. Our longest anterior loop measured 4.2 mm. As a result, when inserting implants anterior to the mental foramen, a set distance cannot be used to calculate the safety zone.

The prevalence of anterior loop was more in left side (59%) as compared to right side (41%) and longer on left side with mean length of 2.5mm ± 1.05mm than right side with mean length of 2.3mm ± 1.1mm.
Studies conducted by Puri\textsuperscript{[10]} and Nascimento EHL et al\textsuperscript{[17]} found that there was no statistically significant difference between the right and left sides in terms of the presence of anterior loop. Some studies shows prevalence of anterior loop greater on right side than left side as shown in studies by Mishra et al\textsuperscript{[18]} in their systematic review and metanalysis and also by Sinha et al\textsuperscript{[13]} in their original research.

The prevalence of anterior loop found to be vary by gender. It was more prevalent in male compared to female. Also, males were found to have a higher mean length compared to females. Similar findings have been reported by Uchida Y et al\textsuperscript{[16]}, Sinha S et al\textsuperscript{[13]} and Sitaraman.\textsuperscript{[12]}

The prevalence of lateral lingual foramen found in this study was 5%. Variation in the prevalence of LLFs could be due to differences in examination methods, study design, or ethnic groups. Literature on the classification of mandibular lingual foramina is inconsistent, and some authors have defined LLFs as foramina lateral to the midline, with others classifying foramina in the mandibular incisor and canine regions as paramedian lingual foramina and those from the first premolar to the third molar regions as lateral lingual foramina.\textsuperscript{[7,8,9]} In some studies, nutritional foramina, which are found near the alveolar process, have been identified as mandibular lingual foramina.\textsuperscript{[20]} In this study lateral lingual foramen found mostly in second premolar region. The Lateral lingual foramen were typically discovered inferior to the mental foramen and closer to the mandible's inferior border. In this study mean distance from lower border of mandible was 5.6mm. The mean vertical diameter of foramen found to be 1.1mm. Foramina with a diameter larger than 1 mm have been suggested to be at risk of severe hemorrhage.\textsuperscript{[21]} In this study we found larger diameter of lateral lingual foramen suggesting high risk during surgery. In patient with increased alveolar bone resorption, which shows ridge deficiencies which leads to superior placement of arteries. Clinician should keep all this variations in mind while treating in mental foraminal area.\textsuperscript{[19]}

AMFs have been reported to have a prevalence of 1.4% to 14.3%. The frequency of an AMF might be related to ethnicity; for instance, Sawyer et al investigated AMFs in 4 ethnic groups and found that they more frequently occurred in African Americans and members of the Nazca culture than in American whites and or Asian Indians.\textsuperscript{[22]} Additionally, different study designs and definitions of AMFs also influence their detection.\textsuperscript{[23,24]} For example, foramina without continuity with the mandibular canal have also been classified as AMFs.\textsuperscript{[23]} AMFs were usually found in the inferior or posteroinferior areas of the mental foramen.\textsuperscript{[25,26]} In literature it is reported that most AMFs were located in posterior areas of the mental foramen, with 65% of AMFs found in the area above the mental foramen, where they would be susceptible to injury from procedures such as dental implant placement.\textsuperscript{[27]} Larger AMFs were suggested to have more nerve bundles, and Iwanaga et al reported that larger AMFs were usually found in an anterosuperior location near the mental foramen.\textsuperscript{[26]} In this study no accessory mental foramen was found due to smaller sample size.

The study is unique in the sense that it was the first study carried out in population of Gujarati but it has some limitations. Sample size is very small to present whole population. Further study is required with larger sample size to access the prevalence of accessory mental foramen before coming to the conclusion. This study was carried out in a single location so similar study should be carrying out in multicentric locations before the results can be generalized.

**CONCLUSION**

Based on results found in this study we can conclude that, In the Gujarati population, the prevalence of anterior loop is high, but the prevalence of lateral lingual foramen and accessory mental foramen is low. As a result, the concept of "a safe region" in the interfornaminal region during surgical procedures should be questioned, and a careful analysis of the region should be undertaken using multiplanar CBCT images during preoperative surgical planning. Wherever a surgical procedure is to be performed near the mental foramen region, the clinician must utilise all imaging modalities available to ensure proper identification and measurements of the anterior loop length to minimize risks.
REFERENCES


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