Assessment of Anterior Loop of Inferior Alveolar Nerve: An Anatomical and Radiographic Study

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Introduction: Many surgical procedures including dental implants and osseous genioplasty is performed in the inter foraminal region of mandible and the anterior loop of inferior alveolar nerve is located within the limits of this area. As a result of vast incompatibility between the results of anatomic and radiographic studies regarding the presence and extension of this loop, we decided to perform a study to compare the result of cadaveric dissection and radiographic evaluation of this landmark. **Materials and Methods** :Anatomic and radiographic analysis were performed on 18 cadaveric hemi mandibles. Presence of mental loop was determined and the extent of anterior loop was measured both in direct anatomical dissection of cadaver hemi mandibles and in CBCT scans. **Results:** 14 hemi mandibles (77%) had mental loop both in radiographic and anatomical evaluations. The mean length of mesial extension of mental loop was 2.43mm in cadaveric dissection and 2.37mm in CBCT evaluation. There was excellent reliability between the mean cadaveric measurement and CBCT scan measurement (α coefficient: 0.983). **Conclusion:** In our study a high prevalence of mental loop was showed and despite the diversity in its length, in most cases the length was less than 3 mm. Moreover, CBCT proved to be an accurate and precise modality in detecting and measuring mental loop.

Keywords: Anatomic Variation; Cadaveric Dissection; CBCT; Mental Loop

Introduction

In placing dental implants in mandibular premolar sites or performing genioplasty, the most significant anatomic landmark to consider is mental nerve. In some cases the inferior alveolar nerve extends beyond the foramen in an anterior and inferior path and curves back to foramen to create a loop. This anterior loop of inferior alveolar nerve makes treatment planning more complicated. Violation of this important morphological landmark might lead to transient or permanent neurosensory disturbances in the area of lower lip. It is necessary to identify the entire path of mental nerve preoperatively to avoid such iatrogenic complications.

In literature variable results have been reported regarding the prevalence of anterior loop of inferior alveolar nerve ranging from 22-28% (1) to 88 % (2) with the striking maximum length of 11mm. This diversity could be attributed to the differences in evaluation technique, since some studies used panoramic radiographs (3) ,While others used CBCT (4) and direct anatomical measurements on cadavers (2).

It should be emphasized that significant anatomic variation exists in different ethnic groups and populations. Thus it would be beneficial to conduct research in different populations. Since CBCT has been proved to be more reliable and accurate than conventional two dimensional radiographs in detecting mental loop (5), we decided to perform a study to determine the correlation between direct measurement in anatomical dissection in cadaveric samples and software interpretation of CBCT in Iranian samples.

Materials and Methods

18 hemi mandibles were selected for this study. They were all from people of Iranian descent and were fixated in formalin. Most of hemi mandibles were partially dentate and few were fully edentulous. The ethics committee of Tehran University of Medical Sciences approved the study design (ethics ID IR.TUMS.VCR.REC.1394.616).

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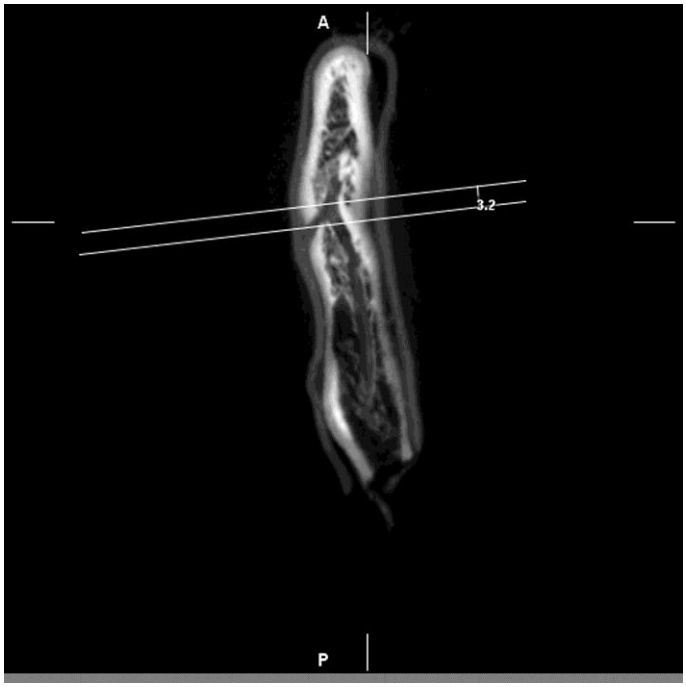

Figure 1. Measuring the distance between the most anterior point of the mental loop and the most mesial point of mental foramen in CBCT

Radiographic evaluation

Samples were mounted on custom made Styrofoam platforms in order to stay stable during imaging. The specimens were correctly positioned in the machine (Asahi, Tokyo, Japan) using the guidance of vertical light line for midsagittal plane and horizontal light lines for occlusal plane. CBCT scan was obtained from all samples with high resolution. Subsequently images were reconstructed using Romexis Viewer version 2/5/9. In order to obtain the most accurate view of the nerve and its rotation, axial reconstructed images were used. The volume was rotated in different angles so that we could select the most convenient cuts to show the rotation of inferior alveolar nerve when forming mental loop (figure1). Eventually the distance between the most anterior point of the mental loop (where incisive nerve began) and the most mesial point of mental foramen was measured in each hemi mandible. Afterwards the panoramic view was reconstructed to trace the course of inferior alveolar nerve so as to help identifying the nerve in surgical dissection.

Anatomical evaluation

With the guidance of reconstructed panoramic views, cortical bone covering the inferior alveolar nerve was removed by a round burr under constant irrigation with saline solution. Then cancellous bone was curetted meticulously to expose the incisive and inferior alveolar neurovascular bundle. At this stage 1 mm of cortical bone surrounding the mental foramen was kept intact to facilitate measurement and bone was removed under the path of nerve for more exposure. By using a CEN-TECH digital caliper the distance between the most mesial point of mental foramen and the most anterior point of mental loop was measured directly (Figure2).

Figure 2. Measuring mental loop in a cadaveric specimen

All surgical dissection was performed by a single surgeon (first author) and all measurements were repeated by two independent observers.

Data and statistical analysis

All statistical analysis was performed with SPSS version 21.0 and the reliability of two measurements was determined by α coefficient.

Results

Among the 18 hemi mandibles, 14 cases had detectable mental loop in cadaveric dissection (77%). In 14 cases with mental loop, the mean amount of the anterior extension of the mental loop was 2.42mm as measured by first viewer and 2.43mm as measured by the second viewer. The α coefficient showed excellent reliability between two viewers' measurement (α: 0.991). The maximum amount of mental loop was 3.92 mm measured by first viewer (range: 1.11- 3.92mm) and 3.88mm measured by second viewer (range: 0.98-3.88mm). The mean amount of anterior extension of mental loop in two measurements by two viewers was 2.43mm. Of the 14 hemi mandibles in which an anterior loop was identified, in no cases %) the length was between 1mm and 2mm, in 6 cases (43%) the length was between 2 mm and 3mm, and in 4 cases (28.5%) the length was between 3mm and 4mm. In CBCT scan evaluation the same 14 hemi mandibles had mental loop (77%).

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The mean amount of anterior extension of mental loop measured in CBCT scan was 2.37mm with maximum amount of 3.9 mm. According to α coefficient, there was excellent reliability between the mean cadaveric measurement and CBCT scan measurement (α coefficient: 0.983).

The difference between the mean amount of direct measurement and radiographic measurement was 0.06mm (range: -0.25 to +0.82).

Discussion

In recent years, the anterior loop of mental nerve has been studied in different ethnic groups throughout the world (1, 6-10). Most of these studies have used imaging techniques to assess the presence and length of this loop including panoramic radiography (11) CBCT (8, 12) and CT scans (10). Some of these studies have compared the ability of these modalities to identify mental loop (5) and have found out that in comparison with panoramic, CBCT provides more accurate and reliable information. Some authors have compared the reliability of conventional radiographs to direct anatomical evaluation in cadaveric specimens. In the study of Kuzmanovic *et al.,* (3), they evaluated 22 cadaveric specimens and tried to determine whether a correlation existed between the anatomically dissected path of the mental neurovascular bundle in a cadaver sample and the radiographically estimated path of mental canal using panoramic. They showed that there is a high degree of misinterpretation of the presence of mental loop in conventional radiographic evaluation and concluded that clinicians should not rely on panoramic radiographs for identifying mental loop during treatment planning. In an another cadaveric research, Mardinger *et al.,* (13) dissected 46 hemi mandibles in search of mental loop and correlated the results with panoramic radiographs. They reported that diagnosis of the anterior mental loops with panoramic radiography does not disclose the true ramification of the inferior alveolar nerve to mental and incisive nerves.

Besides, implant placement in premolar area, genioplasty is another surgical procedure which has the potential to endanger mental nerve and its loop. In a study by Hwang *et al.,* (14) , on 30 fresh hemi mandibles , they traced the inferior alveolar nerve course by serial sections at intervals of 5 mm. In the specimens, the terminal mandibular canal locates at 4.5 mm under the mental foramen. They suggested that surgeons should keep the level of sliding osteotomy of the mentum at least 4.5 mm below the mental foramen to spare the IAN and to avoid neurosensory disturbances. In a recent study by Shariati *et al.,* (15) , CBCT scans of 234 Iranian patients were evaluated and it was revealed that the prevalence of mental loop was statistically similar in males (41%) and females (39%). The mean anterior loop length was 2.77±1.56 mm, without significant sex or age differences. They concluded that the anterior loop might exist in about 40% of patients, regardless of their gender. They suggested that the mean safe anterior distance from the loop is about 3 mm + (2.5-3.1 mm) = 5.5-6.1 mm, regardless of age. In our study we found a relatively high prevalence of mental loop (77%) both in CBCT and in dry mandibles. This was in contrast to some previous radiographic studies which showed the prevalence of 22-28% (1), 48.8% (5), 41.6% (12) and 40% (15) in CBCT. In studies which used panoramic radiography to detect mental loop the prevalence was even lower (27%). This relatively low prevalence could be attributed to the limitations and disadvantages of this radiography, such as two-dimensionality, distortion, and the presence of overlapping structures. In addition, panoramic might overestimate or underestimate the presence and extent of the anterior loop (3). A study conducted by Filo *et al.,* (8) showed the prevalence of 69.7% for mental loop in CBCT evaluation of 1384 hemi mandibles which is comparable to our results (77%). On the other hand, anatomical studies have revealed higher rates of prevalence for the anterior loop of inferior alveolar nerve, with values ranging from 34% (16) to 88% (2). In our study, 14 hemi mandibles (77%) had mental loop in surgical dissection and CBCT succeeded to show the same number of mental loops. It could be concluded that CBCT has high reliability in detecting anterior loop of inferior alveolar nerve when planning for implant placement in the inter foraminal region of the mandible or performing sliding genioplasty.

The mean length of anterior extension of mental loop in our dissection of cadaveric specimens and CBCT evaluation was 2.43mm and 2.37mm respectively (A coefficient: 0.983) which is close to what has been reported in some papers (4, 15). However in some other papers the reported length was slightly shorter (8, 12). Moreover, our study demonstrated that in all cases (100%) with mental loop, the length of the anterior extension of inferior alveolar nerve was less than 4 mm which is similar to the finding of Filo *et al.,* (8) and Do Nascimento *et al.,* (12). Since we performed our study on cadaveric samples, it was not possible for us to determine the correlation between the presence and length of mental loop with age and gender.

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Conclusion

According to the findings of our study CBCT image is proved to exhibit high precision and reliability in determining the presence and measuring the length of mental loop. The high prevalence and the remarkable extent of this important anatomic landmark makes it necessary for surgeons to pay special attention when planning procedures in inter foraminal regions.

Conflict of Interest: 'None declared'.

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