How to Cite:
Jadeja, N., Pawar, M., Singh, P., Newaskar, D. P., Amin, V., & Amin, V. (2022). Comparison between conventional radiograph and 3d volumetric radiograph for determining the morphology and morphometry of mental foramen. *International Journal of Health Sciences*, *6*(S6), 749–758. https://doi.org/10.53730/ijhs.v6nS6.9673

Comparison between conventional radiograph and 3d volumetric radiograph for determining the morphology and morphometry of mental foramen

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***Abstract*---**Objective: The mental foramen is used by oral surgeons during procedures such as extractions, implant placements, osteotomies, nerve blocks, and other surgeries that might potentially harm the neurovascular bundle in the area. The purpose of this research was to evaluate the accuracy of the digitalized volumetric tomography (DVT) in detecting the brain foramen and in assessing its size, shape, and clarity in comparison to the orthopantomogram (OPG) (DVT). Materials and Method: Twenty-five people total took part in the research, with men and women represented equally. Expert three-

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2022.
Manuscript submitted: 18 Feb 2022, Manuscript revised: 27 April 2022, Accepted for publication: 9 June 2022

dimensional (3D) software in DVT and Annotation software in OPG were used to compare and contrast the location, contour, size, and clarity of the cerebral foramen. Results: “The mental foramen was located in the center of the jaw, between the roots of the upper and lower molars and the super inferior cortex of the mandible. The mental foramen was found to be in the same place by both OPG and DVT. Most mental foramen were found to be oval, with the highest definition seen in DVT. DVT provided a more distinct picture of the anatomy, and measurements of the mental foramen were determined to be 0.51 0.06 cm, compared to 0.49 0.05 cm in OPG. The position, roundness, size, and transparency of the mental foramen did not vary significantly between the sexes.” Conclusion: The mental foramen's location may be determined using conventional radiography at the outset, but 3D volumetric radiography is needed to validate the details and prevent difficulties throughout the procedure.

***Keywords*---**digitalized volumetric tomography, 3d volumetric radiograph, mental foramen, orthopantomography.

Introduction

On the body of the mandible, on its anterolateral side, is a bony opening called the mental foramen. In [1] it conveys the neurons and vessels of the mind. [2] Mental foramen location also shifts with age and different ethnic groups. [3] Age has an effect on who is superior and who is inferior. In young children, it is located at the lower mandibular border; in adolescents, it is situated halfway between the alveolar crest and the lower mandibular border; and in adults, it is located close to the alveolar crest. [4] Therefore, radiography is the most popular non-invasive technique for evaluating the mental foramen since it results in few problems after the procedure. The mental foramen may be either oval, circular, or irregular in form. [5] To reduce the risk of problems after surgery, it is important to precisely characterize the mental foramen. Since the mental foramen may vary in size across races, knowing exactly where to place a nerve block might help avoid postoperative neurovascular problems including numbness, tingling, or a loss of feeling in the face. If the mental foramen is well delineated, it is easier to get more accurate morphometry. Patients from low-income backgrounds often undergo a variety of general dental procedures. A rough estimate of the location of the mental foramen may be obtained with the use of optimal radiography methods with precise exposure conditions. Three-dimensional (3D) volumetric imaging is recommended over standard radiography for precise morphometry during extensive operations like implant implantation and osteotomy. Orthopantomography (OPG) and digitalized volumetric tomography (DVT) may be used to assist ensure that the mental foramen is properly located prior to invasive lower facial procedures.

Materials and Methods

An in vivo cross-sectional investigation was conducted. Twenty-five participants were selected among patients visiting the Department of Oral Medicine and

Radiology's outpatient clinic for the research, which was authorized by the Institutional Ethical Committee.“The inclusion criteria were as follows:

- Age group of patients between 15 and 65 years
- Patients with edentulous areas in the posterior region of the mandible.

The exclusion criteria were as follows:

- Patients with systemic disease (rheumatoid arthritis, osteomalacia, osteogenesis imperfecta, osteoporosis) which can affect bone integrity
- Patients suffering from bleeding disorders (hemorrhagic diathesis, drug-induced
- Anticoagulation
- Patients with pathologies in the upper and lower jaws and oral mucous membrane
- Immunocompromised patients (HIV, immunosuppressive medications)
- Drug abusers, alcohol consumers, and heavy smokers
- Psychological and mental disorders
- Noncompliant patients
- Patients who underwent radiotherapy
- Patients with habit of bruxism
- Patients on IV bisphosphonates.”

Dental chairs with lights, mouth veils, sterile gloves, a straight test, a pioneer plate, a kidney plate, cotton, cloth, 0.2 percent chlorhexidine gluconate arrangement, and cheek retractors were used for patient evaluation.“Use of orthopantomography (OPG) technology was made possible (Planmeca Proline CC Panoramic X-beam; Planmeca OY, Helsinki, Finland). The Dutch-made Philips Allura Xper FD20 3D RA advanced deduction angiography equipment was used to capture the high-resolution 3D images.”

Methodology

A complete case history and physical and oral examination were performed after gaining informed permission from all participants. “The radiographic evaluation of the mental foramen included an OPG and a DVT of the posterior jaw. Expert 3D software in DVT and Annotation software in OPG were used to assess the cerebral foramen's placement, contour, dimensions, and visibility.” The radiological results were documented. We also compared the two radiographic methods to one another in further detail. SPSS 16 was used for statistical analysis, and tests like the Chi-square and unpaired t-test were performed.We considered a statistical result to be significant if it was more than 0.05, thus we chose $P > 0.05$. *“Position of the mental foramen*DVT's Expert 3D program and OPG's Annotation software were used to determine where the mental foramen was located.[4]

Position with respect to apices of premolars and molars:

- Position 1: situated anterior to first premolar
- Position 2: situated at the apex of first premolar
- Position 3: situated in between first and second premolar

- Position 4: situated at the apex of second premolar
- Position 5: situated in between second premolar and first molar
- Position 6: situated apex in the of first molar

Position with respect to superoinferior cortex of mandible in vertical plane:

- Position 0: at the superior third of the jaw
- Position 1: at the middle third of the jaw
- Position 2: at the inferior third of the jaw.

Shape of the mental foramen

Expert 3D software in DVT and Annotation software in OPG were then used to study the mental foramen's structure. Round, circular, and other irregular forms were also taken into account..[5]

Size of the mental foramen

The mental foramen was then measured with the use of DVT's Expert 3D program and OPG's Annotation software. The width of the mental foramen was measured horizontally [6] from its proximal to distal endpoints.

Distinctness of the mental foramen

Expert 3D in DVT and Annotation in OPG were used to examine the mental foramen's clarity..[7]

- Position 0: indistinct
- Position 1: distinct.”

Results

This investigation used both traditional and high-definition radiography to assess the position, size, and clarity of the mental foramen. Twenty-five participants with posterior mandibular edentulous regions were recruited after rigorous screening for eligibility. There were a total of 25 cases, 9 men and 16 women of whom were deemed to have no clinical relevance. Patients' ages varied widely, from 15 to 65, with a mean of 35.48 12.69. When examining the anteroposterior side of the jaw bone with OPG and DVT, it was found that in neither technique was the psychological foramen present in front of the major premolar and in agreement with the primary molar. Most often, the psychological foramen was discovered to be aligned with the following premolar in both OPG and DVT (see [Table 1]. Using OPG and DVT to locate the psychological foramen in the superoinferior portion of the jaw bone, it was shown that the middle third of the mandibular cortex is the most consistent location [Table 2].

Table 1

With respect to apices of premolar and molar		OPG		DVT		*P*
	n	*%*	*n*	*%*		
Anterior to 1. premolar	00	00	00	00	1.100	0.777
In line with the 1. premolar	02	08	03	12		
In between 1. and 2. premolar	06	24	05	20		
In line with 2. premolar	13	52	15	60		
In between 2. premolar and1· molar	04	16	02	08		
In line with the 1st molar	00	00	00	00		

Table 2

With respect tosupero inferior complex of mandible	OPG		DVT		P value
Superior third	00	00	00	00	0.637
Middle third	21	89	22	93	
Inferior third	02	11	01	07	

When comparing OPG to DVT, there was no discernible shift in where the mind was located. When looking at the location of the mental foramen across both sexes, we found no. Both OPG and DVT found that the most frequent form for the mental foramen was oval. As may be shown in [Table 3], the mental foramen's shape differed significantly between OPG and DVT. When looking at the mental foramen from a male and female perspective, we found no discernible differences.

Shape of mental foramen	OPG		DVT		P value
Round	00	00	00	00	0.601
Oval	20	90	22	93	
Irregular	03	10	01	07	

On average, the diameter of the mental foramen was 0.49 0.05 cm as measured by OPG. When examined using a digital vascular tomograph, the average diameter of the mental foramen is found to be 0.51 0.06 cm. Both OPG and DVT showed similar mental foramen sizes. When comparing the sizes of mental foramen between the sexes, there was no discernible difference. Unlike in OPG, the mental foramen stood out clearly in DVT. Examination of the mental foramen in both sexes showed no statistically significant variation in its clarity.

Discussion

“Position, shape, size, and distinctness of mental foramen”

The mental foramen is a tiny hole in the jawbone on the anterior (front) side, maybe at the second premolar, through which some of the brain's blood vessels and neurons go. During surgical, local anesthetic, and other invasive treatments, the periapical area of the mandible serves as a significant anatomical marker. [1]

In order to properly diagnose a patient and prepare for any necessary mandibular surgery, it is crucial to know precisely where their mental foramen is located.It is suggested to radiographically identify the mental foramen before attempting to provide standard mental nerve blocks or other therapies at its site due to the high risk of paraesthesia, hemorrhage, and unintentional nerve damages associated with positional misjudgements of mental foramen.[2]

Position of the mental foramen

“The mental foramen is often aligned with the second mandibular premolar, as determined by OPG and DVT. The results of two different radiological examinations of the mental foramen were consistent (Table 1 and Graph 1). Afkhami et al.,[8] Ngeow and Yuzawati, and Juodzbalys et al. all came to similar conclusions. The same conclusion is drawn by many groups of researchers, including Greenstein and Tarnow [9], Yeilyurt et al. [10], Al-Jasserand Nwoku [4], Shankland, Wang et al. [12], Kekere-Ekun TA [13], Kay LW [14], Oliveira et al. [15], and Gungor et al. [16]. [17]

The mental foramen was found to be located 68.1% of the time behind the apex of the second premolar tooth in dry mandibles, according to a study by Singh and Srivastav[6]. Several study teams, including Agarwal and Gupta,[1] Gupta and Soni,[18] Hasan T,[3] Pokhrel and Bhatnagar,[20] Bhandari et al.,[21] Budhiraja et al.,[22] Roy et al.,[23] Nimje et al.,[24] and [24] have found comparable findings from their experiments with dried. Various studies, including those conducted by Babshetet al.[25], Fishel et al.[26], Olasoji et al.[27], Dehghani and Ghanea[28], Al-Khateeb et al.[29], and Neiva et al.[30], have yielded contradictory results as to the precise location of the mental foramen. In contrast to its right-side placement between the first and second premolars, the mental foramen was found by Rai et al.[31] to lie between the second and third premolars on the left side.” The mental foramen was discovered by Kjaer[32] to reside between the main canine and the first molar of the growing jaw.

Our results are consistent with other research that have shown no significant changes in brain foramen location based on gender. Similar results have been found by Jamdade et al. [10] and Pokhrel and Bhatnagar[19]. [33].“We found that the mental foramen, in relation to the super inferior dimension of the mandible in the vertical plane, is often located in the middle third of the mandibular jaw (see [Table 2] and [Graph 2]). Ngeowet al.[9] noticed that the position of the mental foramen changed with age, loss of alveolar bone, and tooth loss.”” The mental foramen is said to shift upward with age, toward the mandibular superior border, according to Gupta and Soni[18]. Major factors were tooth decay and alveolar bone loss. Over the course of a human life, the position of the brain's mental foramen shifted significantly.

The mental foramen was researched by Fishel et al. [26], who classified it into three groups according to how close they were to the tooth's apex, coronal area, and periapical region. Only 24.5% of second premolars had a mental foramen that was coronal to the apex, 13.9% were located at the apex, and 61.6% were apical to the apex. In their study, Budhirajaet al.[21] found that the location of the mental foramen was associated with nutrition and, in turn, influenced the growth

of the mandible. According to Green[34], the mental foramen is often found at a more anterior place on the skull among Caucasoid populations. Seema et al.[35] report that in infants the mental foramen is positioned at the lower border, but in adults it has migrated to the midline between the upper and lower borders to accommodate the presence of permanent teeth.With aging, the mental foramen became more vertical because the alveolar margin shrank due to tooth loss.

Shape of the mental foramen

The mental foramen was most often seen as an oval in both OPG and DVT, as was the case with our investigation. Although it was clear that the form was oval using both OPG and DVT, there were notable discrepancies in the analyses obtained using the two methods [Table 3] and [Graph 3].Results are consistent between Juodzbalyset al.[7] and Agarwal and Gupta [6, 7]. [1].Greenstein and Tarnow[10] found that the shape of the mental foramen may vary from round to oval. The most frequent shape of dried mandibles was an oval, according to many authors (including Hasan T.[3], Bhandari et al.[20], Udhaya et al.[36], Roy et al. [22], Nimje et al. [23], and Vimala et al. [24]). Studies of dried mandibles by Singh and Srivastav[6], Gupta and Soni[18], and Rai et al.[31] all show that the mental foramen is typically circular. No differences in brain foramen shape were observed between the sexes. As far as I could determine from my literature search, no research have used OPG or DVT to compare the anatomy of the brain foramen in the sexes.

Size of the mental foramen

The average width of the mental foramen was found to be 0.49 0.05 cm in our research, whereas the width was assessed to be 0.51 0.06 cm using OPG. It is evident from both [Table 4] and [Graph 4] that there is no discernible difference between OPG and DVT in terms of sizing the mental foramen. Study by Juodzbalys et al. [7] echoes these conclusions. In dried mandible specimens, Singh and Srivastav[6] found that the mental foramen measured 2.8 mm in length. Oguz and Bozkir[37] and Hasan T[3] both put the average width of the mental foramen between 2.93 and 3.14 mm, while Roy et al.[22] claimed that it was around 3.01 mm. Dried mandibles were used in the study by Rai et al.[31], and they found that the average diameter of the mental foramen was 2.63 0.85 mm. According to our findings, there was no difference in brain foramen size between males and females while evaluating them with OPG and DVT. We were unable to locate any studies that examined male and female mental foramen sizes.

Distinctness of the mental foramen

The mental foramen was shown to be more easily distinguishable in DVT than in OPG [Table 5],in this investigation. Unfortunately, the mental foramen has not been thoroughly investigated using 3D volumetric imaging. In their analysis of OPG images of the brain, Greenstein and Tarnow[10] observed that the borders of 25% of the foramina were fuzzy. The mental foramen was visible in 87.5% of panoramic radiographs, according to research conducted by Yosue and Brooks[38]. Studies by Jacobs et al.[39] indicated that the mental foramen was

present in 94% of cases on OPG, albeit it was only clearly visible in 49% of cases. There was no significant difference in the visibility of brain foramen between males and females, as measured by OPG or DVT."As far as we are aware, no previous studies have compared the sexes independently.
The mental foramen has been the focus of OPG and DVT research in this examination because to its prominent location near the base of the jaw. "These methods have been used to learn more about the location, size, form, and degree of differentiation of the mental foramen and other important anatomical features. Although several studies have used preserved mandibles to determine the position of the mental foramen, few have done so in India due to a lack of access to radiography."In contrast, our work has examined the foramen first on OPG and then on DVT for more reliable findings, allowing its usage in actual humans. We also examined the mental foramen's location along the jaw's superior-inferior axis. This occurs because the position of the mental foramen changes with age. "This discovery provides valuable insight into the precise location of the mental foramen, which may be used to plan implants, osteotomies, and other procedures in the posterior part of the mandible with little disruption to the neurovascular bundle in the mental region.

Conclusion

The mental foramen is normally found at the midline of the jaw, in relation to the superoinferior cortex of the mandible in the vertical plane, and along the line of the second premolar with regard to the apices of the premolars and molars. Both sexes exhibit this dispersion pattern."DVT showed more well defined anatomical structures than OPG did, and the most frequent form of the mental foramen was determined to be oval. Neither boys nor females showed any discernible variation in foramen shape.Mental foramen measurements were taken and found to be 0.49 0.05 cm in OPG and 0.51 0.06 cm in DVT. The size of the foramen did not vary significantly across sexes.DVT made the mental foramen more apparent than OPG did, and there was no discernible difference between the sexes.

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