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Morphometric study for determining the anteroposterior position of the mental foramen in dentate human subjects

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Abstract

Background: The mental foramen (MnF) is the place where the mental nerve and mental artery exit the body of the mandible, being an important landmark for dentoalveolar surgery. **Materials and Methods:** For the assessment of MnF topography, we performed a direct morphometric study and two morphometric imaging studies through cone-beam computed tomography (CBCT) scans and orthopantomography (OPG). The following locations of the MnF were investigated: anterior to the first premolar, at the first premolar level, between the two premolars, at the second premolar level, between the second premolar and the 6-year molar, and at the level of the mesial root of the 6-year molar. The data obtained were statistically analyzed by *chi-squared* test. **Results:** Through direct morphometry on dentate dry human mandibles, no statistically significant differences were found for the number of MnF located between the two premolars, at the level of the second premolar and between the second premolar and the 6-year molar, depending on age and analyzed side. The number of MnF located between the second premolar and the first molar varies statistically significantly in relation to the subject's gender but does not vary statistically significantly depending on age and side. By means of imaging morphometry through OPG, we found that the number of MnF located at the first premolar level, between the two premolars, at the second premolar level and between the second premolar and the 6-year molar varies statistically significantly in relation to the age of the patients. Using imaging morphometry through CBCT scans, we found that the number of MnF located between the two premolars, at the second premolar level and between the second premolar and the 6-year molar varies statistically significantly according to the age of the patients. Comparing the results obtained from the three studies, we found that only according to age the number of MnF located between premolars and at the level of the second premolar varies statistically significantly. **Conclusions:** Wide and accurate knowledge of both the MnF topography and the key anatomical landmarks used in locating it proves to be essential and clinically relevant in dentoalveolar and endodontic surgery, and for improving anesthesia techniques.

Keywords: mental nerve, direct and imaging morphometry, OPG, CBCT, mental nerve block.

✉ Introduction

Mental foramen (MnF) is situated on the buccal side of the mandibular body, usually in the premolar region. The MnF externalizes the mental canal and contains the mental neurovascular bundle; hence, it is important for highly effective local anesthesia and dentoalveolar and implant surgery in the posterior mandible [1–5].

MnF topography varies, thus favoring a decreased success rate in the case of mental nerve block and the occurrence of complications during different dentoalveolar surgery procedures in this area [2, 6].

The specialized literature on this topic does not convey a unified perspective when describing the topography of the MnF. The topography of the MnF presents frequent

population variations and even individual variations comparatively left/right side [1, 4, 7–10].

Accurate determination of the MnF location is especially important for implant dentistry, which developed a lot over the last decade [1, 4, 11].

In-depth knowledge of the MnF topography, of the mandibular canal and of the vital neighboring structures is important for loco-regional anesthesia, in endodontics, periodontology, implant surgery and dentoalveolar surgery, *i.e.*, in all therapeutic procedures performed on the posterior mandible [1, 12, 13].

The MnF can be identified by orthopantomography (OPG) and especially by cone-beam computed tomography (CBCT), which requires a low dose of radiation; by being able to provide structural details in the three directions of

space, the latter imaging technique has greatly improved the pre-interventional morphological analysis.

Aim

Research existing in the specialized literature describes differences in the MnF location. Consequently, in this study, we aim to show a combined morphometric determination, by direct and imaging techniques, of the topography of the MnF on Romanian population, particularly its antero-posterior location in relation to the teeth.

Materials and Methods

The topography of the MnF on the sagittal plane (in relation to the teeth) was assessed by an *ex vivo* morphometric study on 27 dentate mandibles from the Francisc I. Rainer Anthropology Institute of the Romanian Academy, Bucharest, the same specimens, with specified gender and age, used in a previous study concerning the topography of the mandibular foramen [8]. At the same time, we carried out two morphometric imaging studies through CBCT scans (19 from partially edentulous patients) and OPGs (21 from dentate patients) from a private dental practice. Patients' written informed consent was obtained for using the radiographs in this research.

Figure 1 – MnF topography.
The anatomic landmarks used for the study [1].
MnF: Mental foramen.

Figure 2 – OPG: the location of the MnF between the two premolars. MnF: Mental foramen; OPG: Orthopantomography.

Figure 3 – Visualization of the left MnF on CBCT image CBCT: Cone-beam computed tomography; MnF: Mental foramen.

Results

The first study: direct morphometry on 27 dentate dry human mandibles

The distribution of the specimens with respect to gender was 18 (66.7%) females and nine (33.3%) males. The average age of the subjects was 29.5 years, with the minimum age of 20 years and the maximum age of 39 years.

Concerning MnF location, the mean obtained values on the right vs. left side were different, as shown in Table 1, which demonstrates morphological asymmetry.

Overall, most commonly, the MnF was located between PM1 and PM2 and at PM2 level in equal percentages, 48.15% of cases, hence in a total percentage of 96.3%. More rarely (3.7%), the MnF was found in another location (Table 1).

The results obtained on the MnF anteroposterior location in relation to the teeth, by direct morphometry in the 27 dry dentate mandibles were statistically analyzed by *chi*-squared test (Table 2).

The following MnF locations (as shown in Figure 1) were investigated on both sides of the mandibles:

- 1 – anterior to the first premolar (PM1);
- 2 – at the level of the first premolar;
- 3 – between the two premolars;
- 4 – at the level of the second premolar (PM2);
- 5 – between the second premolar and the first molar (M1);
- 6 – at the level of the mesial root of the first molar.

For panoramic orthopantomography, a PLANMECA ProMax 2D was used, with the following technical parameters: 68 kV, 10.0 mA, about 15.8 seconds X-ray exposure time, and approximately 13 μ SV the effective radiation dose. Radiographically obtained data were processed with ROMEXIS 4.6 software (Figure 2).

For the CBCT, a NewTom VGi Evo imaging unit was used, with the technical specifications: 1–20 mA, 110 kV, 3.5–4.3 seconds X-ray exposure time range, 18 seconds scanning time, and 100 μ SV effective dose, used in a previous study [8]. Data obtained were analyzed on a computer with New Net Technologies (NNT) ver. 11 software [8]. The measurements expressed in millimeters, on mandibular sections, are at a scale of 1:1 (Figure 3).

The results of the measurements were statistically analyzed using χ^2 (*chi*-squared) test in Stata/MP13 software package. The statistical significance level was set at $p \leq 0.05$.

Table 1 – The results for the MnF locations on dentate dry mandibles

The results of the measurements [%]			
Right side			
Analyzed landmarks	N ₁	N ₂	%
Anterior to the first premolar	27	0	0
At the first premolar level	27	0	0
Between premolars	27	11	40.7
At the second premolar level	27	15	55.6
Between the second premolar and the first molar	27	1	3.7
At the mesial root of the first molar level	27	0	0
Left side			
Analyzed landmarks	N ₁	N ₂	%
Anterior to the first premolar	27	0	0
At the first premolar level	27	0	0
Between premolars	27	15	55.6
At the second premolar level	27	11	40.7
Between the second premolar and the first molar	27	1	3.7
At the mesial root of the first molar level	27	0	0

MnF: Mental foramen; N₁: No. of subjects; N₂: No. of findings.

No statistically significant differences were found for the other locations of the MnF depending on age and the analyzed side (left/right) ($p>0.05$). The number of MnF located between PM2 and M1 varies statistically significantly according to gender ($p<0.05$) but does not vary statistically significantly depending on age and the analyzed side (left/right).

Table 2 – Analysis of the measurements on dentate dry mandibles by chi-squared test

Chi-squared test – all specimens						
Analyzed landmarks	N₁	N₂	Side	Gender	Age	
			p	p	p	
Anterior to the first premolar	27	54	–	–	–	
At the first premolar level	27	54	–	–	–	
Between premolars	27	54	0.276	0.336	0.208	
At the second premolar level	27	54	0.276	0.847	0.208	
Between the second premolar and the first molar	27	54	1.00	0.042	0.055	
At the mesial root of the first molar level	27	54	–	–	–	

N₁: No. of subjects; N₂: No. of findings.

The second study: imaging morphometry through orthopantomography (OPG) in the 21 dentate patients

In this study, the distribution of the females was close to that of males, 11 (52.38%) males and 10 (47.62%) females. The minimum age was 20 years, the maximum age 39 years and the mean age of the subjects was 41.5 years.

The mean values for the landmarks analyzed by OPG imaging morphometry on dentate human mandibles depending on the analyzed side are close, which demonstrates morphological symmetry. There is greater variability in the MnF topography as compared to the previous study; moreover, in this study, the location of the MnF at PM1 level was registered. Most commonly, the MnF was located between PM1 and PM2 in 19 (45.2%) from the total of 42 studied sides, and at PM2 level in 18 (42.9%) from the total of 42 studied sides, hence in a total percentage of 88.1%. In 11.9% of the cases, the MnF was found in other locations (Table 3).

The results obtained on the MnF anteroposterior location in relation to the teeth, by OPG imaging morphometry, for the 21 patients were compared by side, gender, and age through *chi-squared* test (Table 4). The topographical locations of the MnF mentioned in Table 4 vary statistically significantly in relation to the age of the patients ($p<0.05$). There are no statistically significant differences (*chi-squared* test) concerning the topographical locations of the MnF mentioned in Table 4 for the left side vs. the right side and in relation to the gender of the patients ($p>0.05$).

The third study: imaging morphometry by CBCT scans on the 19 dentate patients

The distribution of the patients with respect to gender shows that males are predominant (57.8%), and the average age of the subjects was 56.3 years. The main criterion for patient selection was the presence of premolars.

The different percentage values obtained for the MnF locations in relation to the analyzed side by imaging

morphometry through CBCT scans on dentate human mandibles, showed morphological asymmetry (Table 5).

Table 3 – The results for the MnF locations by OPG examination in dentate patients

The results of the measurements by OPG [%]			
Right side – all patients			
Analyzed landmarks	N₁	N₂	%
Anterior to the first premolar	21	0	0
At the first premolar level	21	1	4.8
Between premolars	21	9	42.9
At the second premolar level	21	9	42.9
Between the second premolar and the first molar	21	2	9.5
At the mesial root of the first molar level	21	0	0

Left side – all patients			
Analyzed landmarks	N₁	N₂	%
Anterior to the first premolar	21	0	0
At the first premolar level	21	1	4.8
Between premolars	21	10	47.6
At the second premolar level	21	9	42.9
Between the second premolar and the first molar	21	1	4.8
At the mesial root of the first molar level	21	0	0

MnF: Mental foramen; N₁: No. of subjects; N₂: No. of findings; OPG: Orthopantomography.

Table 4 – Analysis by chi-squared test of the measurements carried out on OPG in dentate patients

Chi-squared test – all patients, examination by OPG						
Analyzed landmarks	N₁	N₂	Side	Gender	Age	
			p	p	p	
Anterior to the first premolar	21	42	–	–	–	
At the first premolar level	21	42	1.00	0.167	0.003	
Between premolars	21	42	0.757	0.226	0.016	
At the second premolar level	21	42	1.00	0.721	0.009	
Between the second premolar and the first molar	21	42	0.549	0.607	0.023	
At the mesial root of the first molar level	21	42	–	–	–	

N₁: No. of subjects; N₂: No. of findings; OPG: Orthopantomography.

Table 5 – The results for the MnF locations by CBCT examination in dentate patients

The results of the measurements by CBCT [%]			
Right side – all patients			
Analyzed landmarks	N₁	N₂	%
Anterior to the first premolar	19	0	0
At the first premolar level	19	1	5.3
Between premolars	19	9	47.4
At the second premolar level	19	8	42.1
Between the second premolar and the first molar	19	1	5.3
At the mesial root of the first molar level	19	0	0

Left side – all patients			
Analyzed landmarks	N₁	N₂	%
Anterior to the first premolar	19	0	0
At the first premolar level	19	2	10.5
Between premolars	19	7	36.8
At the second premolar level	19	7	36.8
Between the second premolar and the first molar	19	3	15.8
At the mesial root of the first molar level	19	0	0

CBCT: Cone-beam computed tomography; MnF: Mental foramen; N₁: No. of subjects; N₂: No. of findings.

Similar to the previous study, we found greater variability regarding the MnF topography. Most commonly, the MnF was located between PM1 and PM2 in 16 (42.10%) from the total of 38 studied sides, and at PM2 level in 15 (39.45%) from the total of 38 studied sides. These main locations represent a total percentage of 81.55% of the cases. The MnF was less commonly situated between PM2 and M1 (10.55%), and at PM1 level (7.9%).

The results obtained on the MnF anteroposterior location in relation to the teeth, by imaging morphometry through CBCT scans, in the 19 dentate patients were compared by side, gender and age through *chi*-squared test (Table 6). The number of MnF located between PM1 and PM2, at PM2 level, between PM2 and M1 varies statistically significantly depending on age ($p < 0.05$). There were no statistically significant differences for all locations of the MnF mentioned in Table 6, in relation to the analyzed side and the patients' gender ($p > 0.05$).

Table 6 – Analysis by *chi*-squared test of the measurements carried out on CBCT in dentate patients

Chi-squared test – all patients, examination by CBCT						
Analyzed landmarks	N₁	N₂	Side	Gender	Age	
			<i>p</i>	<i>p</i>	<i>p</i>	
Anterior to the first premolar	19	38	–	–	–	
At the first premolar level	19	38	0.547	0.748	0.787	
Between premolars	19	38	0.511	0.624	0.023	
At the second premolar level	19	38	0.740	0.832	0.033	
Between the second premolar and the first molar	19	38	0.290	0.832	0.045	
At the mesial root of the first molar level	19	38	–	–	–	

CBCT: Cone-beam computed tomography; N₁: No. of subjects; N₂: No. of findings.

Analysis of the results as a whole

Analyzing the results for the 67 subjects by the *chi*-squared test, no statistically significant differences regarding the MnF locations mentioned in Table 7 were found for the study, for the right side vs. the left side and according to gender ($p > 0.05$). The number of MnF located at PM1 level and between PM2 and M1 does not vary statistically significantly depending on age ($p > 0.05$). The number of MnF located between PM1 and PM2, and at PM2 level varies statistically significantly depending on age ($p < 0.05$).

Table 7 – Analysis by *chi*-squared test of the results as a whole

Chi-squared test						
Analyzed landmarks	N₁	N₂	Study	Side	Gender	Age
			<i>p</i>	<i>p</i>	<i>p</i>	<i>p</i>
Anterior to the first premolar	67	134	–	–	–	–
At the first premolar level	67	134	0.132	0.649	0.123	0.590
Between premolars	67	134	0.848	0.603	0.262	0.016
At the second premolar level	67	134	0.699	0.384	0.807	0.011
Between the second premolar and the first molar	67	134	0.433	0.730	0.563	0.111
At the mesial root of the first molar level	67	134	–	–	–	–

N₁: No. of subjects; N₂: No. of findings.

Discussions

No similar study could be found in the specialized literature we accessed, that was able to present such a complex analysis of the MnF topography by two methods of imaging morphometry, OPG and CBCT, in addition to direct morphometry.

The measurements were performed by the same person, thus eliminating possible errors.

The studies analyzed as a whole show that the most frequent location of the MnF (45.15%) was between PM1 and PM2, in 61 from the total of 134 registered observations, followed by the position at PM2 level (43.50%), in 59 from the total of 134 registered observations. Separate analysis in men vs. women shows that the most frequent location of the MnF in men was at PM2 level (45.46%), in 28 from the total of 62 registered observations, while in women, the most frequent location was between the two premolars (48.41%), in 32 from the total of 72 registered observations.

The results obtained in the three studies were close in value in terms of the order of frequency of MnF location and demonstrate the existence of left/right symmetry on location of MnF in relation to the sagittal plane by direct morphometry; the same is valid in female patients for CBCT imaging morphometry, only for MnF locations between PM1 and PM2, and at PM2 level. These results show some similarities with other studies in the literature, but also reveal many differences.

Analyzing the MnF topography in relation to the sagittal plane on dry dentate human mandibles from Turkish population, Oguz & Bozkir (2002) [1, 14] showed the following frequent locations: at PM2 level (55.8%), and between PM1 and PM2 (44.10%), with significant differences between the left and right sides. Such results differ from those we presented in this study.

Ngeow & Yuzawati (2003) [1, 15] studied the MnF topography on Malaysian population by panoramic radiographs and showed that in relation to the sagittal plane, the most common location was at PM2 level (69.20%), and between PM1 and PM2 (19.60%), with bilateral symmetry in 67.70% of cases. Again, the results differ from ours.

Kim et al. (2006) [1, 16] evaluated the MnF anteroposterior topography on Korean population, both clinically and by panoramic radiographs, and described the following locations: at PM2 level (64.3%), between PM1 and PM2 (26.8%), and at PM1 level (8.9%). These findings are different from ours.

Al-Khateeb et al. (2007) [17] studied the MnF topography on the sagittal plane by OPG on Jordanian population and showed that its most common horizontal location was between PM1 and PM2, a result close to that presented in this study.

Most of the accessed studies that evaluated the topography of the MnF in relation to the sagittal reference plane were carried out on Indian and Iranian populations.

In a study of dry dentate human mandibles from the population of Bangladesh, Hoque et al. (2013) [1, 18] presented the following locations for the MnF: between PM1 and PM2 (42.45%), at PM2 level (35.9%), and behind PM2 (21.65%), with bilateral symmetry. These results are relatively close to those presented in this study.

By OPG evaluation of Indian population, Parnami *et al.* (2015) [9] illustrated the following anteroposterior locations for the MnF: at PM2 level 61.0%, and between PM1 and PM2 28.7%. The results are different from those obtained by us.

By standardized OPG evaluation of Asian population, Gada & Nagda (2014) [1, 19] described that the common anteroposterior locations for the MnF were: between PM1 and PM2 63.0%, and at PM2 level 20.67%. Symmetry between left and right side was found. These results are different from our study.

By OPG evaluation on Indian population, Verma *et al.* (2015) [20] showed that, on sagittal plane, the MnF was situated at PM2 level (43.33%), and between PM1 and PM2 in 35.41% of cases, with some left-right asymmetry. The results are different from those obtained in this study.

In a retrospective CBCT study on South Indian population, Chappidi *et al.* (2019) [21] showed that, in sagittal plane, the MnF presents the following locations: between PM1 and PM2 (62%), at PM2 level (34%), at the PM1 level (1.6%), and between PM2 and M1 (1.4%). These results are similar to ours; however, the percentages differ, being greater than the ones obtained by us for the location between the two premolars and smaller for the locations at PM1 level, at PM2 level and between PM2 and M1.

Khalid *et al.* (2019) [22] radiographically evaluated the MnF topography in relation to the sagittal plane on Indian population and showed that it is located at PM1 level (45.71%), at PM2 level (38.57%), and between PM1 and PM2 (8.57%); it was not visible in 7.14% of cases. The results are different from those obtained in our study.

Haghanifar & Rokouei (2009) [1, 23] assessed Iranian population by OPG and showed that the MnF was frequently located between PM1 and PM2 (47.20%), and at PM2 level (46.0%), with a symmetry of 85.7%. These results are very close to those presented in this study.

Khojastepour *et al.* (2015) [24] assessed the MnF by CBCT on Iranian population and showed the following anteroposterior positions: at PM2 level (49.4%), and between PM1 and PM2 in 33.2% of cases, with slight left/right and women/men asymmetry. The results are comparable to those obtained by us for male subjects.

By CBCT evaluation of Iranian population, Sheikhhi *et al.* (2015) [25] determined that the most frequent locations of the MnF were: between PM1 and PM2, and at PM2 level. The results are comparable to those obtained by us only in terms of frequency, since percentage values were not presented.

Xie *et al.* (2021) [26] evaluated the MnF topography on Chinese population and demonstrated that it was located at PM1 level in 20% of the cases, at PM2 level in 75% of the cases, and at M1 level in 5% of the cases.

Fabian (2007) [1, 27] studied the anteroposterior position of MnF in Tanzanian population and presented the following locations: at PM2 level (45.0%), between PM2 and M1 (35.0%), between PM1 and PM2 (12.0%), and at M1 level (8.0%), with a right-left symmetry in 78.0% of cases. These results are very different from those presented in our study.

Chkoura & El Wady (2013) [28] evaluated the MnF topography in relation to the sagittal plane on Moroccan population by OPGs and showed the following percentage

values for MnF locations: at PM2 level (62.70%), and between PM1 and PM2 (30.0%). These results are different from those in this study.

A unique study on MnF evaluation by ultrasonography, conducted by Laher *et al.* (2016) on population of South Africa [1, 29], presented for the black population, that MnF was situated between PM1 and PM2 (37.0%), at PM2 level (51.0%), and for the Caucasians between PM1 and PM2 (48.0%), and at PM2 level (36.0%). Caucasian population results are similar to those obtained by us in terms of frequency, but the percentages differ: they are greater than the ones obtained by us for the location between the two premolars and smaller for the location at PM2 level.

In a retrospective study on Egyptian population, Shalash *et al.* (2020) [30] studied the MnF topography on sagittal plane by CBCT and showed that it is located at PM2 level (55.8%), between PM1 and PM2 (26.35%), between PM2 and M1 (11.35%), at PM1 level (4.95%), and at M1 level (1.55%). These results are similar to ours, but the percentages differ, being smaller than the ones obtained by us for the location between the two premolars and greater for all the other locations.

By CBCT evaluation on Belarus population, Kabak *et al.* (2017) [1, 31] presented the following locations on the sagittal plane for the MnF: between PM1 and PM2 (57.70%), and at PM2 level (33.80%). Symmetry between the left and right side was 64.10%. These results are similar to ours in frequency, but the percentages differ, being greater than the ones obtained by us for the location between the two premolars and smaller for the location at PM2 level.

Santini & Alayan (2012) [32], in a study concerning the topography of the MnF, illustrated that on Indian and European populations the most common location was between PM1 and PM2, just as it happened in our study, on the Romanian population.

Zmyslowska-Polakowska *et al.* (2019) [33] evaluated MnF topography on sagittal plane in Polish population and showed that it is most frequently located between PM1 and PM2, followed by the location at PM2 level, an observation similar to ours.

In a retrospective review study on OPG and CBCT, Jasim (2020) [34] analyzed the MnF topography and showed that it was located at PM2 level in the percentage of 49.99%, and between PM1 and PM2 in the percentage of 42.30%. These results are comparable to those obtained by us for male subjects.

Pelé *et al.* (2021) [35] analyzed the MnF anteroposterior topography and illustrated that it was located mostly between PM1 and PM2 (from 50.4% to 61.95%) or at PM2 level (from 50.3% to 57.9%). Then, it was situated between PM2 and M1 (16.7% to 19.4%) or at M1 level (from 6.7% to 10.7%) and exceptionally in front of PM1 or between M1 and M2 (second molar).

According to the accessed references, in the Caucasian population the MnF was frequently located between the premolars and at the level of the second premolar; for Asians (Mongols, Chinese and South Koreans) it was frequently located at the second premolar level and anterior from it, and for African population it was located predominantly at the level of the second premolar and distal to it.

✉ Conclusions

This is a unique and complex study of the MnF topography on the sagittal plane, performed on Romanian population, by direct and imaging morphometry on 67 human mandibles, with a total of 134 observations. Variations regarding the sagittal location of the MnF could be responsible of therapeutic failures following oral rehabilitation procedures in the mandibular premolar area. Accurate knowledge of both the MnF topography and the key anatomical landmarks used in locating it proves to be essential and clinically relevant in dentoalveolar and endodontic surgery, and for improving anesthesia techniques.

Conflict of interests

The authors declare that they have no conflict of interests.

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References

- Gherghiță OR, Nimigean VR, Cismas SC, Nimigean V. Mental foramen topography in dentate subjects – a retrospective study by review of the literature. *Rom J Oral Rehabil*, 2019, 11(2):22–34. <https://www.rjor.ro/mental-foramen-topography-in-dentate-subjects-a-retrospective-study-by-review-of-the-literature/>
- Nimigean V (red). Anatomie clinică și topografică a capului și gâtului pentru medicina dentară – note de curs. Ed. Cernaprint, București, 2014, 9–11 (in Romanian).
- Gungor K, Ozturk M, Semiz M, Brooks SL. A radiographic study of location of mental foramen in a selected Turkish population on panoramic radiograph. *Coll Antropol*, 2006, 30(4):801–805. PMID: 17243553
- Mendonça Amorim M, Bevilacqua Prado F, Bicalho Borini C, Oliveira Bittar T, Volpato MC, Groppo FC, Ferreira Caria PH. Posición del foramen mental en mandíbulas de Brasileños dentados desdentados [The mental foramen in dentate and edentulous Brazilian's mandible]. *Int J Morphol*, 2008, 26(4): 981–987. <https://doi.org/10.4067/S0717-95022008000400033> <https://www.scielo.cl/pdf/ijmorphol/v26n4/art33.pdf>
- Cutright B, Quillopa N, Schubert W. An anthropometric analysis of the key foramina for maxillofacial surgery. *J Oral Maxillofac Surg*, 2003, 61(3):354–357. <https://doi.org/10.1053/joms.2003.50070> PMID: 12618976
- von Arx T, Lozanoff S. Clinical oral anatomy: a comprehensive review for dental practitioners and researchers. Springer International Publishing, Switzerland, 2017, 385–398. <https://doi.org/10.1007/978-3-319-41993-0> <https://link.springer.com/book/10.1007/978-3-319-41993-0>
- Ndiaye ML, Lecor PA, Diatta M, Diop EHC, Diene MN, Diop MM, Toure B. Radiography study of the anatomic position of the mental foramen in a Senegalese population. *Acta Sci Dent Sci*, 2018, 2(2):44–46. <https://actascientific.com/ASDS.php>
- Gherghiță OR, Nimigean VR, Csiki IE, Băran-Poesina V, Virlan MJR, Nimigean V. Direct and imaging morphometry for the localization of the mandibular foramen (MF) in dentate and edentulous human subjects. *Rom J Morphol Embryol*, 2020, 61(3):783–791. <https://doi.org/10.47162/RJME.61.3.16> PMID: 33817719 PMCID: PMC8112752
- Parnami P, Gupta D, Arora V, Bhalla S, Kumar A, Malik R. Assessment of the horizontal and vertical position of mental foramen in Indian population in terms of age and sex in dentate subjects by panoramic radiographs: a retrospective study with review of literature. *Open Dent J*, 2015, 9:297–302. <https://doi.org/10.2174/1874210601509010297> PMID: 26464599 PMCID: PMC4598426
- Afkhami F, Haraji A, Boostani HR. Radiographic localization of the mental foramen and mandibular canal. *J Dent (Tehran)*, 2013, 10(5):436–442. PMID: 24910651 PMCID: PMC4025417
- Güler AU, Sumer M, Sumer P, Biçer I. The evaluation of vertical heights of maxillary and mandibular bones and the location of anatomic landmarks in panoramic radiographs of edentulous patients for implant dentistry. *J Oral Rehabil*, 2005, 32(10): 741–746. <https://doi.org/10.1111/j.1365-2842.2005.01499.x> PMID: 16159352
- Sîrbu VD, Perlea P, Nimigean VR, Bădiță DG, Șerban A, Nimigean V. Morphological assessment of the mandibular canal trajectory in dentate subjects. *Rom J Morphol Embryol*, 2017, 58(4):1401–1408. PMID: 29556634
- Nimigean V, Sîrbu VD, Nimigean VR, Bădiță DG, Poll A, Moraru SA, Păun DL. Morphological assessment of the mandibular canal trajectory in edentate subjects. *Rom J Morphol Embryol*, 2018, 59(1):235–242. PMID: 29940633
- Oguz O, Bozkir MG. Evaluation of location of mandibular and mental foramina in dry, young, adult human male, dentulous mandibles. *West Indian Med J*, 2002, 51(1):14–16. PMID: 12089867
- Ngeow WC, Yuzawati Y. The location of the mental foramen in a selected Malay population. *J Oral Sci*, 2003, 45(3):171–175. <https://doi.org/10.2334/josnusd.45.171> PMID: 14650583
- Kim IS, Kim SG, Kim YK, Kim JD. Position of the mental foramen in a Korean population: a clinical and radiographic study. *Implant Dent*, 2006, 15(4):404–411. <https://doi.org/10.1097/01.id.0000243319.66845.15> PMID: 17172959
- Al-Khateeb T, Al-Hadi Hamasha A, Ababneh KT. Position of the mental foramen in a northern regional Jordanian population. *Surg Radiol Anat*, 2007, 29(3):231–237. <https://doi.org/10.1007/s00276-007-0199-z> PMID: 17375258
- Hoque MM, Ara S, Begum S, Kamal AHMM, Momen MA. Study of morphometric analysis of mandibular foramen in Bangladeshi dry adult human mandible. *Bangladesh J Anat*, 2013, 11(2):58–61. <https://doi.org/10.3329/bja.v11i2.20671>
- Gada SK, Nagda SJ. Assessment of position and bilateral symmetry of occurrence of mental foramen in dentate Asian population. *J Clin Diagn Res*, 2014, 8(2):203–205. <https://doi.org/10.7860/JCDR/2014/7257.4060> PMID: 24701535 PMCID: PMC3972564
- Verma P, Bansal N, Khosa R, Verma KG, Sachdev SK, Patwardhan N, Garg S. Correlation of radiographic mental foramen position and occlusion in three different Indian populations. *West Indian Med J*, 2015, 64(3):269–274. <https://doi.org/10.7727/wimj.2014.143> PMID: 26426182 PMCID: PMC4763904
- Chappidi V, Swapna LA, Dheeraj V, Nikitha GR, Kanakagiri M. Evaluation of morphometric variations in mental foramen and prevalence of anterior loop in South Indian population – a CBCT study. *J Indian Acad Oral Med Radiol*, 2019, 31(2): 134–139. https://doi.org/10.4103/jiaomr.jiaomr_219_18
- Khalid M, Manzoor F, Rasheed A, Salman S, Khawaja SH, Ahmed A. Radiological locations of mental foramen in local population. *Ann Pak Inst Med Sci*, 2019, 15(3):114–118. <https://www.apims.net/index.php/apims/article/view/236>
- Haghanifar S, Rokouei M. Radiographic evaluation of the mental foramen in a selected Iranian population. *Indian J Dent Res*, 2009, 20(2):150–152. <https://doi.org/10.4103/0970-9290.52886> PMID: 19553713
- Khojastepour L, Mirbeigi S, Mirhadi S, Safaee A. Location of mental foramen in a selected Iranian population: a CBCT assessment. *Iran Endod J*, 2015, 10(2):117–121. PMID: 25834596 PMCID: PMC4372786
- Sheikhi M, Karbasi Kheir M, Hekmatian E. Cone-beam computed tomography evaluation of mental foramen variations: a preliminary study. *Radiol Res Pract*, 2015, 2015:124635. <https://doi.org/10.1155/2015/124635> PMID: 26609432 PMCID: PMC4644840
- Xie L, Zhao Z, Huang L, Qin C, Wang W, Xu C. The anatomical research on the mental foramen related to the mental nerve block. *Yangtze Med*, 2021, 5(1):54–60. <https://doi.org/10.4236/ym.2021.51006>
- Fabian FM. Position, shape and direction of opening of the mental foramen in dry mandibles of Tanzanian adult black males. *Ital J Anat Embryol*, 2007, 112(3):169–177. PMID: 18078238

- [28] Chkoura A, El Wady W. Position of the mental foramen in a Moroccan population: a radiographic study. *Imaging Sci Dent*, 2013, 43(2):71–75. <https://doi.org/10.5624/isd.2013.43.2.71> PMID: 23807929 PMCID: PMC3691376
- [29] Laher AE, Motara F, Moolla M. The ultrasonographic determination of the position of the mental foramen and its relation to the mandibular premolar teeth. *J Clin Diagn Res*, 2016, 10(6):OC23–OC27. <https://doi.org/10.7860/JCDR/2016/18808.7992> PMID: 27504329 PMCID: PMC4963689
- [30] Shalash M, Khallaf ME, Ali AR. Position and dimensions of the mental foramen and presence of the anterior loop in the Egyptian population: a retrospective CBCT study. *Bull Natl Res Cent*, 2020, 44:110. <https://doi.org/10.1186/s42269-020-00364-2> <https://bnrc.springeropen.com/track/pdf/10.1186/s42269-020-00364-2.pdf>
- [31] Kabak SL, Zhuravleva NV, Melnichenko YM, Savrasova NA. Topography of mental foramen in a selected Belarusian population according to cone beam computed tomography. *Imaging Med*, 2017, 9(3):49–58. <https://www.openaccessjournals.com/articles/topography-of-mental-foramen-in-a-selected-belarusian-populationaccording-to-cone-beam-computed-tomography.html>
- [32] Santini A, Alayan I. A comparative anthropometric study of the position of the mental foramen in three populations. *Br Dent J*, 2012, 212(4):E7. <https://doi.org/10.1038/sj.bdj.2012.143> PMID: 22349415
- [33] Zmyslowska-Polakowska E, Radwanski M, Ledzion S, Leski M, Zmyslowska A, Lukomska-Szymanska M. Evaluation of size and location of a mental foramen in the Polish population using cone-beam computed tomography. *Biomed Res Int*, 2019, 2019:1659476. <https://doi.org/10.1155/2019/1659476> PMID: 30719439 PMCID: PMC6334310
- [34] Jasim HH. Evaluation of mental foramen location – a review article. *J Med Care Res Rev*, 2020, 3(7):379–385. <https://doi.org/10.15520/mcrr.v3i7.107> <http://mcrr.info/index.php/mcrr/article/view/107>
- [35] Pelé A, Berry PA, Evanno C, Jordana F. Evaluation of mental foramen with cone beam computed tomography: a systematic review of literature. *Radiol Res Pract*, 2021, 2021:8897275. <https://doi.org/10.1155/2021/8897275> PMID: 33505723 PMCID: PMC7806401

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