ОРИГИНАЛЬНАЯ СТАТЬЯ

THE ANATOMICAL LOCATION OF THE MENTAL FORAMEN AND THE PREVALENCE OF THE ANTERIOR LOOP IN THE EGYPTIAN POPULATION: A RETROSPECTIVE CONE BEAM COMPUTED TOMOGRAPHY STUDY

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Strategically, the mental foramens (MF) are important landmarks during implantology techniques. Their location, morphology and anatomical variations required to be considered prior the surgery to prevent mental neurovascular injuries.

Purpose. To assess the location of the mental foramen (MF) and the prevalence of the anterior loop (AL) in the Egyptian population.

Materials and methods. A total of 300 cone beam computed tomography (CBCTs) examinations that satisfied the inclusion and exclusion requirements were investigated. After imaging, the position of MF was recorded as a – below apex of 1st premolar, b – below apex of 2nd premolar, c – between 1st and 2nd premolar. The prevalence of AL was assessed by classifying inferior alveolar canal (IAC) into three patterns: Loop, perpendicular and anterior.

Results. Position of mental foramen: between 1st and 2nd premolar was 154 (51.3%) in the right side and 176 (58.7%) in the left side. Inferior alveolar canal patterns: Loop was 100 (33.3%) in the right side and 106 (35.3%) in the left side. Perpendicular was 192 (64%) on the right side and 184 (61.3%) on the left side. Position of mental foramen and Inferior alveolar canal patterns, there was a statistically non-significant difference between right and left sides.

Discussion. In implant installation, the major consequence is injury to the inferior alveolar nerve (mental foramen). Thus, the incidence of mental neurosensory disturbances due to orthodontic, periodontal and surgical procedures cannot be actually determined. Many authors reported the complication incidence varied from 0-40% in inferior alveolar nerve injuries. The inferior alveolar nerve is the most injured nerve, followed by the lingual nerve. As a result, to ensure a maximum safety in the placement of implants without compromising available space, a CBCT examination is strongly recommended.

Conclusion. The sample population most exhibited MF between 1st and 2nd premolar with the most common pattern detected was perpendicular in nature. Anterior looping was regarded as the second most common pattern in Egyptian population.

Keywords: mental foramen, CBCT, Perpendicular, inferior alveolar canal.

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АНАТОМИЧЕСКОЕ РАСПОЛОЖЕНИЕ ПОДБОРОДОЧНОГО ОТВЕРСТИЯ И РАСПРОСТРАНЕННОСТЬ ПЕРЕДНЕЙ ПЕТЛИ У ЕГИПЕТСКОГО НАСЕЛЕНИЯ: РЕТРОСПЕКТИВНОЕ КОНУСНО-ЛУЧЕВОЕ КОМПЬЮТЕРНО-ТОМОГРАФИЧЕСКОЕ ИССЛЕДОВАНИЕ

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Подбородочные отверстия (ПО) являются важными ориентирами при выполнении различных техник в имплантологии. Их расположение, морфологию и анатомические различия необходимо учитывать при предоперационном планировании во избежание нервно-сосудистых повреждений подбородочной области.

Цель исследования. Оценить расположение подбородочного отверстия (ПО) и распространенность передней петли (ПП) у египетского населения.

Материалы и методы. Всего в исследование было включено 300 конусно-лучевых компьютерных томограмм (КЛКТ), которые удовлетворяли требованиям включения и исключения. После исследования регистрировали положение подбородочного отверстия: а – под вершиной 1-го премоляра, б – под вершиной 2-го премоляра, в – между 1-м и 2-м премолярами. Распространенность передней петли оценивалась путем классификации нижнего альвеолярного канала по трем схемам: петлевой, перпендикулярный и передний.

Результаты. Положение подбородочного отверстия отмечается между 1-м и 2-м премоляром в 154 случаях (51,3%) справа, в 176 случаях (58,7%) – слева. Форма нижнего альвеолярного канала: петлевая – в 100 случаях (33,3%) с правой стороны и в 106 случаях (35,3%) с левой стороны, перпендикулярная – в 192 случаях (64%) с правой стороны и в 184 случаях (61,3%) с левой. Положение подбородочного отверстия и ход нижнего альвеолярного канала статистически не отличались между правой и левой сторонами.

Заключение. В исследуемой популяции наиболее часто встречалась локализация подбородочного отверстия между 1-м и 2-м премоляром, при этом наиболее часто выявлялась перпендикулярная форма. Передняя петля считалась второй по распространенности формой у египетского населения.

Ключевые слова: подбородочное отверстие, передняя петля, КЛКТ, перпендикуляр, нижний альвеолярный канал.

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The mental foramen (MF) is a strategically important landmark during implantology procedures. Its location, morphology, and anatomical variations need to be considered before surgery to avoid mental nerve injury [1]. The anatomic as well as radiographic size, position, shape and symmetry have been reported by several authors [2, 3]. Philips et al. [2] reported that anatomically the mental foramen is generally oval shaped with an average size of 4.6 mm horizontally and 3.4 mm vertically, positioned at the apex of the mandibular second premolar in 62.7% of the population.

The inferior alveolar nerve (IAN) progresses into the mandibular canal in the mandibular body on each side of the mandible. This canal opens posteriorly by the mandibular foramen and anteriorly by the mental foramen. Sometimes, small foramina in the surrounding area of the mental foramen are identified as accessory mental foramina (AMFs). This way, anteriorly, the IAN spreads into two branches: the mental nerve which goes out of the mandible through the mental foramen and enables the sensibility of the chin and the inferior lip while the incisive nerve stays into the mandible and enables the innervation of homolateral incisors and canine [4].

The mental nerve has separate ways to reach the mental foramen. Solar et al. presented a classification of intraosseous part of the mental nerve with three different types [5]. Type 1: no loop was found, and the anatomy was Y-shaped with the incisive branch usually as wide as the main branch. The mental branch leaves the inferior alveolar nerve posterior to the opening of the mental foramen. Type 2: no loop was found, and the anatomy was T-shaped with the incisive branch usually as wide as the main branch. The mental branch leaves the inferior alveolar nerve perpendicular to the opening of the mental foramen. Type 3: an anterior loop was found, and the anatomy was Y-shaped with the incisive branch usually as narrow as the main branch. The mental nerve branched from the inferior alveolar nerve anterior to the mental foramen [6]. Earlier studies have shown that MC course and MF position may vary between different populations [7, 8].

The present study assesses the location of the mental foramen and the prevalence of the anterior loop in the Egyptian population.

Methods.

Subjects.

A retrospective study. The study used a sample of 300 CBCTs of 162 (54%) males and 138 (46%) females; mean age of 43.8 ± 14.1 years that satisfied the inclusion and exclusion requirements. The CBCT scans were obtained from the oral radiology department from a peri-

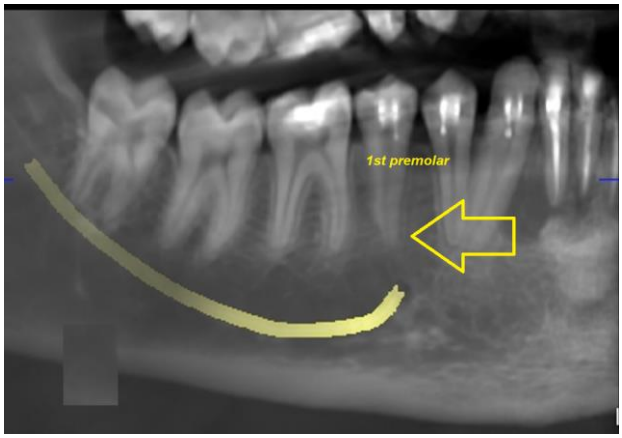

Fig. 1 (Рис. 1)

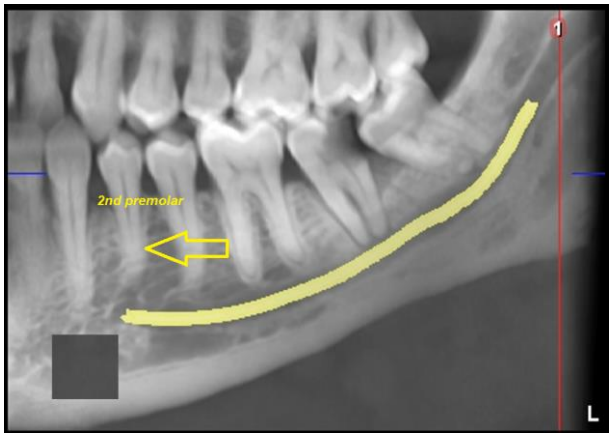

Fig. 2 (Рис. 2)

Fig. 1. CBCT of lower jaw (right side) sagittal view showing.

The position of MF is below apex of 1st premolar (yellow arrow).

Рис. 1. КЛКТ, нижняя челюсть, правая сторона, сагиттальная реконструкция.

Локализация подбородочного отверстия книзу от верхушки 1-го премоляра (желтая стрелка).

Fig. 2. CBCT of lower jaw (left side) sagittal view showing.

The position of MF is below apex of 2nd premolar (yellow arrow).

Рис. 2. КЛКТ, нижняя челюсть (левая сторона), сагиттальная реконструкция.

Локализация подбородочного отверстия книзу от верхушки 2-го премоляра (желтая стрелка).

od of January 2022 to December 2023.

Sample size.

Assuming position for the MF to be between the first and second premolar teeth (51%). a sample specificity of 0.9, the sample size needed for a two-sided 95% specificity confidence interval with a width of at most 0.1, is 300. The whole table sample size needed so that both confidence intervals have widths less than 0.1, is 300, the larger of the two sample sizes [9].

Eligibility criteria.

The following inclusion criteria were used: sample should only consist of Egyptian individuals. Presence of permanent dentition. All teeth should be present next to MF, from canine to first molar, on both sides.

Exclusion criteria were: presence of any pathologic lesion, obscuring the MF region.

Acquiring CBCT scans.

CBCT scans were acquired from the CBCT unit (planmeca pro-face model, Romexis software version 5.3.5.80 Finland-Helsinki), voxel size 200 microns.

CBCT data analysis.

Data from CBCT scans were exported in Digital Imaging and Communications in Medicine (DICOM) format into the Romexis ™ software for image analysis and nerve tracing. We used nerve mapping tools point by point. Starting from the lingual position of the inferior alveolar nerve until the buccal emergence from the mental foramen following the nerve curvature into the mandibular canal.

All CBCT scans were evaluated independently by two observers, one radiologist and one specialist in oral and maxillofacial surgery. The CBCT images were evaluated in four views i.e., reconstructed panoramic, sagittal, coronal, and axial.

The position of MF was recorded as (a) Below apex of 1st premolar, (b) Below apex of 2nd premolar, (c) Between 1st and 2nd premolar (Fig. 1-3).

The prevalence of AL was assessed by classifying inferior alveolar canal (IAC) into three patterns are perpendicular, anterior and Loop (Fig. 4-6).

Statistical analysis.

Data was fed to the computer and analyzed using IBM SPSS software package version 20.0 (Armonk, NY: IBM Corp). Comparisons between the two stages for categorical variables (qualitative data) were assessed using the Marginal Homogeneity Test. Significance of the obtained results was judged at the 5% level.

Results.

Here, males were 162 (54%) while Females were 138 (46%). Mean age was 43.8 ± 14.1 (Table №1). Position of mental foramen: Between 1st and 2nd premolar was 154 (51.3%) on the right side and 176 (58.7%) in the left side. Below apex of 2nd premolar was 136 (45.3%) in the right side and 104 (34.7%) in the left side. Below apex of 1st premolar was 8 (2.7%) in the right side and 18 (6%) in the left side. None was 2 (0.7%) on the right side and on the left side. Inferior alveolar canal patterns:

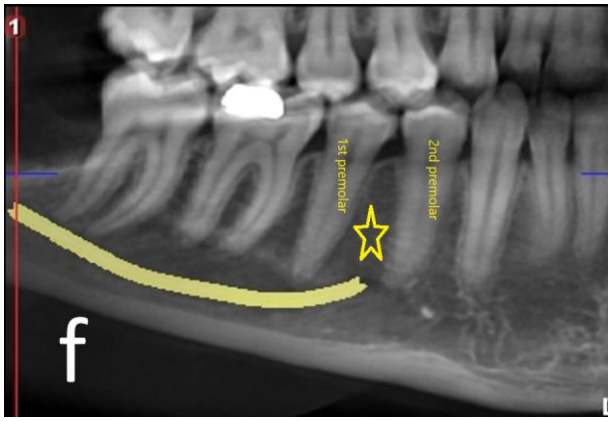

Fig. 3 (Рис. 3)

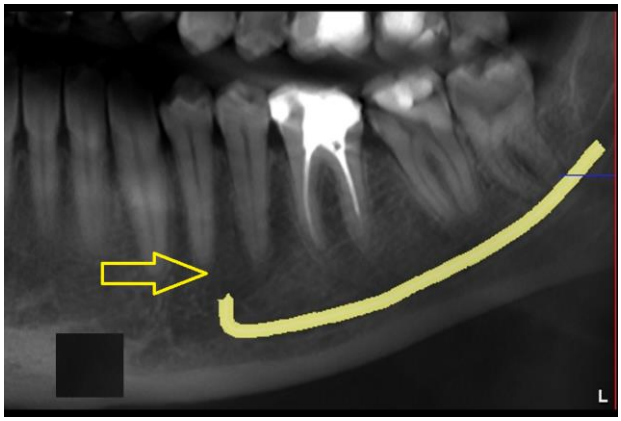

Fig. 4 (Рис. 4)

Fig. 3. CBCT of lower jaw (right side) sagittal view showing.

The position of MF is between 1st and 2nd premolar (yellow star).

Рис. 3. КЛКТ, нижняя челюсть (правая сторона), сагиттальная реконструкция.

Локализация подбородочного отверстия между 1-м и 2-м премолярами (желтая звезда).

Fig. 4. CBCT of lower jaw (left side) sagittal view showing.

Perpendicular pattern of inferior alveolar canal.

Рис. 4. КЛКТ, нижняя челюсть (левая сторона), сагиттальная реконструкция.

Перпендикулярный ход передней петли нижнего альвеолярного канала.

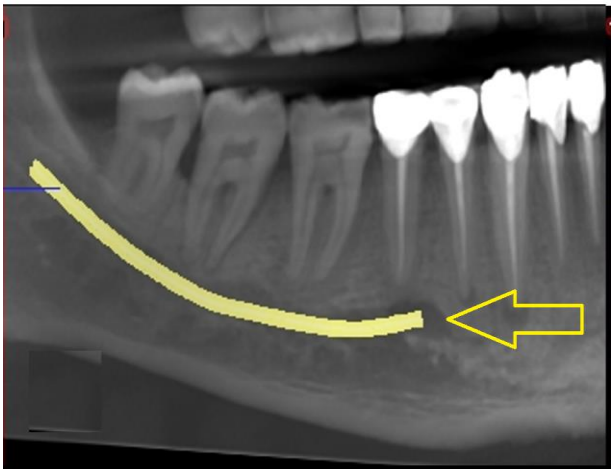

Fig. 5 (Рис. 5)

Fig. 5. CBCT of lower jaw (right side) sagittal view showing.

Anterior pattern of inferior alveolar canal.

Рис. 5. КЛКТ, нижняя челюсть (правая сторона), сагиттальная реконструкция.

Передний ход передней петли нижнего альвеолярного канала.

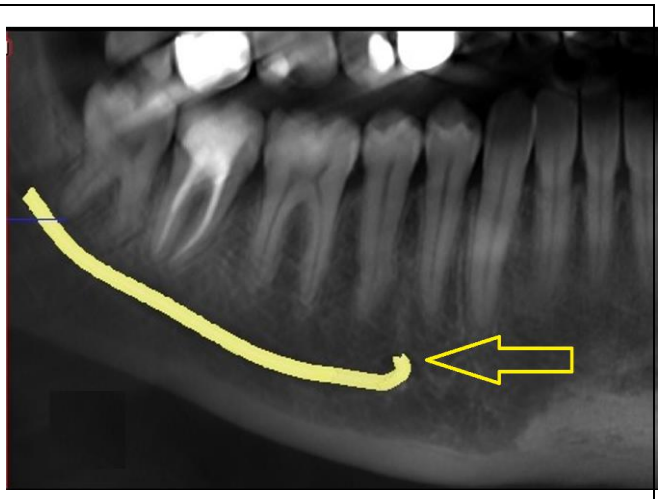

Fig. 6 (Рис. 6)

Fig. 6. CBCT of lower jaw (right side) sagittal view showing.

Loop pattern of inferior alveolar canal.

Рис. 6. КЛКТ, нижняя челюсть (правая сторона), сагиттальная реконструкция.

Петлевой ход передней петли нижнего альвеолярного канала.

Table №1. Distribution of the studied cases according to demographic data (n = 300).

	No. (%)
Gender	
Male	162 (54)
Female	138 (46)
Age (years)	
Mean ± SD	43.8 ± 14.1
Median (Min. – Max.)	44 (13 – 75)

Table №2. Distribution of the studied cases according to position of mental foramen in each side (n = 300)

	Right side	Left side
Position of Mental foramen		
None	2 (0.7%)	2 (0.7%)
Between 1st and 2nd premolar	154 (51.3%)	176 (58.7%)
Below apex of 2nd premolar	136 (45.3%)	104 (34.7%)
Below apex of 1st premolar	8 (2.7%)	18 (6%)
Inferior alveolar canal patterns		
Loop	100 (33.3%)	106 (35.3%)
Perpendicular	192 (64%)	184 (61.3%)
Anterior	8 (2.7%)	10 (3.3%)

Loop was 100 (33.3%) in the right side and 106 (35.3%) in the left side. Perpendicular was 192 (64%) on the right side and 184 (61.3%) on the left side. Anterior was 8 (2.7%) on the right side and 10 (3.3%) in the left side (Table №2). Relation between gender with position of mental foramen and inferior alveolar canal patterns in each side. Position of Mental foramen and Inferior alveolar canal patterns, there was a statistically non-significant difference between right and left sides (Table №3).

Discussion.

During oral surgery or implant installation, a major consequence is damage to the inferior alveolar nerve or mental foramen [10]. The incidence of mental neurosensory disturbances resulting from orthodontic, periodontal, and surgical procedures cannot be determined [11]. Juodzbalys et al. reported the complication incidence, which varies from 0% to 40% of implant related inferior alveolar nerve (IAN) injuries [10]. The IAN is the most injured nerve (64.4%), followed by the lingual nerve (28.8%) [12]. The damages could range from mild paresthesia or dysesthesia to complete anesthesia and/or pain [13]. Many functions (speech, eating, kissing, drinking, etc.) will be affected [14]. Damage can result from the traumatic local anesthetic injections or during the dental implant site osteotomy or placement or direct injury with scalpel with extreme alveolar process resorption [10]. CBCT allow collecting extensive information about the MF anatomy, its environment and anatomical variations that can exist when some clinical parameters vary as sex, side, or dental status.

The present study focused on assessing the location of the mental foramen and the prevalence of the anterior loop in the Egyptian population based on CBCT. After imaging, 300 CBCTs were used to record the position of MF as (a) Below apex of 1st premolar, (b) Below apex of 2nd premolar, (c) Between 1st and 2nd premolar.

The prevalence of AL was assessed by classifying inferior alveolar canal (IAC) into three patterns: Loop, perpendicular and Anterior. The precise identification of MF and AL is a crucial factor while administering mental nerve block and performing surgical procedures in the specified area. This parameter can only be compared with similar studies carried out in different population groups. Variations exist in the position of MF among different racial groups. The present study indicated that the most common position of MF was Be-

Table №3. Relation between gender with position of mental foramen and inferior alveolar canal patterns in each side (n = 300).

		Gender		χ^2	^{MC}p
		Male (n = 162)	**Female (n = 138)**		
Position of mental foramen	**Right side**				
	None	0 (0.0%)	2 (1.4%)	1.806	0.682
	Between 1st and 2nd premolar	84 (51.9%)	70 (50.7%)		
	Below apex of 2nd premolar	72 (44.4%)	64 (46.4%)		
	Below apex of 1st premolar	6 (3.7%)	2 (1.4%)		
	Left side				
	None	0 (0.0%)	2 (1.4%)	2.234	0.532
	Between 1st and 2nd premolar	90 (55.6%)	86 (62.3%)		
	Below apex of 2nd premolar	60 (37.0%)	44 (31.9%)		
	Below apex of 1st premolar	12 (7.4%)	6 (4.3%)		
Inferior alveolar canal patterns	**Right side**				
	Loop	54 (33.3%)	46 (33.3%)	1.352	0.535
	Perpendicular	106 (65.4%)	46 (62.3%)		
	Anterior	2 (1.2%)	6 (4.3%)		
	Left side				
	Loop	64 (39.5%)	42 (30.4%)	3.150	0.203
	Perpendicular	96 (59.3%)	88 (63.8%)		
	Anterior	2 (1.2%)	8 (5.8%)		

χ^2: **Chi square test** MC: **Monte Carlo**

p: p value for comparing between the studied categories.

tween 1st and 2nd premolar 154 (51.3%) in right side and 176 (58.7%) in left side. 84 (51.9%) in males and 70 (50.7%) in females in the right sides and 90 (55.6%) in males and 86 (62.3%) in females in the left side. In accordance with some studies MF is mostly located between 1st and 2nd premolars [15].

The IAC pattern in the present study was categorized into loop, perpendicular and anterior patterns. The most common pattern detected was perpendicular in nature 192 (64%) in right and 184 (61.3%) in left sides. The prevalence of anterior loops in Wei et al. study was 68.6 % (33.3% right side and 35.3% left side) [16]. Earlier CBCT studies revealed the prevalence of an anterior loop range between 48% and 94% [17, 18]. For treatments involving 4 to 5 implant placements in the mandibular interforaminal region, the most distal implant is recommended to be found as close as possible to the mental foramen to ensure the longest extension of the distal cantilever [19]. At the same time, deciding a safety margin to avoid violating the anterior loop is also important when placing implants mesially to the mental foramen. Although the recommended safety margin to the mental foramen differs in different articles, most investigators have suggested a safety margin of 5 mm [20].

As a result, to ensure a maximum safety in the placement of implants without compromising available space, a CBCT examination is strongly recommended.

Conclusion.

The sample population most exhibited MF Between 1st and 2nd premolar with the most common pattern detected was perpendicular in nature. AL was regarded as the second most common pattern in Egyptian population.

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