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Original Article

ASSESMENT OF ANATOMIC VARIATIONS OF THE MANDIBULAR LINGUAL FORAMINA IN EGYPTIAN POPULATION USING CONE-BEAM COMPUTED TOMOGRAPHY (CROSS SECTIONAL STUDY)

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Abstract

Introduction: To avoid any major difficulties during surgery in the anterior mandibular area, it is crucial to identify the precise location and number of lingual foramina. **Aim of the study:** To assess the anatomic variations of mandibular lingual foramina in Egyptian population using cone beam computed tomography. **Materials and methods:** A total number of 365 CBCT scan have been assessed to detect the number of lingual foramina and their position in relation to the midline using Cranex 3D CBCT machine. **Results:** Out of 365 patients 233(63.8%) had one lingual foramina while 123(34.2%) had 2 and only 7 (1.9%) had 3 foramen. **Conclusion:** At least one lingual foramina was found close to midline so care should be taken during any surgical procedures in this area.

Keywords: Lingual foramina, Cone beam computed tomography, Egyptian population, CBCT

I. INTRODUCTION

There is significant diversity in the number and anatomical distribution of the lingual foramina, which are vascular and neural structures that originate from the floor of the mouth and pass through the lingual side of the mandibular cortical bone to supply the mental area. (1,2)

The lingual foramen is situated in the midline of the mandibular anterior region, and it can be located either superiorly or inferiorly to the mental spine. (3,4) The sublingual and submental arteries in the floor of the mouth pass to the mandible through these foramina, sending branches to the mylohyoid muscle, peripheral muscles, mucous membrane, and gingiva. The mental spine is located in the medial region of the lingual surface of the mandible and is surrounded by foramina connected by intra-osseous canals. (5,6)

Before undergoing any lower anterior surgery, such as grafting or implant placement, it is crucial to evaluate the positions and alignment of anatomical landmarks in the lingual foramina region because trauma injuries to this area can be fatal. This will help to avoid any potential complications later on. (7)

Mandibular incisive nerve neuropraxia, sublingual hemorrhage, intraoperative bleeding,

and nerve injury are among the problems that might result from lingual foramina injury. (8)

In cases of total edentulous prosthesis rehabilitation, dental implants are now the preferred option. The possibility of sublingual hemorrhage from lingual cortex perforation during the surgery makes this technique potentially lethal in certain situations. A lingual periosteum hemorrhage may occur, causing enlargement of the oral cavity floor, airway blockage, and ultimately the patient's death. (9)

Two-dimensional panoramic radiography and other imaging modalities are insufficient to identify the location and quantity of foramina. Prior to any surgical operation in the mandibular anterior region, Cone Beam Computed Tomography (CBCT) can precisely identify the number and position of the lingual foramina because of its accuracy. (10)

II. MATERIAL AND METHODS

Study Design: Observational Cross-sectional Study

Setting and Location:

1-The data collection was obtained from the database available at the department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Misr International University.

2- CBCT database scans were previously performed for Egyptian patients as part of their dental examination and treatment demands.

Participants: A total sample of (365) lower anterior area of the mandible to show the anatomical variation of mandibular lingual foramen in Egyptian population

Inclusion Criteria: Images of the lower Anterior area are selected according to the following:

1-Absence of serious pathological lesions in the mandible

2-Good-quality CBCT image of the mandible

3-Absence of severe atrophy of the mandible

4-Absence of any impacted teeth in the mandible.

5-Males and females starting from Egyptian population starting from 18 years old.

Exclusion Criteria:

1-Any artifact demonstration that obscures the area of interest.

2-Previous treatment with radiotherapy or patients having osteoporosis or diseases that affect bone quality and morphology.

Imaging Protocol of the Scans:

All the assessed CBCT scans were performed using Cranex 3DX ® SOREDEX, Finland using exposure parameters FOV: 8 X 6 cm, kVp: 90, mA: 6.3,Exposure Time: 12.6 seconds and Voxel Size: 0.2 mm (200 μm) as shown in figure (1).

Figure (1): Cranex 3D CBCT machine

Data and Measurements: CBCT images were collected from the computer database by convenient sampling. Scans were only labeled by ID Number, patient data were hidden for patient privacy. All images from CBCT examinations were acquired in a digital DICOM format. The images were then imported to OnDemand3D ® App (Cybermed, Seoul, Korea). Gnathion (Ga) was selected as a midline reference point which is the lowest point on the anterior margin of the lower jaw in the midsaggital plane as shown in figure (2). Then number of lingual foramina was detected on cross sectional images and measurements were calculated from the lingual foramina to the midline reference point and to the inferior border of the mandible as shown in figure (3 and the data collected and sent for statistical analysis.

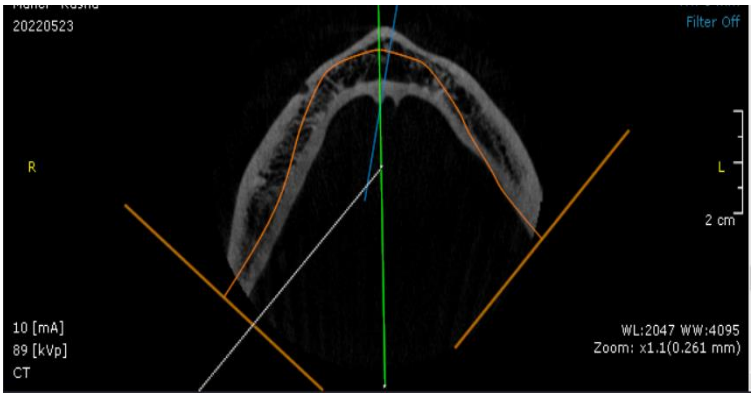

Figure (2): Mandibular midline

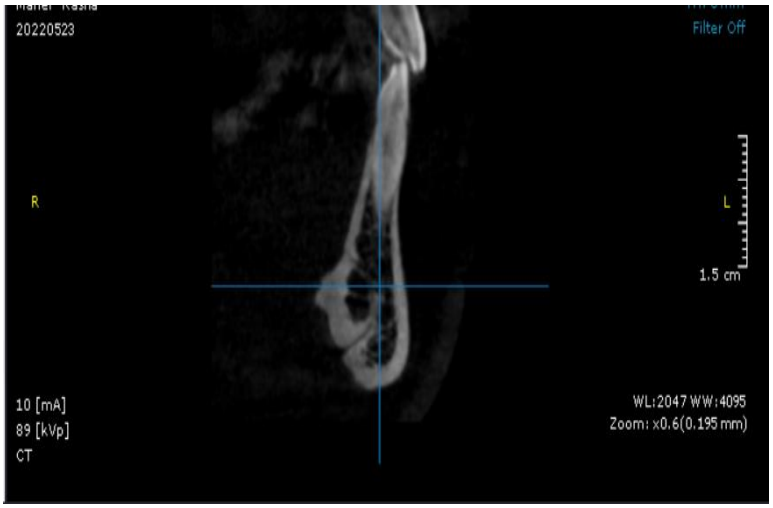

Figure (3): Mental foramina cross sectional images

III. RESULTS

Statistical Analysis: Categorical data were presented as frequency and percentage values and were analyzed using chi-square test followed by pairwise comparisons utilizing multiple z-tests with Bonferroni correction. Numerical data were tested for normality using Shapiro-Wilk's test. They were found to be normally distributed and were presented as mean with 95% confidence interval, standard deviation, median and range values. They were analyzed using independent t-test. The significance level was set at $p \leq 0.05$ for all tests.

1-Demographic Data: The study was conducted on 365 cases, 204(55.9%) of which were males and 161(44.1%) were females. The mean age of the cases was (29.63±4.32) years. Table 1, Figure 4

Table 1**:** Summary statistics for demographic data

Parameter			Value
Sex	**Male**	**n**	204
		%	55.9%
	Female	**n**	161
		%	44.1%
Age (years)	**Mean±SD**		29.63±4.32

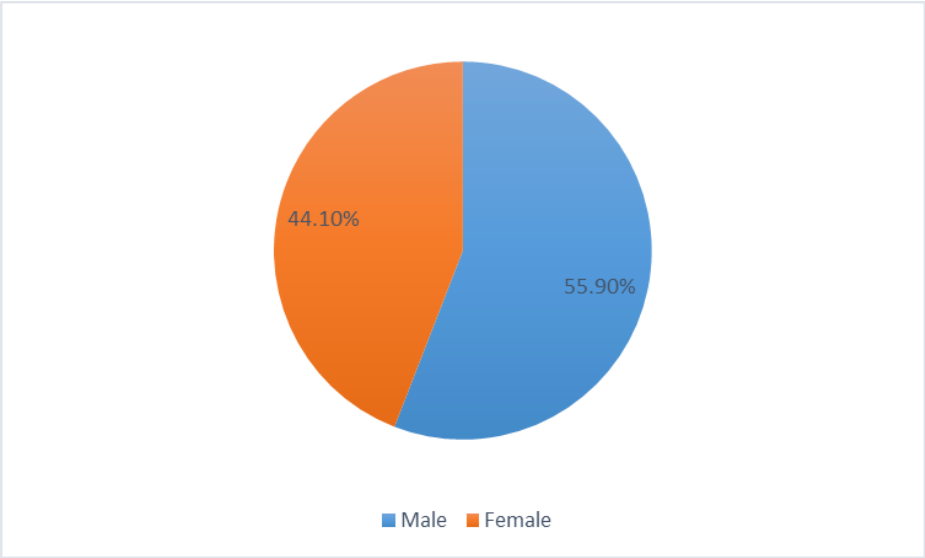

Figure (4): Pie chart showing gender distribution

2-Number of lingual foramina: Out of the studied cases, 233(63.8%) had one lingual foramina, 125(34.2%) had two and only 7(1.9%) had three. Table 2, Figure 5

Table 2: Summary statistics for number of lingual foramina

Parameter			Value
Lingual foramina number	**One**	**n**	233
		%	63.8%
	Two	**n**	125
		%	34.2%
	Three	**n**	7
		%	1.9%

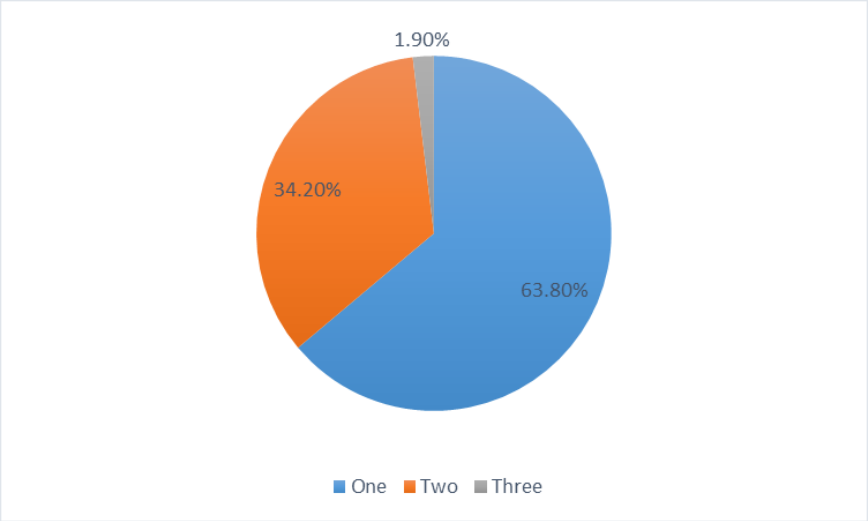

Figure (5): Pie chart showing number of lingual foramina

3-Lingual foramina relations: For distance to midline, the mean value was (1.38) with 95% confidence interval of (1.33:1.43), standard deviation value was (0.52), median value was (1.00) and the range was (1.00-3.00). For distance to inferior border, the mean value was (0.96) with 95% confidence interval of (0.90:1.03), standard deviation value was (0.63), median value was (1.00) and the range was (0.00-2.00). Table 3

Table 3: Summary statistics for lingual foramina relations

Parameter	Mean	95% confidence interval		SD	Median	Min	Max
		Lower	Upper				
Distance to midline (mm)	1.38	1.33	1.43	0.52	1.00	1.00	3.00
Distance to inferior border of the mandible (mm)	0.96	0.90	1.03	0.63	1.00	0.00	2.00

4- Correlations between age and lingual foramina relations: There was a positive weak correlation between age and distance to midline that was statistically significant (rs=0.183, p<0.001), while the correlation between age and distance to inferior border was not statistically significant (p=0.084). Table 4, Figure 6,7

Table 4: Correlations between age and lingual foramina relations

Variables	rs (95%CI)	p-value
Age- distance to midline	0.183 (0.082:0.280)	**<0.001***
Age- distance to inferior border	-0.091 (-0.191:0.012)	**0.084ns**

*; significant (p ≤ 0.05) ns; non-significant (p>0.05)

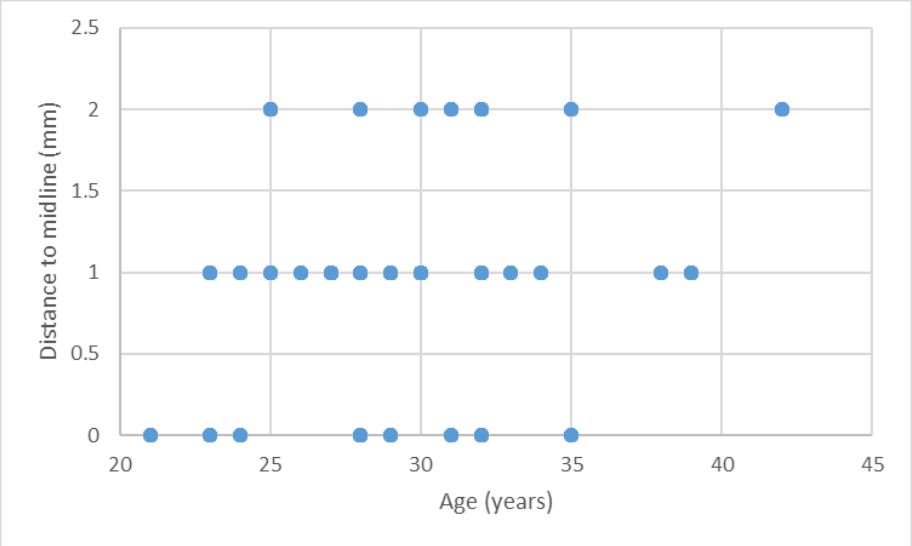

Figure (6): Scatter plot showing the correlation between age and distance to midline

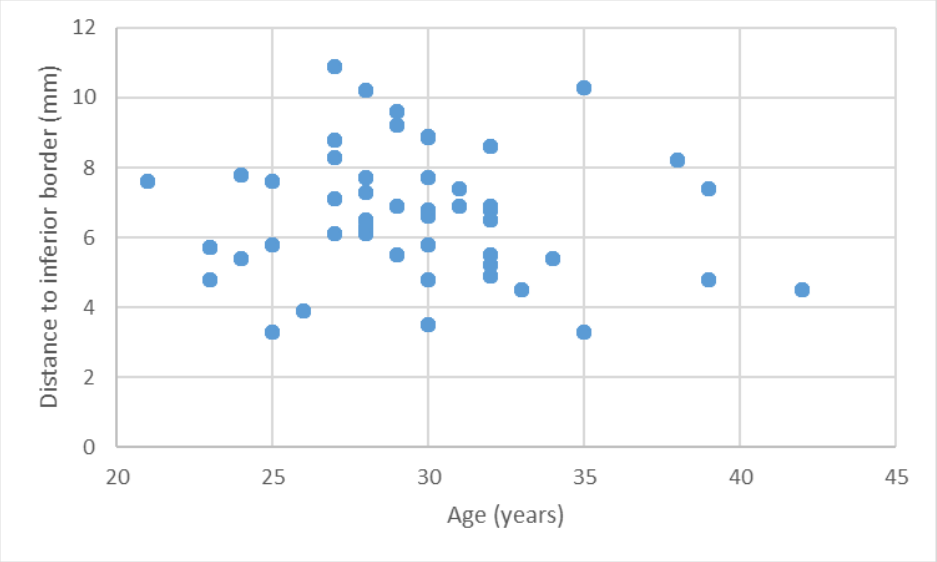

Figure (7): Scatter plot showing the correlation between age and distance to inferior border

5-Associations with sex: There was a significant association between sex and number of lingual foramina with significantly higher percentage of females having two foramina and significantly higher percentage of males having three (p=0.005). There was also a significant association between sex and distance to inferior border with males having significantly higher mean distances than females (p<0.001). The association with distance to midline was not statistically significant (p=0.265). **Table 5, Figures 8,9,10**

Table 5: Association with sex

Parameter			Sex		p-value
			Male	Female	
Number of lingual foramina	One	n	138^{A}	95^{A}	0.005*
		%	67.6%	59.0%	
	Two	n	59^{A}	66^{B}	
		%	28.9%	41.0%	
	Three	n	7^{A}	0^{B}	
		%	3.4%	0.0%	
Distance to midline (mm)	Mean±SD		1.00±0.65	0.92±0.60	0.265ns
Distance to inferior border (mm)	Mean±SD		7.17±1.79	6.10±1.70	<0.001*

Values with different superscript letters within the same horizontal row are significantly different *; significant (p ≤ 0.05) ns; non-significant (p>0.05)

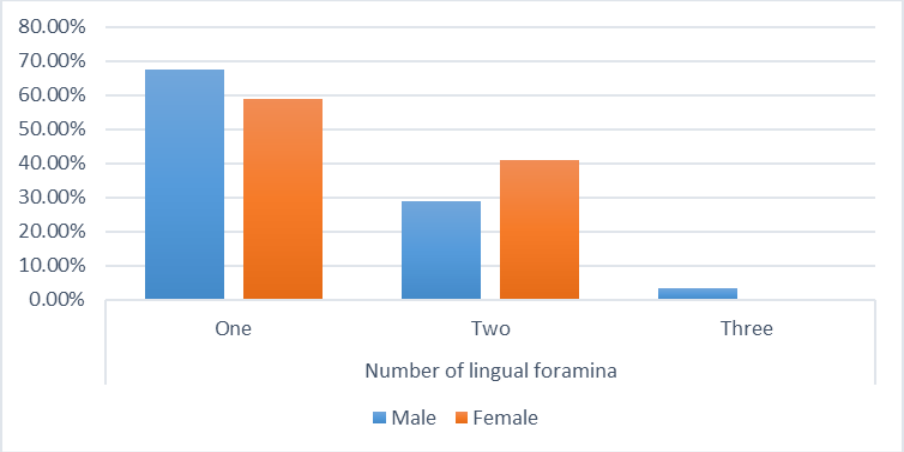

Figure (8): Bar chart showing the association between sex and number of lingual foramina

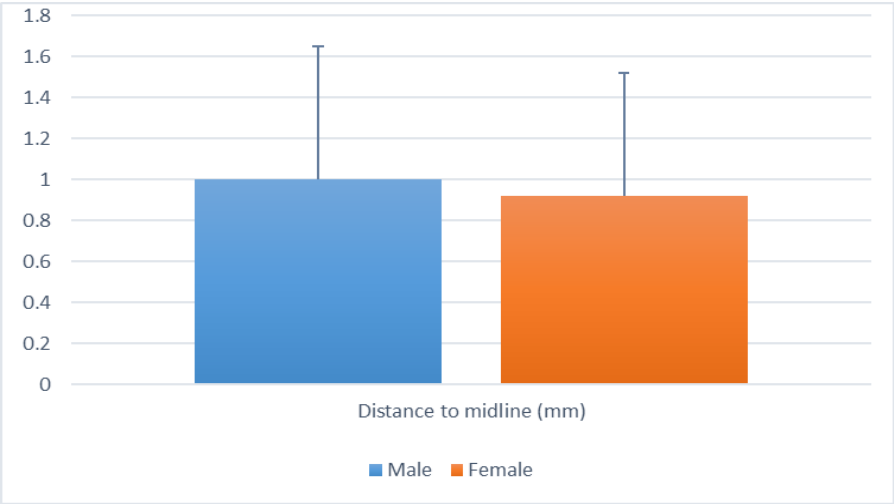

Figure (9): Bar chart showing the association between sex and distance to midline

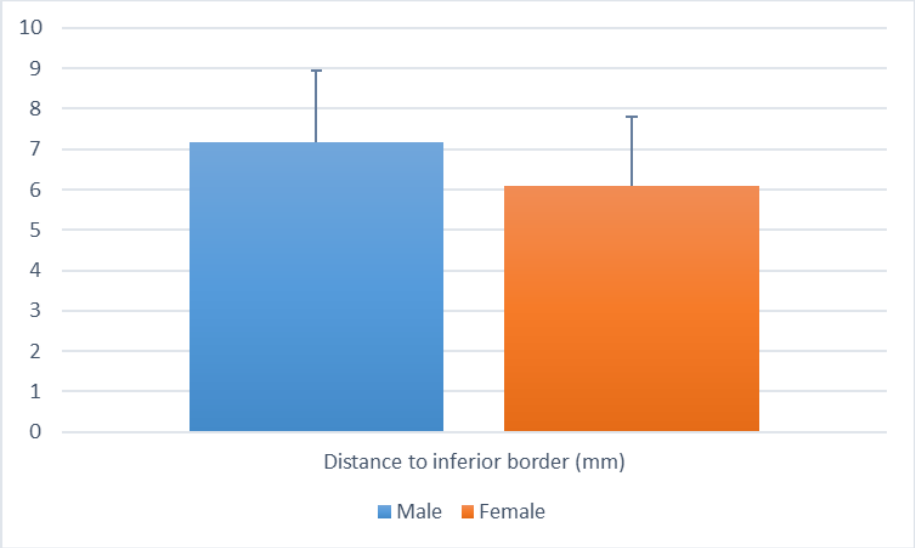

Figure (10): Bar chart showing the association between sex and distance to inferior border

IV. DISCUSSION

Two anatomical features in the anterior mandible region are the canals and foramina. During any surgery, they often shield vital structures like arteries and nerves from harm. Serious bleeding and/or nerve damage could arise from any damage to the nerves or arteries. (11)

One example of a computer-based imaging system that provides superior advantages over 2D imaging systems is cone beam computed tomography, which reduces the risk of surgical problems, eliminates superimposition/n, and precisely estimates operative locations. (12)

Some studies on the lingual foramen revealed absence of lingual foramen as seen in the study of Katkami et al (13) who revealed 2 patients without lingual foramina and this coincides with 2 other studies carried out by Von et al (14) and Rosano et al (15) who found few patients without any lingual foramen representing 1.8% and 3.4% respectively. These results differ from the results obtained in our study, where all the cases examined had lingual foramina but with variable number and location.

Sanomiya et al (16) found the highest frequency was the presence of 2 lingual foramina with an incidence of 32.3% , three lingual foramina with an incidence of 27%, and finally four lingual foramina with an incidence of 17.7%. Von et al (14) reported 2 lingual foramina with an incidence of 28.2% of the patients,Sheikhi et al (17) who reported 2 lingual foramina with an incidence of 34%, and Rosano et al (15) with an incidence of 32.8%. These results coincide with the results obtained by our study, where we found 2 lingual foramina in 124 out of 365 cases with an incidence of 34.2%.

Scaravilli et al (18) reported one lingual foramen in 10% of the study sample and was similar to what Woo et al (19) and Rosano et al (15) reported with an incidence of 12% and 10.3% respectively.

Regarding the distance from the lingual foramen to the inferior border of the mandible many studies were performed to measure this distance such as Choi et al (20) and Liang et al (21) who noted respective distances of 10.08 ± 2.06 mm, 12.58 ± 2.49 mm, 11.2 ± 3.1 mm, and 11.5 ± 2.8 mm. The results obtained from our study regarding this aspect differs from all of the above results and was found to be 7.17mm± 1.79. This difference could be due to different ways of measurement, variation in sample size, ratio of both genders and ethnicity between the different studies.

According to Kim et al (22) the mean distance from the lower border of the mandible to the MLF was slightly greater in

males which coincides with our study. Uchida et al (23) a study was carried found that the distance from the LF to the inferior border of the mandible was 13.26 mm (SD ± 2.34) in Iranian population.There were statistically significant differences between genders and distances were greater in men than in women which agree with our study.

In our study the occurrence of 2 lingual foramina in females is slightly higher than 2 lingual foramina in males who had a higher incidence of 3 lingual foramina. This criterion was not frequently discussed in the literature however, in a study carried out by Santos et al (24) on Brazilian population, they found that the mean number of foramina was almost equal between both sexes.

Tagaya et al (25) reported that the horizontal distance from LF to the midline showed no significance difference when measured in left or right sides and this coincides with our study , also in our study there was a positive weak correlation between age and distance from midline that was statistically significant.

V. CONCLUSION

Care should be taken before any surgical procedure in the anterior lower area to avoid injury of the lingual foramina which is fatal.

Conflict of Interest:
The authors declare no conflict of interest.

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This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors

Ethics:
This study was approved by ethics committee of faculty of dentistry, Cairo university on: 28/9/2021, approval number: 15-9-21.

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