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Research Paper

Osteometric Study of the Mandibular Foramen in Dry Adult Human Mandibles of South-East Nigerian Population

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ABSTRACT
This study was carried out to determine the location of the mandibular foramen of Nigerian population in South-East Nigeria. A total of Sixty-five (65) dry adult human mandibles obtained from the Departments of Human Anatomy of the University of Port Harcourt, University of Calabar, Niger Delta University, Nnamdi Azikiwe University, Nnewi campus and Abia State University. The following parameters of the mandibular ramus were measured in order to locate and describe the position of the mandibular foramen (MF) using a digital vernier caliper: The distance from the anterior border (AB) of ramus to the mandibular foramen (AB-MF), mandibular foramen to the posterior border (PB) of ramus (MF-PB), the distance from the anterior border to the posterior border of the ramus (AB-PB), the distance from the mandibular notch (MN) to the mandibular foramen (MN-MF), from the mandibular foramen to the mandibular base (MF-MB) and mandibular notch to the mandibular base(MB) (MN-MB), the distance from the mandibular foramen to the Gonion (G) (MF-G). The data obtained were tabulated and statistically analyzed. The mean AB-MF and MF-PB distances were 20.95±3.10mm and 13.73±1.87mm respectively while the mean MN-MF distance was 24.64 ±3.06mm and 27.60 ±3.72mm for MF-MB distance. The mean MF-G distance was 24.20±3.46mm. However, the AB-PB distance was 37.02±3.88mm while the distance MN-MF was 52.35±4.83mm. A good knowledge of the position of the mandibular foramen will be beneficial to anthropologists during paleo-anthropological studies and to maxillofacial surgeons, oncologists and radiologists in preventing neurovascular complications and radiologic misinterpretations while working on mandibles.

***KEY WORDS**: Osteometry, Mandibular foramen, mandibles, South-East Nigerian Population.*

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I. INTRODUCTION

Mandibular Foramen (MF) is an opening on the medial surface of the mandible (Drake et al, 2015). The Inferior Alveolar Nerve (IAN) passes through the foramen to enter the mandibular canal, coursing through the body of the mandible inferior-anteriorly and then emerges through the mental foramen into the chin. In addition to supplying all lower teeth and much of the associated gingivae, the nerve innervates the mucosa and skin of the lower lip chin as well as skin of the mylohyoid muscle and digastric muscle (Drake et al, 2015).

MF has been found useful (along with the mental foramen) as a reference point in morphometric analysis during paleoanthropological studies and in identification of human remains, due to its stable relationship with the base of the mandible (Neiva et al, 2004; Kaufman et al, 2000; Murlimanju et al, 2011; Mathur and Joshi 2018). In addition, the foramen is known to be of considerable significance during mandibular dento-alveolar surgeries, endodontic treatments, orthographic surgeries (Mathur and Joshi, 2018) and implant placement. Dueto the relationship between IAN and MF, the foramen also constitutes an important landmark in

IAN Block anaestheticتechnique (Drake *et al*, 2015; Moore *et al*, 2017), which remains one of the most common anesthetic technique employed worldwide, especially in dentistry (Drake *et al.*, 2015; Blacher*et al.*, 2016; Jain *et al.*, 2020).

Anatomical variations in the morphology and position of MF have been reported in different populations (Bee *et al*, 2010; Murlimanju et al, 2011; Pancer et al, 2014; Nayak et al, 2019; Iwanaga et al, 2020), in different age groups of the same population and even, within the same individual (Ashkenazi *et al*, 2011; Khan et al, 2016). In addition, radiographic and cadaveric studies of the mandible have demonstrated the existence of accessory mandibular foramina (Sherman, 1989; Katakami et al, 2004; Murlimanju et al, 2011; Pancer et al, 2014).

MF variations have been reported to contribute to failures of IAN block anaesthetic technique (Sherman, 1989; Katakami et al, 2004; Murlimanju et al, 2011; Pancer et al, 2014; Nayak et al, 2019; Iwanaga et al, 2020; Jain et al, 2020).Also, the variations are said to account for a number of neurovascular complications in oro-dental and maxillo-facial surgical procedures (Daw et al, 1999: Balcioglu et al, 2016), and as sites for the spread of tumors following radiotherapy in the lateral surface of mandible (Fanipunda& Matthews, 1999).

Despite the numerous significances of MF, there is paucity of literature on the morphological and positional variations in MF among Blacks in West Africa in general and Nigeria in particular. In order to achieve better surgical outcomes in the mandible and to avoid neurovascular complications associated with morphological/positional variations in the anatomy of MF, determination of the location of the MF among Blacks in West Africa will be beneficial, particularly to dental surgeons. This is more so when it has been documented that anatomic variations in MF exists in different populations, within the same populations and even within the same individuals in a population. Besides, availability of data on morphological and positional variations of MF among Blacks in West Africa, will be beneficial during paleo-anthropological studies and in forensic identification of skeletonized human remains,especially in Nigeria where there have been increased incidents of insurgent/terrorist attacks, mass killings, kidnappings and human trafficking with increasing number of missing individuals. Additionally, knowledge of the morphological and positional variations in the anatomy of MF will provide superiority in radiologic interpretation and prosthetic rehabilitation as well as in mandibular fracture managements and in the treatment of benign and malignant tumors of the mandible.

This study aims to determine the precise location of the mandibular foramen in relation to mandibular ramus landmarks and the mandibular ramus quadrant in which the mandibular foramen is localized in the horizontal and vertical planes among Nigerian population in South-East Nigeria.

II. MATERIALS AND METHOD

This study was designed and conducted in the University of Port Harcourt, Choba, River State, using 65 dry adult mandibles of unknown age and sex.The ethical clearance for the study was obtained from department of Anatomy in the same University. The mandibles were obtained from the Anatomy museum of the University, and from the bone banks at the University of Calabar, Cross River State; Niger Delta University, Bayelsa State; Abia State University, Uturu, Abia State; Nnamdi Azikiwe University, Nnewi Campus, Anambra State, Nigeria. Mandibles that were damaged or that lacked sockets for third molar tooth were excluded. Mandibles that were partially- or totally-dentated with preserved anatomical structures and sockets for the third molar tooth on both sides were selected and used for this study. Also, the selected mandibles had the left and right rami with intact mandibular foramina and as a result of this, a total of 130 mandibular foramina (65 on each side) were assessed in the study.All the measurements were taken by one observer in order to avoid inter-observer bias.

Measurements of parameters - The position of each mandibular foramen relative to various landmarks in the mandibular ramus was measured using a digital vernier caliper calibrated to 0.1mm accuracy. In order to locate the position of the mandibular foramen, the methods of Russa & Fabian (2014) and Padmavathi *et al*. (2014) were adopted for this study. The following parameters were measured:

a. Horizontal distance from the nearest point on the anterior border (AB) of the ramus to the midpoint of the anterior border of the mandibular foramen (MF) (that is, AB-MF).

b. Horizontal distance from the midpoint of the posterior border of the mandibular foramen to the nearest point on the posterior border (PB) of the ramus (MF-PB).

c. Horizontal distance from the anterior border (AB) of the ramus to the posterior border (PB) of the ramus across the foramen, in order to ascertain the width of the ramus (AB-PB).

Subsequently, the horizontal distance from the anterior to the posterior border (AB-PB) of the mandibular ramus was calculated, in order to determine the width of the ramus (see Figure 1). Also, the sum of the distances obtained from (AB-MF) and (PB-MF) was subtracted from the distance (AB-PB) to determine the anterior-posterior width of each foramen.

Other parameters measured were the vertical distance MN-MF, from the inferior-most point on the mandibular notch (MN) to the border of the mandibular foramen (MF) and the distance MF-MB from the lowest point on the inferior border of the mandibular foramen (MF) to the base of the mandible (MB). Additional parameters measured were the respective distances from the inferior-most point on the mandibular notch (MN) to the base of the mandible (MB) across the mandibular foramen (MN-MB). Lastly, vertical distance (MF-G) was measured from the mandibular foramen (MF) to the gonion (G).

Determination of location of MF - In order to locate the quadrant of the ramus in which the foramen was localized, the following measurements and calculations were done.

a. The width of the foramen obtained from subtraction of the sum AB-MF and PB-MF distances from the AB- PB distance was divided into half and added to the distance gotten from AB-MF to obtain the midpoint of the Mandibular foramen. This is illustrated below:

i. $(Ab \rightarrow Pb) - (Ab \rightarrow Mf + Pb \rightarrow Mf) = widthofforamen(W_f)$

ii. $\frac{W_f}{2} = midpointofforamen(MpF)$

iii. $MpF + Ab \rightarrow Mf = anteriorposteriordistance\,(APD)$of MF

iv. $\frac{APD}{Ab \rightarrow Pb} * 100 = anterioposteriorlocalization(APL)$

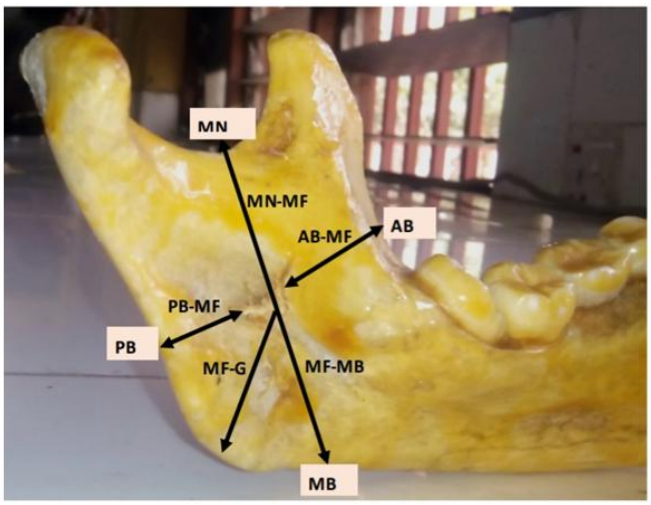
b. The percentage of the distance obtained from (*iii*) with the distance got from AB-MF was calculated to locate Mandibular foramen anterior-posteriorly (APL).

c. The vertical localization of the Mandibular foramen was obtained by calculating how much of the distance obtained from MN-MF is represented in the percentage of the distances obtained from MN-MB

$$\frac{Mn \rightarrow Mf}{Mn \rightarrow Mb} * 100 = superiorinferiorlocalization(SIL)$$

Values from 0 to 25% comprised the first quadrant; from 26% to 50%, the second; from 51% to 75%, the third; and from 76% to 100%, the fourth quadrant (See Figure 2).

Presentation of Data – Data were represented in frequencies, mean and standard deviation. T-test was used to compare means between the parameters of left and right mandiblesand a value of $p<0.05$ was taken to be statistically significant.Chi-square test was performed to show an association between the 2nd and 3rd anterior-posterior and superior-inferior localization of the foramen. Significance was accepted at $p< 0.05$.The student's t-test was used to determine the difference between the right and left sides of the mandibular ramus and $p<0.05$ was taken to be statistically significant.



*MN-mandibular notch, MF-mandibular foramen, MB- mandibular base of ramus, AB/PB- anterior and posterior boarder of mandibular ramus, G- gonion.

Figure 1: Part of Left Mandible showing schematic representation of all measured parameters.

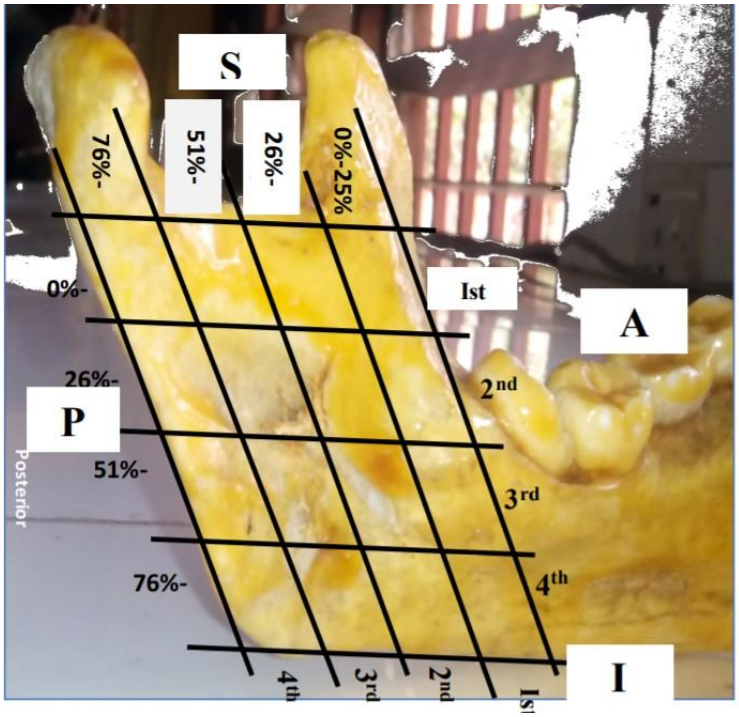


Figure 2: Schematic representation of the division of the mandibular ramus into quadrants. (P= posterior, S= superior, A= anterior, I= inferior

III. RESULT

The mean horizontal distance from the anterior border of the mandibular ramus to the anterior border of the mandibular foramen (AB-MF) for both sides was 20.95 ±3.10 mm while the mean horizontal distance from the posterior border of ramus to the posterior border of the mandibular foramen (PB-MF) was 13.73 ± 1.87 mm. The mean of the horizontal distance from the anterior border to the posterior border of the mandibular ramus (AB-PB) was 37.02 ± 3.88 mm. From the mandibular notch to the mandibular foramen (MN-MF), the mean vertical distance obtained was 24.64 ± 3.06 mm while the mean vertical distance from the mandibular foramen to the mandibular base (MF-MB)was 27.90 ± 3.72 mm. A mean vertical distance of 52.35 ± 4.83 mm was recorded from the mandibular notch to the mandibular base (MN-MB), with a mean vertical distance of 24.20 ± 3.46 mm from the mandibular foramen to the gonion (MF-G).The mean width of the mandibular ramus(across the mandibular foramen horizontally) was 2.34 ± 1.17 mm (Table 1).

Table 1: Mean Distances (of both sides) from the mandibular foramen to various landmarks of the mandible(*MN- mandibular notch, MF- mandibular foramen, MB- mandibular base of ramus, AB/PB- anterior and posterior boarder of mandibular ramus, G- gonion, AMF-accessory mandibular foramen)

Parameter(mm)	Total No. Studied	Mean (mm)	Standard Deviation	Standard Error of Mean	Minimum (mm)	Maximum (mm)
AB-MF	130	20.95	3.10	0.27	14.51	30.06
PB-MF	130	13.73	1.87	0.16	8.87	19.60
AB-PB	130	37.02	3.88	0.34	27.43	49.72
MN-MF	130	24.64	3.06	0.27	16.60	33.40
MF-MB	130	27.90	3.72	0.33	17.38	37.83
MN-MB	130	52.35	4.83	0.42	42.33	63.31
MF-G	130	24.20	3.46	0.30	16.66	31.91
MF WIDTH	130	2.34	1.17	0.10	0.07	5.79

Table 2: Displays the mean of the distances for the right and left mandibles, with respect to the location of the mandibular foramen in the horizontal and vertical axis of the mandibular ramus. The mean horizontal distance from the anterior border of the ramus to the mandibular foramen (AB-MF) was 20.71 ± 3.16 mm (right side) and 21.19 ± 3.05 mm (left sides). The mean horizontal distance from the mandibular foramen to the posterior border of the mandibular ramus (MF-PB) was 13.75 ± 1.88 mm (right) and 13.72 ± 1.89 mm (left). The mean horizontal distance from the anterior border to the posterior border (AB-PB) was 36.94 ± 3.86 mm (right) and 37.10 ± 3.93 mm (left). The mean vertical distance from the mandibular notch to the mandibular foramen (MN-MF) was 24.76 ± 3.05 mm (right) and 24.52 ± 3.08 mm (left) while the mean vertical distance from the mandibular foramen to the mandibular ramus base (MF-MB) was 28.01 ± 3.58 mm and 27.79 ± 3.88 mm for the right and left sides respectively. Also, the mean vertical distance from the mandibular notch to the mandibular ramus base (MN-MB) was 52.71 ± 4.56 mm (right) and 51.94 ± 5.09 mm (left). The mean distance from the mandibular foramen to the gonion (MF-G) was 24.90 ± 3.08 mm (right) and 23.50 ± 3.69 mm (left).The width of the foramen was 2.49±1.20 mm and 2.19 ±1.13mm for the left and right sides respectively. There was asignificant difference between the sides.

Table 2: Descriptive characteristics of Distances (of each side) from the mandibular foramen to various landmarks of the mandible

Side of the mandible		No.	Mean	Std. Deviation	Std. Error Mean	Maximum	Minimum
AB-MF	**Right**	65	20.708	3.159	0.392	30.06	10.13
	Left	65	21.188	3.052	0.379	28.86	15.48
MF-PB	**Right**	65	13.748	1.875	0.233	17.86	10.13
	Left	65	13.722	1.889	0.234	19.60	8.87
AB-PB	**Right**	65	36.943	3.861	0.479	49.65	27.43
	Left	65	37.098	3.927	0.487	49.72	27.77
MN-MF	**Right**	65	24.757	3.051	0.378	31.39	16.60
	Left	65	24.515	3.084	0.383	33.40	17.19
MF-MB	**Right**	65	28.006	3.580	0.444	37.83	17.38
	Left	65	27.787	3.883	0.482	36.51	18.56
MN-MB	**Right**	65	52.713	4.559	0.566	63.31	42.58
	Left	65	51.937	5.088	0.631	62.22	42.33
MF-G	**Right**	65	24.900	3.081	0.382	30.32	16.91
	Left	65	23.500	3.688	0.457	31.91	16.66
SIL(%)	**Right**	65	47.086	5.643	0.700	64.51	34.66
	Left	65	47.253	4.328	0.537	56.78	37.10
APL(%)	**Right**	65	59.014	5.180	0.642	69.28	37.81
	Left	65	60.170	3.835	0.476	69.03	51.64
SIZE	**Right**	65	2.488	1.197	0.149	5.79	0.33
	Left	65	2.188	1.133	0.141	5.25	0.07

On the right side, 50%(*n = 65)* of mandibles studied had mandibular foramen located on the 2nd and 3rdquadrant superior-inferiorly and anterior-posteriorly (Table 3). Same was obtained on the left. Chi-square (X^2) test revealed no significant association between the 2ndand 3rdquadrants, anterior posteriorly and superior inferiorly at $p < 0.05$.

Table 3: Anterior-Posterior and Superior-Inferior Location of Mandibular Foramen

Side	Placed Anterior-Posteriorly	Anterior-Posterior Quadrant	Placed Superior-Inferiorly	Superior-Inferior Quadrant
Right	50% (*n*=65)	2nd and 3rd	65%	2nd and 3rd
Left	50% (*n*=65)	2nd and 3rd	65%	2nd and 3rd

*Anterior-posteriorly ($X^2 = 0.01$; *p* value=1.00)
Superior-inferiorly ($X^2 = 2.031$, *p* value = 0.49

IV. DISCUSSION

This research studied the location of 130 mandibular foramina on 65 mandibles of a South-East Nigerian population. This population is Sub-Saharan African, one of the five major subdivisions of humankind (Scott et al., 2018) and the population's language belongs to the *Niger-Kordofanian* phylum, one of the three major Sub-Saharan African language phyla (Greenberg, 1963). Sub-Saharan Africa has an extensive genetic diversity leading to several subdivisions of humankind occurring in the region (Choudhury et al, 2018; Scott et al, 2018) and despite this level of diversity, osteometric studies of the mandibular foramen in the varying populations of Sub-Saharan Africa is sparse, particularly among Sub-Saharan African populations of West Africa, including Nigeria where over 250 ethnics/tribes exist; hence the need for our study of the Nigerian population in South-East Nigeria.

Another justification for our work arose from reports that MF shows variations in morphology and position and that the variations differ from population to population, and even within the same population as well as within the same individual of the same population (Bee et al, 2010; Murlimanju et al, 2011; Pancer et al, 2014; Nayak et al, 2019; Iwanaga et al, 2020). The variation also exists in different age groups of the same population (Ashkenazi *et al*, 2011; Khan et al, 2016).

All these variations are believed to occur dueto mainly environmental (racial) differences, genetics, craniofacial growth, diet, anatomical variability and ageing (Asfar et al, 1997; Ashkenazi *et al*, 2011; Jobling, 2012; Karthikeya Patil, 2016; Jurmain et al., 2017; Stanford et al., 2017). These can explain the differences and similarities between the findings from our study (as discussed below) and those from previous studies in different populations (Table 4). Despite this, we acknowledged that different methodologies adopted in similar studies render difficult, a direct comparison of the different study outcomes. In addition to this, the shape of the foramen varies, and is most influenced by differently shaped lingula (Kilarkaje, 2004).

It was observed from this study that the anterior-posterior dimension of the ramus was greater anterior to the foramen than posterior to the foramen, that is, distance AB-MF is greater than distance PB-MF. This indicates that the mandibular foramen on the mandibles of the South-East Nigerian population were located in the posterior region of the ramus. This finding is similar to that reported from previous studies by Oguz et al. (2002) in Turkish population; Ennes and Medeiros (2009) among Brazilians; Prajna et al. (2013) among Indians; Russa and Fabian (2014) in Tanzanians; Mbajiorgu (2000) on Zimbabweans; Lavanya et al. (2011), Padmavathi et al., (2014) in South Indians and by Jain et al, (2019) among East Europeans.

Further findings from this study showed that the AB-MF dimensions were greater on the left than on the right. This was similar to previous studies on different populations (Mbajiorgu, 2000; Lavanya et al., 2011; Afadhali and Fabian, 2014; Padmavathi et al., 2014) but differs from what was reported among Turkish population by Oguz*et al,* (2002) and in Brazilian population by Ennes and Medeiros (2009), in which the right AB-MF length was greater than that of the left.

From this study, the anterior and posterior dimensions of the ramus relative to the foramen were different from those reported from a number of previous studies as shown in Table 4.These differences could be as a result of age, ethnic differences and sex as well as diet and developmental changes. The study showed that along the vertical axis, the distance from the mandibular foramen to the mandibular notch (MN-MF) was less than the distance from the mandibular foramen to mandibular base (MF-MB), indicating that the mandibular foramen was located in the superior halfof the ramus. This was similar to what was reported from a Turkish population by Oguz et al. (2002) and from a Zimbabwean population by Mbajiorgu (2000).

In addition, mandibular foramen in this study was located in the 2nd and 3rd quadrants superior-inferiorly and anterior-posteriorly respectively. This is similar to a finding obtained from a study carried out on mandibles of Brazilian population, wherein the foramen was positioned at the 3rd quadrant anterior-posteriorly and superior-inferiorly (Ennes and Medeiros, 2009). Studies among Indian populations (Padmavathi et al, 2014; Shalini *et al*, 2016) showed that the foramen was located at the junction of the 2nd and 3rd quadrants in a superior-inferior direction, unlike what was obtained from our study. When the position of the foramen on both sides of the mandible were compared, there was no significant association in the position of the foramen along anterior-superior and a superior-inferior direction. That is similar to what was observed by Shalini et al. (2016) studies on mandibles of Indian populations.

It was noted in this study that the distance from the mandibular foramen to the gonium (MF-G distance) in Nigerian mandibles was longer on the right than on the left. This implies that the dimensions of MF-G on both sides of the mandible are asymmetrical and it suggests that, despite Sub-Saharan Africans (formerly known as Negriods) having similar skull pattern, there could be slight differences in the component parts of their respective skulls.

Comparing what was obtained from previous studies to the present one, it was observed that the distance from the mandibular foramen to Gonium (MF-G distance) of the Nigerian mandible was higher than that obtained from Indian (Prajna et al, 2013) and Tanzanian (Russa and Fabian, 2014) populations. The width of the mandibular foramen was also considered in this study and it was found to be 2.49mm (right) and 2.18mm (left). The width on right was larger than on the left by about 0.38mm, indicating an asymmetry in the width of foramina (see Table 2). When compared with the width obtained from the South Indians, which was 3.2mm (right) and 3.1mm (left), MF width was larger among the South Indians than in the Nigerian population. This could be due to environmental (racial) differences, genetics, craniofacial growth, diet, anatomical variability and ageing (Asfar et al, 1997; Ashkenazi et al, 2011; Jobling, 2012; Karthikeya Patil, 2016; Jurmain et al., 2017; Stanford et al., 2017)

This study has further shown the existence of morphologic and positional variations in the anatomy of mandibular foramen, particularly in Nigerian population in South-East Nigeria. These variations have been reported to contribute to failures of IAN block anaesthetic technique (Sherman, 1989; Katakami et al, 2004; Murlimanju et al, 2011; Pancer et al, 2014; Nayak et al, 2019; Iwanaga et al, 2020; Jain et al, 2020) and in spite of the popularity of the IAN Block, its failure rate is considered to be significantly high (Shalini et al, 2016; Jain et al; 2019). The variations have also been reported to account for a number of neurovascular complications in oro-dental and maxillo-facial surgical procedures (Daw et al, 1999: Balcioglu et al, 2016). Achieving successful anaesthesia of IAN entails the deposition of local anaesthetic solution on the nerve just before it enters the Mandibular Foramen (Varsha et al., 2012; Russa & Fabian, 2014; Drake et al, 2015). Interestingly, there is no specific intra-orally visible bony landmark to guide in the correct location of the mandibular foramen during local anaesthetic injections (Khan et al, 2016). As such, there is need for data on the location of MF on the mandibles of South-East Nigerian population.

The data obtained from our study may be beneficial in locating the MF during oro-dental and maxilla-facial surgeries, radiologic interpretation and prosthetic rehabilitation as well as in mandibular fracture managements and in the treatment of benign and malignant tumors of the mandible. In addition, data on MF will be beneficial during paleo-anthropological studies and in forensic identification of skeletonized human remains,especially in Nigeria where there have been increased incidents of insurgent/terrorist attacks, mass killings, kidnappings and human trafficking with increasing number of missing individuals.

Limitations: The study encountered some limitations. Age and sex of the sample were unknown. Due to this, we could not determine the effects of age and sex on the parameters studied. Also, the sample size is considered small and does not reflect the entire ethnic nationalities in Nigeria. These limitations should be considered in future studies.

Table 4: Comparison of study findings with those of some selected previous studies.

Study by Author(s)	Country of Sample	Sides	AB-MF (mm)	PB-MF (mm)	AB-PB	MN-MF (mm)	MF-G (mm)	MF-MB (mm)
Mbajiorgu EF, 2000	Zimbabwe		18.95	22.50				
			14.30	28.44				
Oguz&Bozkir., 2002	Turkey	Right	16.90	14.09		22.37	-	
		Left	16.78	14.37		22.17	-	
Kilarkaje et al (2005)	Middle-East Asians	Right	18.5 ± 1.9	-		21.6 ± 3.1	25.1 ± 4.2	
		Left	18.5 ± 2.0	-		21.6 ± 3.4	24.7 ± 4.4	
Ennes&Medeiros, 2009	Brazil	Right	1 3.9 ± 3.0	10.6 ± 2.1	26.8 ± 3.2	22.1 ±3.9		18.8 ± 3.3
		Left	1 4.3 ± 2.8	11.1 ± 1.6	26.1 ± 4.1	21.8 ± 3.3		19.4 ± 3.6
Prado *et al.*, 2010	Brazil	Right	19.2 ± 3.6	14.2 ± 2.4		23.6 ± 3.1	-	28.3 ±3
		Left	18.8 ± 3.8	13.9 ± 2.6		23.1 ± 3.0	-	23.1 ± 3
Varsha Shenoy et al (2012)	India (South India)	Right	16.1	11.7		23.60	-	
		Left	16.3	11.3		23.60	-	
Samanta*et al.*, 2013	India	Right	15.72 ± 2.92	13.29 ± 1.74		22.70 ± 3.0	21.54 ± 2.92	

		Left	**16.23 ± 2.88**	**12.73 ± 2.04**		**22.27 ± 2.92**	**21.13 ± 3.43**	
Hoque et al, 2013	**Bangladesh**	**Right**	**16.34±1.97**	**14.14±2.36**	**-**	**22.29±3.43**	**-**	**-**
		Left	**16.27±1.91**	**14.04±2.32**	**-**	**22.18±3.32**	**-**	**-**
Manthur and Joshi, 2018	**India**	**Right**	**15.78 ± 2.72**	**11.29 ± 1.99**		**22.91 ± 3.88**	**21.10 ± 3.28**	
		Left	**16.09 ± 2.30**	**11.48 ± 2.03**		**22.95 ± 3.50**	**21.18 ± 2.96**	
		Left	**15.76 ± 2.23**	**11.95 ± 1.50**		**22.90 ± 3.36**	**21.67 ± 4.10**	
Shalini et al, 2016	**India**	**Right**	**17.11±2.74**	**10.47±2.11**	**31.76±3.83**	**21.74±2.74**	**-**	**22.33±3.32**
		Left	**17.41±3.05**	**9.68 ±2.03**	**31.49±3.97**	**21.92 ±3.33**		**25.35±4.5**
Jain et al, 2019	**Latvia**	**Right**	**16.88**	**12.31**	**27.34 ± 3.84**	**17.41**		**19.80**
		Left	**17.33**	**11.75**	**27.48 ± 3.80**	**18.01**	**-**	**20.11**
Present study	**Nigeria**	**Right**	**20.708**	**13.748**	**36.943**	**24.757**	**24.900**	**28.008**
		Left	**21.188**	**13.722**	**37.098**	**24.515**	**23.500**	**27.787**

V. CONCLUSION:

Findings from this study showed that mandibular foramen of mandibles of Nigerian population in South-East Nigeria were located on the second and third quadrant superior-inferiorly and anterior-posteriorly. The study also showed that the foramen was found more at the posterior-superior aspect of the mandibular ramus along the horizontal and vertical axes. It is believed that the findings will be of benefits during paleo-anthropological studies and forensic human identification. The findings will also be beneficial to maxillofacial surgeons, oncologists and radiologists in preventing neurovascular complications and misinterpretations.

VI. RECOMMENDATIONS:

1. Further Osteometric studies of mandibles of known age and sex of South-East Nigerian population on a larger sample size.
2. Further Osteometric studies of mandibles of populations of other ethnic Nigerian nationalities.

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