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Anatomy

# The Study of Some Selected Facial Foramena Using Cadaver and Radiographic Methods in Nigerian Population

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# Abstract Original Research Article

**Background:** A comprehensive study of the human skeletal features and variations between and within populations are beneficial both for clinical applications and determination of racial characteristics of populations. This statement implies that a comprehensive study on the u-shaped bone, mandible of Nigerians is of clinical importance and allows for studies on racial differences between Nigerians and others, and equally within Nigerians. **Materials and Methods:** The study comprised twenty-seven human male cadavers obtained from the anatomy laboratories of two different universities in Nigeria. Measurements from panoramic and periapical radiographs of the mandibular foramen, mandibular canal and mental foramen. **Results and Discussions:** The position of the foramen was variable in different individuals, but the mental foramen was predominantly located below the lower second premolar tooth, and the mandibular foramen and was located on the posterior surface of the ramus of mandible. **Conclusions:** The percentage distribution of the mental foramen in relation to the lower second premolar tooth was not at variance with those of other races or population groups. The mandibular foramen was present on the inner surface of the ramus of the mandible. This research work is of clinical and anatomical significance to medical practitioners for a successful inferior alveolar and mental nerve block anesthesia and the prevention of damage to the mental nerve during surgical procedures in the lower jar.

**Keywords:** Mental foramen, Mandibular foramen, Mandible, Mandibular canal and Radiography.

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# INTRODUCTION

A comprehensive study of the human skeletal features and variations between and within populations are beneficial both for clinical applications and determination of racial characteristics of populations. This statement implies that a comprehensive study on the u-shaped bone, mandible of Nigerians is of clinical importance and allows for studies on racial differences between Nigerians and others, and equally within Nigerians [1].

One commonest or most regulating performed nerve block in dental surgery is the inferior alveolar nerve block. The inferior alveolar nerve passes through the mandibular foramen, through the mandibular canal, to transverse through the mental foramen as mental nerve. Considering the course, the nerve runs through, it is necessary to locate the exact position of mandibular foramen, mental foramen and the distribution of the mandibular canal [2-5]. This study is only possible to determine with a detailed cadaveric and radiographic study. The mandibular canal opens directly from the mandibular foramen and descends obliquely forwards in the body of the mandible, then horizontally forwards in the body below the alveoli, with which it communicates by small canals [2-5]. The site for inferior alveolar nerve block or anaesthesia is the mandibular foramen. This is an ovally shaped foramen, while the mental foramen is oval in some individuals and round in some others. A radiographic determination of the mandibular foramen and the mental foramen may be carried out using the following radiographic imaging technique, such as Orthopantomography, Tomography, Magnetic Resonance Imaging, Plain Radiography, Fluoroscopy, Computed Tomography, Spiral Tomography using the computed tomography to explain the process of radiography [6-10].



Fig-1: The foramena in the mandile [21]

#### **Computed Tomography**

Conventional body section radiography is also referred to as tomography. In its simplest form, linear body section radiography has the following elements; xray tube, patient and film. Computed tomography is a specialized x-ray imaging technique that can either use a contrast material or not. In this technique, an image is created by using an array of individual small x-ray sensors/detectors and a computer. This is done by spinning the x-ray source and thus the small x-ray sensors /detectors around the patient. The data is then collected from multiple angles, which is later sent to the computer where it is processed. The processed information is used to create image on the video screen. The major difference between computed tomography, other radiographic imaging technique and orthopantomogram is three dimensional while the image or x-ray produced in others is two dimensional. The CT has the ability to differentiate between densities which are similar but very slightly different. After the optimal CT images are obtained on the monitor screen, they can be put on film by the permanent record or hard copy, which is made from the stored electronic images [6-10].

#### **Panoramic Radiography**

The panoramic radiograph is a composite radiograph of the teeth as well as both jaws. In one film it shows us if you have the normal number of teeth, wisdom teeth, missing teeth, impacted teeth or extra teeth. The mandibular canal can be localized using panoramic radiography or spiral tomography [11-15].

There are have works reported on mandibles by previous authors [1-20].

#### Aim of the Study

- To determine the exact position of the mental foramen, mandibular foramen and the mandibular canal in Nigerians.
- To check for the effect of age and race on the size, shape and position of the mandibular canal, mental foramen and mandibular foramen.

# **MATERIALS AND METHODS**

## **Research Design**

The study was non-experimental.

#### Sample Size and Sampling Technique

The study comprised twenty-seven human male cadavers obtained from the anatomy laboratories of two different universities in Nigeria. Measurements from panoramic and periapical radiographs of the mandibular foramen, mandibular canal and mental foramen. The cadavers were randomly selected for the study.

#### **Criteria for Subject Selection**

Nigerian cadavers exclusively were assembled from University of Port Harcourt, Port Harcourt and Nnamdi Azikiwe University, Nnewi campus and Maxilofacial and Dental Centre, Port Harcourt for this study.

#### **Ethical Clearance**

Ethical clearance was obtained from the Research Ethics Committee of the University of Port Harcourt, Nigeria.

#### **Data Collection**

Gendex secondent microprocessor x-ray machine was used. The following steps, were followed during this course:

- STEP I- Firstly, the hairs were shaved off from the head, and the saw-blade used to open the head and its contents removed, after which the mandibles were extracted at the temperomandibular joints.
- STEP II- The mandibles were soaked in tap water at a temperature range of 60-65'C for 12 hours. This was done to allow for simmering of the bones, and then in tap water at a temperature of 37°C for approximately 2 weeks to ensure proper maceration of tissues. After this, the bones were soaked in 2% caustic soda for 1-4hours to remove remaining tissues.
- STEP Ill-After the removal of the bones from the caustic soda, they were brushed and properly rinsed in cold tap water. The bones were put in 10% hydrogen peroxide for 2 weeks, afterwards rinsed with running water in order to remove traces of hydrogen peroxide. Finally, the bones were sun dried for 2 days and polished using the polyguard polish.

A dental panoramic x-ray imaging apparatus was used for the radiographic method. The apparatus

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comprises an x-ray source for radiating an object with x—rays. An x-ray image detecting means for detecting an image of x-rays which passed through the object. A swivel for integrally swiveling of the x-ray source and the x-ray detecting means around the object. An image storing means for shoring image information output from the x-ray detecting agent during the period when the swivel means operates and an image processing means on the basis of image information stored in the image storing means.

At the Maxillofacial and Dental centre, the radiographic machine used was the Gendex secondent Microprocessor. This was produced in Italy by Gendex, in December 2003 with a voltage of 230v, 60/60 Hz, 5A and an output of 65KV. This machine produce 3 kinds of x-ray films: The occlusal x-ray, periapical x-ray and bywinged (x-ray for children).

#### Precautions

The following precautions was employed to avoid some methodological problems:

- The use of hand gloves to avoid contamination of the skin and the burning of the skin by the caustic soda employed.
- Laboratory coat was used to prevent the splashing of chemicals used on the body and to avoid x-ray irradiation.

• A disinfectant to wash hands after every work in the laboratory to prevent contamination of the hands with gems from the cadavers.

#### **R**ESULTS

The following parameters were measured:

#### **Mental Foramen**

The vertical distance between the alveolar crest of the mandible and the mental foramen, the horizontal distance between the mental foramen and the symphysis menti, the vertical distance between the inferior border of the base of mandible and the mental foramen; the posterior border of the ramus of the mandible and the mental foramen

#### **Mandibular Foramen**

The vertical distance between the mandibular foramen and the mandibular notch, the horizontal distance between the mandibular foramen and the posterior border of the ramus of the border of the mandible.

All these measurements were taken for both left and right parts. From the data obtained above, the mean values and the standard deviations were calculated.

In table-1, the result showed the parameters measured on the right and left sides.

Table-1. The filtun and Standard Deviations of Various filtusitements on the Handiste														
	Distance		Distance		Distance		Distance		Distance		Distance		Distance	
	between		between		between		between		between		between		between	
	mental		mental		mental		mental		mandibular		mandibular		mandibular	
	foramen and		foramen and		foramen and		foramen and		foramen and		foramen and		foramen and	
	symphysis		the alveolar		inferior		posterior		inferior		mandibular		posterior	
	menti		crest of		border of the		border of the		border of the		notch		border of the	
			mandible		base of		ramus of		base of				ramus of	
					mandible		mandible		mandible				mandible	
	LEF	RIG	LEF	RIG	LEF	RIG	LEF	RIG	LEF	RIG	LEF	RIG	LEF	RIG
	Т	HT	Т	HT	Т	HT	Т	HT	Т	HT	Т	HT	Т	HT
ME	2.74c	2.76c	1.45c	1.47c	1.47c	1.46c	7.69c	7.74c	2.89c	2.92c	2.03c	2.07c	1.62c	1.59c
AN	m	m	m	m	m	m	m	m	m	m	m	m	m	m
S.D	0.17c	0.19c	0.14c	0.16c	0.20c	0.19c	0.45c	0.56c	0.27c	0.25c	0.23c	0.23c	0.22c	0.23c
	m	m	m	m	m	m	m	m	m	m	m	m	m	m

#### Table-1: The Mean and Standard Deviations of Various Measurements on the Mandible

In table-2, there was no significant difference in the data obtained.

#### **Mental Foramen**

The average vertical distance between the alveolar crest of mandible and the mental foramen were 1.45cm and 1.47cm on the left and right respectively.

The average vertical distance between the inferior border of the base of mandible and the mental

foramen were 1.47cm and 1.46cm on the left and right respectively.

The average horizontal distance between the mental foramen and the posterior border of the ramus of mandible were 7.69cm and 7.74cm on the left and right respectively.

The average horizontal distance between the mental foramen and the symphysis menti were 2.74cm and 2.76cm on the left and right respectively.

	Distance Distance		Distance	Distance	Distance	Distance	Distance	
	between	between	between	between	between	between	between	
	mental	mental	mental	mental	mandibular	mandibular	mandibular	
	foramen	foramen and	foramen and	foramen and	foramen and	foramen and	foramen and	
	and	the alveolar	inferior	posterior	inferior	mandibular	posterior	
	symphysis	crest of	border of the	border of the	border of the	notch	border of the	
	menti	mandible	base of	ramus of	base of		ramus of	
			mandible	mandible	mandible		mandible	
Т-	0.408	0.489	0.188	0.362	0.424	0.639	0.489	
calculated								
T-	2.000	2.000	2.000	2.000	2.000	2.000	2.000	
tabulated								
P-value	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P-0.05	
	No	No	No	No	No	No	No	
	significant	significant	significant	significant	significant	significant	significant	
	difference	difference	difference	difference	difference	difference	difference	

#### Mandibular Foramen

The average vertical distance between the mandibular foramen and the inferior border of the base of mandible were 2.89cm and 2.92cm on the left and right respectively.

The average vertical distance between the mandibular foramen and the mandibular notch were 2.03cm and 2.07cm on the left and right respectively.

The average horizontal distance between the mandibular foramen and the posterior border of the ramus of the mandible were 1.62cm and 1.59cm on the left and right respectively.

From the twenty-seven human male cadavers used, the results obtained showed that the position of the mental foramen was present below the lower second premolar tooth in 19 mandibles (70.4%), while the remaining 8, it was present between the first and the second premolars (29.6%). The shape of the mental foramen was oval in 17 mandibles (62.9%) and the remaining 10 mandibles (37.1%) it was round in shape.

#### **Measurements Obtained from Radiographs**

Only the mental foramen was visible using the panoramic radiographs and the periapical radiographs derived from the panoramic x-ray machine and the Gendex microprocessor. The following measurements were done using seven radiographic films in the mental foramen, they include the following: distance between the mental foramen and the symphysis menti 1.4cm, distance between the mental foramen and the alveolar crest of the mandible 0.92cm; finally, average distance between the mental foramen and the inferior border of the base of mandible 0.84cm.

A total of six radiographs showed the position of mental foramen to be below the lower second premolar (85.7%) and the remaining one, was between the first and second premolar (14.3%). The shape of the mental foramen was oval in the seven (7) radiographic or x-ray films.

# DISCUSSIONS

This study was done in order to investigate the exact positions of the mental foramen and the mandibular foramen is Nigerians. The following results were obtained:

The distance between mental foramen and the symphysis menti were 2.74cm and 2.76cm on the left and right respectively.

The distance between the mental foramen and the inferior border of the base of mandible on the left was 1.47cm, while on the right 1.46cm.

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The distance between the mental foramen and the posterior border of the ramus of mandible were 7.69cm and 7.74cm on the left and right respectively.

The distance between the mental foramen and the alveolar crest of the mandible on the left was 1.45cm and right 1.47cm.

The distance between the mandibular foramen and the mandibular notch on the left was 2.03cm and right 2.07cm.

The distance between the mandibular foramen and the posterior border of the ramus of mandible on the left was 1.62cm and right 1.59cm.

The distance between the mandibular foramen and the inferior border of the base of mandible on the left was 2.89cm and right 2.92cm.

The results obtained showed that those from dry human male cadavers were consistent with that from the radiographs. The shape of the mental foremen from the radiographs indicated it was oval and from the cadavers, the foramen with oval structure were higher in position. Again, the position of the foramen was below the lower second premolar tooth in both cadaveric and radiographic measurements. Comparison of the results obtained from this study with those reported by previous authors in other races, showed that there were no significant differences in the result [11-15]. The result obtained from other research works on Indians, Zimbabweans, British, the Chinese and other races stated that the percentage of occurrence of the mental foramen were prevalently below the lower second premolar tooth [16-20].

# **CONCLUSION**

The percentage distribution of the mental foramen in relation to the lower second premolar tooth was not at variance with those of other races or population groups. The mandibular foramen was present on the inner surface of the ramus of the mandible. This research work is of clinical and anatomical significance to medical practitioners for a successful inferior alveolar and mental nerve block anesthesia.

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#### **Conflict of interest**

We write to state that there is no conflict of interest.

#### Source of funding-Self-funding.

#### Author's contribution

We write to state that both authors have contributed significantly, and that all authors are in agreement with the contents of the manuscript. 'Author A' (Josiah S. Hart) designed the study and protocol, 'reviewed the design, protocol and examined the intellectual content and 'Author B' (Ezon-Ebidor I. Edibamode) wrote the first draft of the manuscript, managed the literature search and managed the analyses of the study. All authors read and approved the final manuscript.

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