

# Assessment and determination of human mandibular and dental arch profiles in subjects with lower third molar impaction in Port Harcourt, Nigeria

Akinbami Babatunde Olayemi

Department of Oral and Maxillofacial Surgery, University of Port Harcourt, Port Harcourt, Nigeria

**Address for correspondence:**

Dr. Akinbami Babatunde Olayemi, Department of Oral and Maxillofacial Surgery,  
College of Health Sciences, University of Port Harcourt, Rivers State, Nigeria.

E-mail: akinbamzy3@yahoo.com

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## ABSTRACT

**Aim:** The aim of this study was to determine the normal size of the mandible and the difference in dental arch length and total teeth size space that is necessary to prevent lower third molar impaction. **Background:** The mandible is an important component of facial skeleton and its morphology is relevant to the determination of acceptable aesthetics. In addition, function of the dentition is dependent on the available space for positioning of all the teeth including the third molar, and for enough space to be created, the sizes of the mandible and dental arch must be within normal ranges. **Materials and Methods:** Impaction of the lower third molar was assessed by clinical evaluation and radiography. The total length of the mandible is determined by adding the distance between the midpoint of the tragus and soft tissue around the angle of the mandible to the distance between the angle and the soft tissue in the region of the chin. Mandibular width is the distance between the two angles of the mandible. The teeth sizes of the three anterior teeth, the two premolars, and the two molars were measured with a divider/ruler and recorded. The anterior-posterior distance of the arch from the midline to the retromolar pad was also measured. **Results:** There were 44 (53%) females and 39 (47%) males. Eighty-one (97.6%) of the participants were between 16 and 23 years old, while 2 (2.4%) were in the fourth decade. There were 38 (45.8%) cases of impaction and 45 (54.2%) cases of unimpacted mandibular third molar. The means/standard deviation values for mandibular length for males in each group are  $18.20 \pm 0.98$  and  $18.20 \pm 1.13$  cm, respectively. The values for mandibular length for females in each group are  $17.20 \pm 0.76$  and  $17.60 \pm 1.07$ . There are significant differences between the genders for mandibular length ( $P < 0.05$ , 95% CI). The means/standard deviation values for mandibular width for both genders in each group are also shown. There are also significant differences between the genders for mandibular width ( $P < 0.05$ , 95% CI). Normal sized mandible should have a length within or above 17.22–19.33 cm in males and 16.44–18.67 cm in females, while normal dental arch-total teeth size difference range should be within or above 0.71–1.20 cm in males and 0.76–1.10 cm in females in order to accommodate a properly erupting third molar. **Conclusions:** Based on these figures, clinicians may be justified to perform a preventive or therapeutic surgical removal of the impacted lower third molars of the postpubertal patients whose parameters fall below these set values. This study is also useful for evaluation of patients who would need orthognathic and reconstructive surgeries.

**Keywords:** Dental arch, impaction, mandible, third molar

## INTRODUCTION

Aesthetics is a feature that is strongly linked to the facial profile of the human, and the facial profile is mainly based on the skeletal

framework. The mandible is an important component of this basis and therefore its morphology is relevant to the determination of acceptable aesthetics.<sup>[1-3]</sup> In addition, function of the dentition is also dependent on available space for the positioning of all the

teeth including the third molar,<sup>[2-4]</sup> and for enough space to be created, the sizes of the mandible and dental arch must be within normal ranges.

Body parameters such as weight, height, body mass index, and skull/jaw factors such as the length, width of the body, and ramus of the mandible as well as the dental arch may interact to predispose to impaction of lower third molar.<sup>[3-7]</sup>

Mandibular third molar impaction is frequently associated with an insufficient growth of the mandible, and length of the mandible and difference in the size of the dental arch and the total teeth size are the most important factors responsible for the occurrence of the third molar impaction.<sup>[1,3,5-8]</sup> Disproportionate sizes of the teeth, arch, and jaws are influenced by both environmental factors and genetic make-up of the individual.<sup>[5-9]</sup>

Therefore, in order to guide the clinical selection of patients for prophylactic or therapeutic surgical removal of impacted mandibular third molar,<sup>[10-14]</sup> it is vital to determine the benchmark values for these two parameters.

The aim of this study was to determine the normal length of the mandible, and the difference between the dental arch length and total teeth size that is necessary to prevent lower third molar impaction.

## MATERIALS AND METHODS

This was an analytical case-controlled randomized study conducted in the Department of Oral and Maxillofacial Surgery, College of Health Sciences, University of Port Harcourt, Port Harcourt, Nigeria, between February 2009 and October 2009. The sample population was selected by simple random method. The study group included subjects of both genders and who were at least 16 yrs old. They were students of the College of Health Sciences, University of Port Harcourt and Rivers State School of Science and Technology which came from different tribes representing the entire geographical regions of the country. In addition, consecutive patients who attended the clinic were included. Ethical clearance was obtained from the College Research and Ethics Committee and the participants also gave informed consent.

Excluded from the study were subjects below 16 years, those with one or more missing tooth, those with retained deciduous tooth/teeth, and those with moderate to severe malocclusion and asymmetry of the face.

An impacted tooth is one that is not in the normal upright position, such that the occlusal surface of its crown does not reach the occlusal level line of the dentition, after the processes and stages of eruption are completed.<sup>[6]</sup> Such a tooth may either be completely buried within alveolar bone entirely covered by mucosa or parts of the crown may show in the mouth. The subjects were categorized into two groups: those who had impacted third molar and those who did not have impaction. Impaction of the lower third molar was assessed mainly by clinical evaluation; but for those whose last molar were completely buried under the bone/gum and those that requested for treatment, periapical

radiographs were done. Failure of the tooth crown to reach the occlusal level of second molar, inclination of the tooth to the second molar, and anterior ramus of the mandible were the criteria used to determine the presence, type, and position of the impacted third molar.

### Mandibular Size Measurement

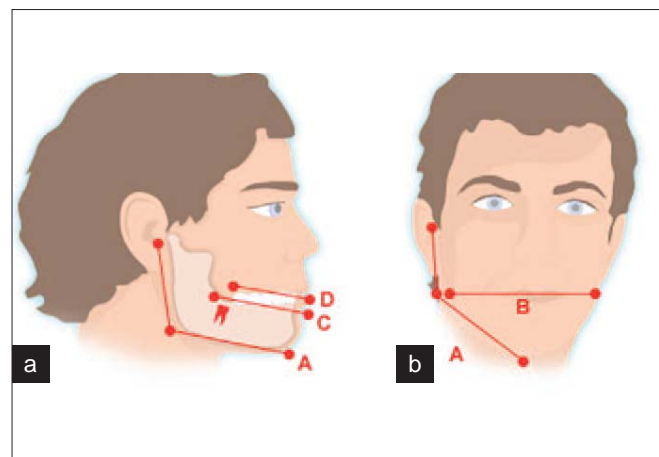
Figure 1 shows lateral view of the face demonstrating right half of the mandible and frontal view of the face demonstrating mandibular width, respectively.

ML-mandibular length (A): represents the addition of the linked vertical and horizontal lines; MW-mandibular width (B); alveolar arch length (C); total teeth size (D); (C and D) represent difference between alveolar arch length and total teeth size which is the space available for the third molar to erupt.

The mandibular index (MI) was assessed by measuring the length and width of the mandible [Figure 1]. The measurements were done directly on the face of the subjects/patients by the same person to avoid interexaminer errors, but standard linear calibrations were made.

Marks are drawn with ball pen markers at specific landmarks on the face, these are tragus of the ear, soft tissues in the region of the angle and chin. The mandibular condyle is represented on the face by the midpoint of the tragus of the ear. The angle is at the junction between the vertical part (ramus) and horizontal part (body) of the mandible. The symphysis of the mandible is represented on the face by the soft tissue in the region of the chin.

Mandibular length (A) is the total distance from the condyle (represented by midpoint of tragus) to the symphysis (represented by the soft tissue in the region of the chin) as shown in Figure 1a. The length is determined by adding the distance from the midpoint of the tragus to the soft tissue in the region of the angle of the mandible and the distance from the soft tissue in the region of the angle to that of the chin. Both distances were measured separately on the skin with flexible tape rule and then added together to avoid the difficulty of measuring around a curve.



**Figure 1:** a) Mandibular length measurement. b) Mandibular width measurement

Mandibular width (B) is the distance between the two angles of the mandible [Figure 1b]. The submental tissue folds in our subjects were not bulky so they did not impede the measurement of the width. The measurements were done directly on the subjects/patients with flexible tape rule closely adapted to displace the facial soft tissues. Rigid calipers are useful when submental tissues are bulky. MI was calculated by dividing the width of the mandible (B) by the length of the mandible (A) and values were recorded for Group 1 (impaction) and Group 2 (no impaction).

**Total Teeth Size Measurement**

The total teeth sizes of the three anterior teeth, the two premolars and the two molars (D) [Figure 1], were measured with the two pointed sharp ends of a sterilized divider from the mathematical set. First, the three anterior teeth which included central, lateral incisors, and canine were measured, one point of the divider touching the mesial surface of the central incisor and the other point of the divider touching the distal surface of the canine, this distance between the two points of the divider was then determined for each subject using the ruler. Same was done for the two premolars and the two molars, and the three values were added to give the total teeth size (width).

**Dental Alveolar arch Measurement**

The anterior-posterior distance of the arch from the midline to the retromolar pad (C) on right or left side was measured [Figure 1]. The anterior end of the dental arch is represented by the interdental papilla between the central incisors and the posterior end of the arch is represented by the mesial edge of the retromolar pad; a sterile strip is placed between these two points in the subject/patient's mouth for measurement; the distance is determined by marking the posterior limit on the strip with a pen; and the marked strip is removed and positioned on a ruler to determine the length of the dental alveolar arch. The difference between the dental alveolar arch and the total teeth size of the seven teeth was calculated (C-D) and recorded for both groups.

**Statistical Analysis**

Descriptive statistics was used to determine the frequency, means, and standard deviation for each parameter, (ML, MW, dental arch length, total teeth sizes, and arch-teeth size) for the two groups. Data were analyzed using the statistical package of the SPSS version 10 (SPSS, Inc., Chicago, IL, USA). *t* test was used

to compare differences between the values obtained for the two groups with *P* values set at 0.05 and 0.01, confidence interval 95% and 99%. *P* values <0.05 and 0.01 were considered significant. The benchmark range values of the parameters were determined by choosing the lowest value of the frequency distribution curve in the impacted group and the highest value of the frequency distribution curve in the unimpacted group of both genders.

**RESULTS**

Eighty-three subjects constituted the study population, out of which 44 (53%) were females and 39 (47%) were males. Cases that represented the impacted group were 38 (45.8%) and 45 (54.2%) cases formed the unimpacted group. Eighty-one (97.6%) of the participants were between 16 and 23 years old, while 2 (2.4%) were in the fourth decade. Values, means, and standard deviation for all the factors are shown [Tables 1 and 2]. Data showed that mean values for the parameters were lower in the impacted group than control group.

There was statistical significant correlation between total tooth sizes with mandibular length in this study and correlation coefficient value was 0.521. There was also correlation between dental arch length and mandibular length; correlation coefficient value was 0.421 and *P* < 0.01. The one-tailed significance table for correlation between mandibular length and arch/total teeth size difference also showed a coefficient value of 0.182 (*P* < 0.05).

The means/standard deviation values for mandibular length for males in each group are 18.20 ± 0.98 and 18.20 ± 1.13 cm, respectively [Table 1]. The values for mandibular length for females in each group are 17.20 ± 0.76 and 17.60 ± 1.07 cm, respectively [Table 2]. There is significant difference between the genders for mandibular length (*P* < 0.05, 95% CI).

The means/standard deviation values for mandibular width for both genders in each group are also shown in Tables 1 and 2. There is also significant difference between the genders for mandibular width (*P* < 0.05, 95% CI).

Values for the dental arch variables in both genders are also reflected in Tables 1 and 2. There is no significant difference

**Table 1: Ranges, means, and standard deviations of mandible and dental arch variables for males in groups 1 and 2**

Variables	Diagnosis	Male (39)	Impaction (15)		P value
			No impaction (24)		
			Minimum	Maximum	
Mandibular width (cm)	Impaction	12.50	16.00	14.20 ± 0.96	0.528
	No impaction	12.50	16.00	14.10 ± 0.96	
Mandibular length (cm)	Impaction	17.00	20.50	18.20 ± 0.98	0.048
	No impaction	16.00	20.50	18.20 ± 1.13	
Mandibular index	Impaction	0.61	0.86	0.78 ± 0.07	0.104
	No impaction	0.63	0.91	0.78 ± 0.08	
Alveolar arch length (cm)	Impaction	6.00	7.40	6.68 ± 0.39	0.069
	No impaction	6.20	7.40	6.80 ± 0.33	
Total teeth size (cm)	Impaction	5.10	6.30	5.80 ± 0.39	0.228
	No impaction	5.20	6.20	5.70 ± 0.29	
Difference in arch length and teeth size (cm)	Impaction	0.60	1.20	0.85 ± 0.14	0.003
	No impaction	0.80	1.40	1.09 ± 0.11	

**Table 2: Ranges, means, and standard deviations of mandible and dental arch variables for females in Groups 1**

Variables	Diagnosis	Female (44)	Impaction (23)		P value
			No impaction (21)		
			Minimum	Maximum	
Mandibular width (cm)	Impaction	11.50	15.00	13.30 ± 0.87	0.501
	No impaction	12.00	15.00	13.20 ± 0.83	
Mandibular length (cm)	Impaction	15.50	18.50	17.20 ± 0.76	0.043
	No impaction	15.30	19.00	17.60 ± 1.07	
Mandibular index	Impaction	0.68	0.85	0.78 ± 0.05	0.109
	No impaction	0.63	0.91	0.75 ± 0.06	
Alveolar arch length (cm)	Impaction	5.90	6.80	6.48 ± 0.22	0.072
	No impaction	6.00	7.10	6.48 ± 0.25	
Total teeth size (cm)	Impaction	4.90	5.90	5.47 ± 0.27	0.227
	No impaction	5.00	6.00	5.43 ± 0.26	
Difference in arch length and teeth size (cm)	Impaction	0.60	1.10	0.91 ± 0.15	0.004
	No impaction	0.90	1.20	1.03 ± 0.07	

**Table 3: Range values of mandibular length and difference in the dental arch-total teeth size for males and females**

Determinant variables	Males	Females	P value
Mandibular length (cm)	17.22-19.33	16.44-18.67	0.048
Difference in arch length and teeth size (cm)	0.71-1.20	0.76-1.10	0.056

between the genders for mandibular length ( $P > 0.01$ , 95% CI).

The range of value obtained for mandibular length was 17.22-19.33 cm for males and 16.44-18.67 cm for females [Table 3].

Also in Table 3, the range of value obtained for the differences in dental arch length and total teeth size was 0.71-1.20 cm for males and 0.76-1.10 cm for females. There are significant differences in the two parameters between both sexes.

## DISCUSSION

Clinical anthropometric measurements are very useful because of the small thickness of overlying facial soft tissues.<sup>[1,2]</sup> In this study, the length of the mandible and the dental arch-total teeth size difference was assessed by clinical anthropometric method. In a recent report by Akinbami and Didia,<sup>[3]</sup> these two factors have been found to be the main contributors to the occurrence of mandibular third molar impaction. Other factors that may play minor roles in the occurrence of this impaction include physical body characteristics such as (weight, height, and body mass index) and mandibular width, index, and mandibular cortical index.<sup>[3-8]</sup>

These factors are invariably determined by the differential and complex effects of the interplay of both genetic and environmental influences on the pattern and direction of growth and development of the whole skull.<sup>[6,8]</sup> Mandibular growth after puberty is not appreciable and if the third molar is not fully and properly positioned at the age of 17, it is certain that it will remain impacted.<sup>[3,4,6,8,9]</sup> In addition, when there is insufficient space in the arch, physiological migration of the seven teeth will still not allow the third molar to position properly.<sup>[6,8,10-15]</sup>

In this study, it was found that positive relationship was observed between mandibular lengths with alveolar arch lengths, total teeth

sizes, and difference in the arch lengths and teeth sizes. This is in support of other previous studies.<sup>[1,5-7,16-23]</sup>

A major strength of this study is that it will serve as a veritable basis for subsequent studies. With a thorough search of the literature, no study has been done to define a range of values for the length of the mandible which is useful not only to assess the growth of the mandible for possibilities of impaction of third molar but also for the reason of aesthetic facial profiles and baseline requirement for orthognathic surgery. Knowledge of the normal values of the mandibular length is relevant for comparison and evaluation of sizes of the mandible intraoperatively, in patients who need corrective orthognathic and reconstructive surgeries.

This anthropological study has favorably revealed that individuals whose mandibular length and length of dental arch and total teeth size difference are below 16.44 and 0.71 cm, respectively, are most likely to have a lower third molar impaction and those above 19.33 and 1.20 cm, respectively, are least likely to have impaction. Therefore, normal sized mandible should have a length within or above 17.22-19.33 cm in males and 16.44-18.67 cm in females, while normal dental arch-total teeth size difference range should be within or above 0.71-1.20 cm in males and 0.76-1.10 cm in females to allow the third molar to position properly.

## CONCLUSIONS

Therefore, based on these values, it is recommended that clinicians may be justified to perform a preventive surgical removal of the impacted lower third molars of the postpubertal patients whose parameters fall below these set values because with increasing age, bone density increases and extraction becomes more difficult.<sup>[4,12,17]</sup> This decision is, however, subject to patients' consent following thorough explanation of the advantages of this early intervention and also the disadvantages of delay. This study is also widely applicable for comparison and clinical evaluation of sizes of the mandible in patients who would need corrective orthognathic and reconstructive surgeries.

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