ASSESSMENT OF MASSETER MUSCLE THICKNESS IN AN ADULT NIGERIAN POPULATION: AN ULTRASOUND BASED STUDY

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ABSTRACT
Knowledge of the masseter muscle thickness (MMT) is important in individualizing facial reconstruction as it forms a major part of facial musculature involved in mastication. MMT in two different states (Relaxed: MMT-Relaxed and Clenched: MMT-Clenched) was assessed in a young adult population in Nigeria using ultrasonography. Results show that MMT-Relaxed and MMT-Clenched for the total population were 13.41±3.10mm and 17.03±3.50mm respectively. The value for males in both states was significantly higher than those of their female counterparts (P=0.000) at P<0.05 being level of significance. The values are in slight agreement with previous studies and will serve as a guidepost in further understanding of the morphology and functional aspects of masseter muscle in an African population.

Keywords: Masseter Muscle, Ultrasound, Nigeria, Africa

1. INTRODUCTION

Anatomical facial reconstruction methods heavily depend on the construction of facial muscles, especially the muscles of mastication for defining face structure and individualization to each skull[1]. Thus, knowledge of the structural disposition of the masseter muscle as one of the single largest and most important structure built in anatomical facial reconstruction methods[2] cannot be over-emphasized.

Wilkinson[3] stated that the masseter muscle is a bulky strong muscle found in the cheek region. It is rectangular in shape and in the frontal view it curves from the inferior boarder of the zygomatic arch to the inferior edge of the ramus and that its thickness can be estimated by undercutting the total soft tissue depth at mid-ramus by a couple of millimeters. Brunel et al[4] also described the masseter muscle as being multipennate and possessing three layers (superficial, intermediate and deep) that are partially separated by tendinous septa and which overlap one another from the superior to deep and anterior to posterior. Other studies have reported differences in the morphological disposition of the human masseter muscle stating variations in course and orientation[5]. The variations in the structural disposition of the deep and superficial fibres duringmastication have been described by some authors[6].
Some studies have reported the anatomy of the muscle in relation to the individuals' physiognomy and other anthropometric variables. Newton et al[7] reported an increase in muscle size and thickness with age, attaining a certain degree of stability in adulthood and decreasing in size with advancing age. Boom et al[8] posited that larger masseter muscles are associated with larger skull breadth, shorter vertical face heights and more acute mandibular angles. Also, Weijs and Hillen[9] stated that the thickness and the strength of the masseter correlated significantly with facial morphology, Bakke et al[10] described the maseter muscle in relation to bite force; and Raadsheer et al[11], using frontal photographs, ultrasound and bite force measurements affirmed that subjects with a long face pattern showed a thin masseter and smaller bite force as opposed their short faced counterparts.

These structural variations and relationships have not been described for our environment and so it is absolutely necessary to make a preliminary morphological assessment of the masseter muscle using its thickness as a veritable parameter as this will serve as a

guide to further studies on the structure of the muscle in an environment where information on the morphological status of the muscle is non-existent. It will also aid the soft tissue surgeons, forensic anthropologists and anatomists in the precise description of the muscle as it relates to literature, racial inclinations and facial reconstruction models.

The choice of ultrasound in determining the masseter thickness is guided by the recommendations of previous studies[11,12,13], which in some cases have made meaningful comparisons between Ultrasound and MRI and CT and have described reliability and advantageousness of the ultrasound methods. This is also coupled with the knowledge that ultrasound is advantageous in the assessment of soft tissues of the body.

2. SUBJECTS AND METHODS

2.1 Sample Selection:

A convenient sample of 60 subjects (30 males and 30 females) who voluntarily consented to participate in the study was recruited from students of the Faculty of Basic Medical Sciences, Ebonyi State University, Abakaliki, Southeast Nigeria. The students were between the ages of 19-30 years. The following criteria were used in selection:

a) Individuals with permanent and non-distorted dentition
b) Individuals without history of orthognatic treatment
c) Individuals without any marked jaw asymmetry or craniofacial disorders
d) Those without any congenital anomalies of the face, lip and mouth

These criteria were based on medical histories and clinical examinations[13].

2.2 Study Centre:

The study centre was in an ultrasound scanning centre – Veramax imaging centre, Abakaliki, Ebonyi State, Southeast Nigeria. This ultrasound and Imaging centre receives patients from within Abakaliki metropolis and beyond. Their patients are mostly obstetric patients and individuals with soft tissue pathology including all forms of intra-abdominal pathologies. It is well staffed with a total of twelve (12) very qualified resident Medical Imaging Scientists who carry out quality research. The centre receives patients from all private hospitals in Abakaliki Metropolis, Ogoja metropolis, Afikpo Metropolis and beyond and those not accommodated in the Federal Medical Centre, Abakaliki and Ebonyi State University Teaching Hospital, Abakaliki, Ebonyi State, all in Southeast Nigeria. The centre also serves as a mini-research centre for such morphological studies using ultrasound as they possess a variety of scanning machines.

2.3 Scanning Protocols:

The masseter muscle thickness of the subjects was measured by one imaging scientist to avoid interobserver variability. A real time scanner (Siemens SI 150) with a 7.5MHz transducer was used to take the measurements. The thickness of the masseter muscle was measured at a site crossed by the muscle in a line joining the lateral commissure of the mouth to the intertragic notch of the ear[14]. During imaging, the transducer was held perpendicular to the surface of the skin and special care was taken to avoid excessive pressure. The measurement site was the thickest part of the masseter, close to the level of the occlusal plane, approximately in the middle of the mediolateral distance of the ramus. The measurements were performed unilaterally on the right side of the masseter muscle with the subjects in a supine position under two different conditions: when the teeth were occluded gently with the muscle in a relaxed position and during maximal clenching with the masseter muscle contracted[11,13]. Data realized from the measurements were expressed as means±SD.

2.4 Ethical Approval:

In line with Belmont report of 1979 where respect for persons, beneficence and justice are recommended in every research involving human subjects, ethical approval was obtained from the Ethics/Research committee of the Faculty of Basic Medical Sciences, Ebonyi State University, Abakaliki, Southeast Nigeria.

3. RESULTS

Table 1: Shows the Descriptive Statistics for the different states of Masseter Muscle thickness for all the subjects

SEX	Masseter Muscle Thickness In Relaxed State (MMT-Relaxed) (mm)	Masseter Muscle Thickness in clenched state (MMT-clenched) (mm)
Male		
N	30	30
Mean	14.87	19.07
SD	3.42	3.69
Female		
N	30	30
Mean	11.94	15.00
SD	1.82	1.66
Total		
N	60	60
Mean	13.41	17.03
SD	3.09	3.50

The table above displays the mean and SD of the thickness of masseter muscle in both relaxed and clenched states (MMT-Relaxed and MMT-Clenched) for both males and females. The MMT-Relaxed state was 14.86±3.42mm and 11.94±1.82mm for males and females respectively. The MMT-Clenched state was 19.07±3.69mm and 15.00±1.66mm for males and females respectively. The mean±SD of the assessed population was 13.41±3.09mm and 17.03±3.50mm for MMT-Relaxed and MMT-Clenched respectively.

Table 2: Shows comparison of the MMT-Relaxed and MMT-Clenched between sexes and the general population

Comparisons	N	t-value	df	P-value
Between MMT-Relaxed and MMT-Clenched for the assessed population	60	19.888	59	0.001
Between MMT-Relaxed and MMT-Clenched of males	30	16.437	29	0.000
Between MMT-Relaxed and MMT-Clenched of females	30	14.032	29	0.000
Between MMT-Relaxed of males and females	60	17.435	59	0.000
Between MMT-Clenched of males and females	60	16.953	59	0.000

Table 2 shows the comparisons between the measured parameters within and across the sexes. MMT-Relaxed was significantly lower than MMT-Clenched within and across all the sexes at P<0.05. It also shows that MMT-Relaxed and MMT-Clenched for males are significantly higher than those of females (P=0.000 and 0.000 respectively) at P<0.05.

The ages of the subjects ranged from 19-30 with a total mean of 23±1.83. The males had a slightly higher mean age than their female counterparts even though it was not statistically different (P=0.220) at P< 0.05. The females had a mean age of 21±0.9 while the males had a mean age of 24±2.2.

4. DISCUSSION

The contribution of facial and mastication muscles to an individual's physiognomy cannot be overemphasized and as such more clues on the morphological disposition of these muscles are needed to provide the necessary guide in facial reconstruction procedures that are carried out in our environment.

Our study has shown that MMT-Relaxed for males and females are 14.86±3.42mm and 11.94±1.81mm respectively while MMT-Clenched for males and females were 19.07±3.69mm and 15.00±1.66mm respectively. The disparity between the values in MMT-Relaxed and MMT-Clenched states can be explained by the contraction and subsequent thickening of the masseter fibres that culminated to the observed significantly higher thickness in clenched states. In the entire assessed population, the MMT-Relaxed and MMT-Clenched were 13.41±3.09mm and 17.03±3.50mm. These values are in consonance with those of Satrigolu et al[13] who stated that their MMT-Relaxed and MMT-Clenched were 13.56±1.95mm and 14.57±1.83mm respectively for a Turkish population. In another population, Kubota et al[15] recorded 15.8±3.0mm. Bennington et al[12] reported 11.1±1.3mm and 9.5±1.2mm for males and females respectively in clenched state; values relatively smaller than those obtained in this study. Ruf et al [16] reported 15.1±1.9mm and 13.3±1.6mm for males and females respectively (also in clenched state). These variations in the thickness of the masseter across different populations may be associated with racial perspectives and the relative indulgence in masticatory activities that may have led to the attendant adaptive increase in size. It may also be associated with the orientation and size of the muscle fibres

that may have genetic and environmental backdrop.

The males in this study have shown to have higher MMT-relaxed and MMT-Clenched than their female counterparts (P= 0.000 and 0.000 for MMT-Relaxed and MMT-Clenched respectively). This may be due to the difference in age between the males and females even though it was not significant but may have contributed significantly to the difference between the sexes. Newton et al[7], described age as a factor in the increase in muscle thickness and development. In addition, the genetic and physiological make-up and environmental inclinations of males encourage muscular development and the mastication muscles are not left out.

The reliability of ultrasound and the methodology in this study was inferred from the positive recommendations of previous studies[12,11.13] and the values derived from this study have shown consonance with these studies, though with slight environmental deviation. The findings from this study will obviously serve as a guidepost in the study of the muscles of mastication especially the masseter, in our environment. We also suggest that these values of MMT-Relaxed and MMT-Clenched should be correlated with anthropometric facial parameters to possibly validate or otherwise, the findings of previous studies in our own environment. The novelty of this study also draws from the fact that no study in sub-Saharan Africa has reported these findings from an African population.

CONCLUSION

This study concludes that the MMT of young adults in Nigeria is in slight consonance with those of other adult populations with males having a significantly higher MMT than females. It also infers that the findings can serve as a guide in facial reconstruction and individualization within our environment.

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