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Anthropometric Measurement of Mastoid Process Using Multidetector Computed Tomography

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ABSTRACT

Introduction

Mastoid process is one of the most important landmark of the skull. It is a part of temporal bone and contains air filled space which is called mastoid air cells. It is also an attachment of different neck muscles. Normal measurement of the mastoid process is very important for surgeons' point of view. This study was aimed to assess the normal dimension of mastoid process.

Methods

The study was a descriptive cross-sectional study conducted on 104 patients, at Department of Radiology and Imaging, College of medical sciences, Bharatpur, Nepal. All CT examinations were performed using Toshiba 160 slice CT scanner. The data was analyzed using Statistical Package for the Social Sciences (SPSS) version 16 (SPSS, Inc., an IBM Company, Chicago, IL). Descriptive statistics was used to analyze the data.

Results

Among the 104 patients who participated in the study, 38 (36.5%) were male and 66 (63.5%) were female. All the measurements of mastoid process taken in males were higher than in females except the anterior inclination angle which was more in female on both right and left side. The volume of mastoid process in males was 14.16±5.3 and 14.69±6.6 on right and left side respectively while in female it was less.

Conclusions

The present study estimated the normal dimension of mastoid process. The normal dimension of mastoid process in male is larger than in females..

Keywords: CT scan; 3D reconstruction; MPR; mastoid process.

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INTRODUCTION

The mastoid process is a conical bony projection lying in the posterior region of the temporal bone. The mastoid process is also an attachment structure for various muscles such as the occipitofrontalis, auricularis posterior, sternocleidomastoid, splenius capitis and longissimus capitis.[1] Mastoid process has also been utilized for the identification of gender of the human skeleton.[1-3] Identification of gender of the human skeleton is more precise with the help of pelvis which is not always available.[4] In this instances the human mastoid process has also been used. Gender determination with the help of mastoid process is done both metrically and non-metrically. Gender determination is done by using manual method such as Vernier caliper, xerographic copies and CT images. Recently few studies are done using CT scans.[1,3,5-7] Ct scan is rapid tool for cross-sectional study. Advancement in CT scan imaging is very helpful for multi-planner and 3D imaging and measurement of the different parameters of the mastoid process. MRI imaging is also useful for the cross-sectional measurement of the mastoid process, but it is expensive and more time consuming than CT scan imaging. The present study was aimed at assessment of the various measurement of mastoid process using multi-planner and 3D reconstructed CT imaging.

METHODS

A descriptive cross-sectional study was conducted at the Department of Radiology and Imaging of College of Medical Sciences, Chitwan-10, Bharatpur, Nepal. The study duration was six months from March, 2021 to August, 2021. Ethical approval for this study was obtained from Institutional Review Committee of College of Medical Sciences, Bharatpur, Chitwan, Nepal (COMSTH-IRC/2021-48). The patients who were scheduled to undergo the CT scan of head for other reasons other than mastoid process and those who gave written consent to participate in the study were included in the study. These patients were from the age group 19 to 70 years of age of both genders with no any abnormality related to mastoid process. The CT scans were not performed only for the research purpose. Patients with pathology or trauma to mastoid process, pediatric patients, pregnant women, CT scans with artefacts obstructing the anatomical landmarks of mastoid process were excluded from study.Demographics details of the patients were collected in predesigned proforma. All the measurement of the mastoid process was taken as described by Allam FA.[8] Measurement of both right and left sides were done. The following measurements were taken: Conventional mastoid height (cMH), True mastoid height (tMH), Oblique sagittal diameter (OSD), Oblique coronal diameter (OCD), Maximal oblique sagittal diameter (OSD max), Maximal oblique coronal diameter (OCD max), Mastoid volume, Anterior inclination angle and Medio-lateral inclination angle.The data was analyzed using Statistical Package for the Social Sciences (SPSS) version 16 (SPSS, Inc., an IBM Company, Chicago, IL). Frequency, percentage, mean and standard deviation were calculated. The data was then presented in form of tables.

RESULTS

Out of total 104 patient 38 (36.5%) were male and 66 (63.5%) patients were female. The mean age of patients was 51.9 years (Table 1).

Table 1. Age and gender wise distribution of patients.

Characteristics	Category	Frequency (%)
Gender	Male	38 (36.5)
	Female	66 (63.5)
Age (Mean ± SD) yrs		51.94±15.63

Table 2 showed the gender wise distribution of various dimensions of mastoid process on both left and right side. Male showed increased measurement of all dimensions except the anterior inclination angle which was more in females.

Table 2. Gender wise distribution of the various measurement of the mastoid process.

Variables	Male (n=38)		Female (n=66)	
	Right	Left	Right	Left
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Conventional mastoid height (cm)	3.32±0.37	3.26±0.32	2.95±0.37	2.93±0.43
True mastoid height (cm)	3.77±0.49	3.73±0.56	3.32±0.48	3.20±0.51
Oblique sagittal diameter (cm)	2.41±0.38	2.28±0.53	2.13±0.49	1.99±0.61
Oblique coronal diameter (cm)	1.78±0.45	1.83±0.39	1.58±0.45	1.54±0.46
Maximal oblique sagittal diameter (cm)	3.43±0.66	3.42±0.68	3.19±0.67	3.07±0.79
Maximal oblique coronal diameter (cm)	2.08±0.34	2.11±0.45	2.05±0.35	1.94±0.35
Mastoid volume (cm^3)	14.16±5.3	14.69±6.6	11.91±5.71	10.74±6.07
Anterior inclination angle	73.63±8.30	74.32±7.64	75.26±9.19	74.83±9.18
Medio-lateral inclination angle	75.79±16.39	81.68±16.57	76.70±13.89	76.48±13.46

DISCUSSION

In anthropology and forensic medicine, the gender determination from the skeletal remains of importance. The mastoid process has earned special interest in forensic medicine owing to its slowly growing nature and being highly resistant to physical damage due to its location.[8] This structure varies morphometrically between males and females. The stronger muscular action of sternocleidomastoid and other muscles of neck are suggested for the variation.[6,8] Even is severe malnutrition there is still the significant difference in size of mastoid process in males and females.[9] The mastoid process has been studied with the help of computed tomography (CT) scanning, Magnetic Resonance Imaging (MRI), computer based anthropometry etc. Here in this study too we used CT scanning method.

Present study conducted in 104 patients show mean age of 51.9 with standard deviation of 15.6 and 38 (36.5%) were male and 66 (63.5%) patients were female. cMH, tMH, OSD, OCD, OSD (max), anterior inclination angle and medio-lateral inclination angles in males were higher than comparing with females. Overall volume of mastoid process was larger in males measuring 14.15 cm^3 and 14.68 cm^3 of right and left mastoid process respectively and in females it was 11.91 cm^3 and 10.74 cm^3 respectively.

Allam et al[8] in their study conducted among 80 Egyptian population concluded conventional mastoid height, and oblique sagittal diameter and mastoid volume were accurate and reliable for sex discrimination among the studied population. Another study by Yilmaz et al reported the males to have greater dimension than females.[6] This was similar to our study which showed males have greater dimension of the mastoid process. Saini et al[10] conducted a study in South Indian population showed significant sexual dimorphism of the mastoid process with males showing higher dimension of the mastoid process which was similar to our study.

Significant difference in the mastoid process measurement between the males and females were also revealed in other various study conducted in Germans and Portuguese[11], Brazillians [12,13], and American Whites[14,15] with variable accuracy. Highest accuracy was found among the Japanese population (85%) from single variable (mastoid width) and 92% using the mastoid height and width together.[16]

The present study also has limitations. The first limitation was the small sample size and the use of data from the single centre. Due to this the findings of the study cannot be generalized to other population and hence a multicentric study has also to be conducted further.

CONCLUSIONS

In this study the various dimensions of the mastoid process measurement show difference between the male and females. Most of the measurements were more in males than in females in both right and left sides.

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