RESEARCH ARTICLE

ANTHROPOMETRICS AND ODONTOMETRICS IN GENDER DETERMINATION – AN OBSERVATIONAL COMPARITIVE STUDY

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ARTICLE INFO	ABSTRACT
	Background: Sex determination is one of the prime factors employed to assist in the personal identification. It was realized that anthropometric measurements of the hand has been very useful tool in sex determination. Apart from this dental evidence is also considered as valuable tool in sex determination. **Aim:** This study is intended to correlate the Anthropometric parameters like hand length, hand breadth and Odontometric parameter like mesio-distal dimensions of mandibular canines in gender determination. **Materials and Methods:** A total of 60 subjects constituting a sample size of 120 (both right and left sides) were included. Hand length is measured as the straight distance from the metacarpophalangeal wrist crease to the most forwardly projecting point on the middle finger. Hand breadthis measured as straight distance from the most laterally placed point on the head of 2nd metacarpal bone to the most medially placed point on the head of 5th metacarpal bone. The mesio-distal dimensions of mandibular canine is measured from mesial aspect of canine to distal aspect of canine on dental cast. **Results:** All measurements showed significant sexual dimorphism with p-value < 0.05 except the mesio distal dimensions of left mandibular canine with p-value 0.83. Among all parameters Left Hand length had shown high accuracy in sex determination with high mean difference (12.1) between males and females. **Conclusion:** Hand length, Hand breadth and Right mandibular canine had shown sexual dimorphism and therefore they can be used for sex determination.

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INTRODUCTION

Person identification and sex determination often go hand in glove and most oftenly it refers to identification of person, living or dead, based on certain characteristics. Forensic anthropometry is a scientific specialization which deals with identification of human remains with the help of metric techniques (Varu *et al*., 2016). In present situation, mutilated body parts are found due to increased events of natural and man-made disasters. In such cases, forensic anthropologist can

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provide a hesitant identification of unknown remains by framing a 'biological profile', which encompasses the determination of stature, sex, age and ethnicity (Kanchan and Krishan, 2013). Such tentative identification is important as it helps to confine the pool of victims in mass death scenarios by excluding individuals who do not have the same biological attributes (Varu *et al*., 2016). Among the primary parameters of identification viz. race, sex, age and stature, determination of sex is one of the prime criteria in establishing the identity of an individual (Khaled *et al*., 2011). As per the documented scientific literature, an individual hand when recovered and brought for examination, it can provide treasured information about the sex of the individual. Age of epiphyseal union varies in both sexes. Thus sex determination from hand dimensions

can immeasurably help the forensic scientists in identification of human remains (Khaled *et al.*, 2011). An individual hand when recovered and fetched for examination it can deliver valuable evidence about the stature, sex, and age of the person and at the same time Odontometrics (estimation of tooth dimensions) is also an adjunct method in sex determination since teeth are resilient to post-mortem destruction and fragmentation. Because no two mouths are alike and dentition is as individual as fingerprints, it can be used for human identification (Daniel *et al.*, 2014). Today, dentist's judgement is esteemed widely as a source of treasured data that can be used to answer questions that arise during a death investigation (Paramkusam *et al.*, 2014). In fragmented cranial bones, if mandible could be obtained; measurements of canine tooth might prove as one of the means of determining sex. Canines are the most stable teeth that bear the greatest degree of sexual dimorphism and plays a high valuable role in identification (Bakkannavar *et al.*, 2015). Of all the teeth in the human dentition, the canines are the least frequently extracted teeth because of the relatively decreased incidence of caries and periodontal disease (Saikiran *et al.*, 2014). Moreover, it has been stated that the mandibular canine showed a greater degree of sexual dimorphism than the maxillary canine. Mandibular canines have been called as the 'key teeth' in human identification (Silva *et al.*, 2016). The benefits of determining sex from odontometric features are simple, inexpensive, reliable, and easy to perform. The present study is aimed to correlate anthropometric measurements and odontometric measurements as possible forensic tools in sex determination among the mixed population of west Godavari district.

MATERIALS AND METHODS

The present cross-sectional study was carried out among the subjects reported to the Department of Oral Medicine and Radiology, Vishnu Dental College, Bhimavaram, Andhra Pradesh, India. An observational cross-sectional study was conducted among 60 subjects (30 males and 30 females) with a sample size of 120 (both right and left sides) of age range 20-25 years. Each subject was explained about the need for the study and an informed consent was obtained from each subject. Ethical approval was obtained from the Institutional Research Ethics Committee. Healthy individuals with no affected general or bony growth with Intact teeth and healthy periodontium and the subjects who had agreed to participate and signed the terms of informed consent were included in the study. Subjects with missing mandibular canines, presence of restorations or any prosthesis of mandibular canines, history of orthodontic treatment and syndromes which interferes with growth of the body or tooth anomalies which alters the tooth dimensions were excluded from this study. The following parameters are checked in all the subjects.

Measurement of hand length (Fig. 1): The length of each hand is measured using a digital vernier callipers. The subject is asked to place his hand on a table with the fingers together and thumb abducted. Hand length is measured as the straight distance from the metacarpophalangeal wrist crease to the most forwardly projecting point on the middle finger (Dhawan*et al.*, 2016)

Measurement of hand breadth (Fig. 2): The breadth of hand is measured as straight distance from the most laterally placed point on the head of 2nd metacarpal bone to the most medially placed point located on the head of 5th metacarpal bone with the help of digital vernier calipers (Dhawan *et al.*, 2016).

Measurement of mesio-distal dimensions of mandibular canine (Fig. 3): Plaster models of the lower dental arch of each subject obtained from alginate impressions were poured with dental stone. A standardized procedure is followed for mixing of dental stone with water, taking fixed water/powder ratio (W/P ratio) for all the models constructed. A calibrated dispenser is used for dispensing of dental stone and water so that a uniform W/P ratio was maintained. The mesio-distal dimensions of mandibular canine is measured from mesial aspect of canine to distal aspect of canine on dental cast with the help of digital vernier calipers (Pramod *et al.*, 2014). The obtained data was subjected for statistical analysis.

RESULTS

Graph 1: Shows the mean values of males and females for all the parameters. The mean values of all the parameters were higher in males than females. The mean values of hand length on right side for males and females are 186.37mm and 174.77mm and on left side was 186.73mn and 174.63 respectively. The mean values of hand breadth on right side for males and females are 83.77mm and 75.23mm and on left side was 82.13mm and 74.33mm respectively. The mean values of mesio distal diameter of right mandibular canine in males and females was 6.57mm and 6.23mm respectively and for left mandibular canine was 6.67mm and 6.4mm respectively.

Table 1: Shows statistically significant results with p value 0.05 between males and females in all the parameters except mesio distal dimension of left mandibular canine. Among all the anthropometric parameters used in the present study, hand length on left side shows high significance with a mean difference of 12.1 in gender determination. Among odontometric parameters used in the present study, mesio distal diameter of mandibular canine on right side shows statistically significant results when compared to the left side with a mean difference of 0.33 in gender determination.When compared to anthropometrics and odontometrics, anthropometric parameters

Table 1. Statistical comparison of male and female hand dimensions and mesio distal width of canine

| Parameters	Sex	N	Mean	Std. Deviation	Mean difference	P values[*]
Hand length in mm (right)	Male	30	186.37	9.747	11.600	.000(S)
	Female	30	174.77	8.573		
Hand length in mm (left)	Male	30	186.73	9.759	12.100	.000(S)
	Female	30	174.63	8.442		
Hand breadth in mm (right)	Male	30	83.77	4.400	8.533	.000(S)
	Female	30	75.23	2.712		
Hand breadth in mm (left)	Male	30	82.13	4.125	7.800	.000(S)
	Female	30	74.33	2.905		
Right mand.canine in mm	Male	30	6.57	.504	0.333	.013(S)
	Female	30	6.23	.504		
Left mand.canine in mm	Male	30	6.67	.606	0.267	.083(NS)
	Female	30	6.40	.563		

p value   0.05 is significant

shows significant results with high significance as observed in hand length on left side.

DISCUSSION

Determining a person's sex is crucial part of human identification (Silva*et al*., 2016). DNA technology has simplified the issue of sex determination to a great extent, but technology has its limitations with regard to skilled man power, time and financial issues involved, especially in developing countries and in cases when DNA analysis cannot be performed (Khaled *et al*., 2011). Various techniques in forensic anthropology are still most commonly employed for identification of human remains. It is not uncommon to find the peripheral parts of the body such as hand and foot in mass disasters and assault cases where the body is dismembered to conceal the identity of the victim. It is of great scientific importance to investigators in the field of forensic anthropometry, especially to develop identification standards using anthropometric measurements of body
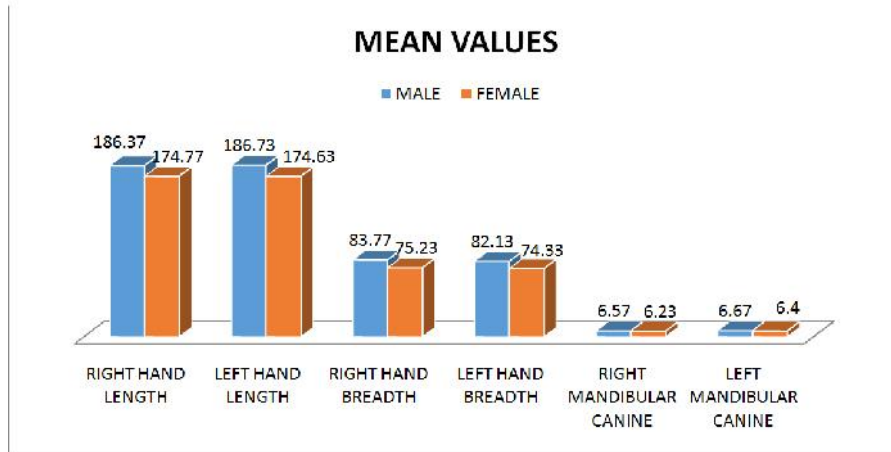
Graph 1. Mean values of males and females for anthropometric and Odontometric parameters

Fig. 1. Measurement of Hand Length

Fig. 2. Measurement of Hand Breadth

Fig. 3. Measurement of Mesio-Distal Dimensions of Mandibular Canine

(Khaled *et al*., 2011). "Sexual dimorphism'' refers to those differences in size, stature and appearance between male and female that can be applied to dental identification because no two mouths (dentitions) are alike. The canine teeth have been routinely used for human identification purposes because they have shown the greatest degree of sexual dimorphism across numerous populations (Silva *et al*., 2016). The mandibular canines have a mean age of eruption of 10.87 years and are less affected than other teeth by periodontal diseases. These are the last teeth to be extracted with respect to age. Canines are also better likely to survive severe trauma such as air disasters, hurricanes, or conflagration. These findings indicate that mandibular canines can be considered as the "key teeth" for personal identification (Reddy *et al*., 2008). The present study was carried out to correlate the anthropometric measurements like hand length, hand breadth and Odontometric measurements like mesiodistal dimensions of mandibularcanine in gender determination. In the present study, measurement of hand length on left side shows high statistically significant results in gender determination with a mean difference of 12.1 (as shown in Table 1) when compared with all the parameters used in the study which was in contrast with study conducted by Varu *et al* which showed that measurements of hand breadth has highest accurate results in determination of sex, followed by measurements of hand length and hand index, this may be due to effect of genetic and environmental factors are different on different populations, so no two populations can have same anthropometric measurements (Varu *et al*., 2016). According to Kanchan and Rastogi *et al*, of all hand dimensions, hand breadth has shown the highest accurate results in sex determination but in the present study hand length on left side shows high statistically significant results, this is because the various hand measurements tend to differ in various ethnic groups which was shown in earlier studies and also population differences between the two studies may in addition be the probable reason for difference in the findings (Kanchan *et al*., 2009). Bindurani *et al* also showed statistical significant difference of hand dimensions and hand index in males and females which is in accordance with present study, this may be due to the hand length, hand breadth, hand shape index and other hand dimensions are sexually dimorphic markers because they are influenced by prenatal estrogen and testosterone levels (Bindurani *et al*., 2016). According to Dey *et al*, Hand length and hand breadth show statistically significant male – female differences at p<0.001 but Hand Breadth was found as best predictor of sex in comparison with hand length which was in contradiction with the present study (Dey *et al*., 2015).

Among Odontometric parameters, in the present study we found higher sexual dimorphism in right mandibular canine (6.4%), where as left mandibular canine is insignificant which was in accordance with Saikiran Ch *et al* who has shown that the right mandibular canine showed a greater sexual dimorphism than left mandibular canine (SaikiranCh *et al*., 2014). According to Kakkar *et al*. mandibular canine width showed significant results when compared with the inter-canine width and the Mandibular Canine Index showed statistically no significance in sex determination (Kakkar *et al*., 2013). According to Paramkusam *et al*. Sexual dimorphism was calculated based on mesio-distal width of canines and was found to be highest for the left mandibular canine which was in contradiction with the present study. This controversy exists regarding the degree of sexual dimorphism due to different ethnic groups (Paramkusam*et al*., 2014). Rajarathnam B N *et al*

showed that left mandibular canine showed a greater sexual dimorphism (6.96%) when compared to the right mandibular canine (6.90%) which was in contrary with the present study (Rajarathnam *et al*., 2016). It is because the right-left differences between homologous teeth are smaller than the differences between the teeth of monozygotic twins, suggesting that the side differences can be attributed to environmental influences. According to Garn, intra individual variations in crown size and similarities between isomers and antimeres might be derived from specific intrauterine events during odontogenesis and less from genetic effects ((Rajarathnam *et al*., 2016). According to Sharma *et al*, Left mandibular canine exhibited greater sexual dimorphism when compared with right mandibular canine which was in contradiction with the present study (Sharma *et al*., 2014). According to Dalli *et al*. Right upper canine showed the maximum accuracy in gender determination followed by right lower and left upper canines (Dalli *et al*., 2016). The present study was intended mainly to determine the comparision between anthropometrics and Odontometrics in estimation of gender of the individual. The present study has shown that anthropometric parameters shows significant results when compared to Odontometric parameters, with high significance was observed in hand length on left side in gender estimation. However, few limitations are present in the study. The presence of low sample size in the current study is a major drawback. The other limitation could be the age group, where a little increase in the inclusion of age group of the subjects would provide a better view of the reliability.

Conclusion

Anthropometric analysis for sex determination can be an useful tool in forensic sciences. Though Anthropometry play a key role in gender differentiation with high accuracy, canine can also be considered as an alternative in determination of gender.

Acknowledgements

Conflicts of interest

No conflicts of interest

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