J Indian Acad Forensic Med. April-June 2013, Vol. 35, No. 2 **ISSN 0971-0973**

Original Research Paper

Determination of Sex by Shape and Size of Hyoid Bone

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Abstract

Identification is the task that an investigator does when an unknown dead body is found with an allegation of crime. Identification is often a difficult task in many of the criminal cases due to decomposition by the time the dead body has been noticed. The present study was conducted to know the relationship of the sex with the shape and size of the hyoid bone. Excised hyoid bones from 81 male and 49 female dead bodies were studied from a South Indian population. Results showed that hyoid bones were highly polymorphic in size and shape across the ages in both sexes. However V shaped hyoid bone was more common compared to U shaped hyoid bone in adult males. The Length and the width of the hyoid bone were larger in males compared to females. The study of hyoid bone will be inadequate in sex determination and needs to be considered along with the measurements of other bones of the same individual for more accuracy.

Key Words: Hyoid bone, Shape, Size, Greater horn, Sex, Identification

Introduction:

Identification assumes great significance in criminal investigations. Determining the age and sex of the individual are the most essential data in establishing the identity of unknown skeletal remains. Studies have been done on establishing the sex from femur, sternum, clavicle, radius, ulna, scapula and others. [1-6] Determining sex from hyoid bone has not been reported from South India.

The present study was conducted to know the relationship of the sex with the shape and size of the hyoid bone.

Materials and Methods:

The prospective study was conducted on 130 cases, that were selected by simple random sampling and details such as sex were noted. In each case hyoid bone was carefully dissected from the neck structures. Observations of the hyoid bone like size, shape were noted with the help of sliding calipers and screw gaze. (Fig. 1)

1. **Width of hyoid (BC):** maximum distance between the greater horns;
2. **Length (AP):** distance from the anterior middle of the body of hyoid to the point lying mid-way between the tips of the greater horns;
3. **Thickness of the greater horns:** minimum diameter at the junction of posterior one third and the anterior two thirds

The hyoid bone was viewed as to belong to either of the two shapes.

- **'V'(Parabolic) Shape** of the hyoid bone, where the width was greater than the length
- **'U' (Hyperbolic) Shape** of the hyoid bone, where the width was equal or less than the length.

Data was designed on a master chart and analysed statistically using SPSS version 15. T-test, fisher's exact test and chi-square test were used to find statistical significance. P<0.05 is considered to be statistically significant.

Fig. 1: Measurements of the Hyoid Bone by Calipers and Screw Gaze

Results:

In our study distribution of V shaped and U shaped bones across the ages was not showing any remarkable trend.

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In males, 56% had V shaped hyoid bones and 44 % had U shaped hyoid bones. In females, 45% had V shaped hyoid bones and 55 % had U shaped hyoid bones. Association between shape and sex was not significant statistically as per fishers exact test. (Table 2)

Present study showed that Hyoid bones were highly polymorphic in size across the ages in both sexes. Their Length ranged between 3 Cms and 4.5 Cms. Their width ranged between 3 Cms and 5.5 Cms. The smallest hyoid bone belonged to a male victim aged 4 years and it was measuring 3 x 3 Cms. In victims aged 12 or more, 3 Cms was the least measure noted in length and 3.5 Cms was the least measure noted in width of the bones. (Table 3)

The average antero-posterior length of hyoid bone was 3.93 Cms and average width was 4.37 Cms in males above 20 years. Average stature of these males was 167 Cms while the average antero-posterior length of hyoid bone was 3.55 Cms and average width was 3.84 Cms in females above 20 years. Average stature of these females was 160 Cms. On comparing the dimensions in sexes, the average length and the average width of the hyoid bone was larger in males by 0.38 Cms and 0.53 Cms respectively.

In our study 17.7% of the cases showed greater horns measuring less than 2 mm in thickness. 10% of the cases had Hyoid bones with bilaterally thin greater horns and 7.7% of the cases had unilaterally thin greater horns. Thin left greater horn was more commonly found than thin right greater horn. 22.4% of the Females and 14.8% of the males had thin greater horns. (Table 4)

The victim aged 4 years had both greater horns thinner than 2mm in thickness. Thin greater horns were reported from almost all age groups without any particular trend beyond 12 years of age. In Females aged 21-30 years, 26.3% of them were having bilaterally thin greater horns and 10.6% were having unilaterally thin greater horns. (Fig. 2)

Discussion:

Identification is the task that an investigator does when an unknown dead body is found with an allegation of crime. Identification is often a difficult task in many of the criminal cases due to the onset of decomposition by the time the dead body has been noticed. Because of the inability for facial recognition and the loss of soft tissues in a putrefied body, sex determination will have to be done with skeletal remains. Age is an important characteristic that helps in identification which has been researched and published from the same set of hyoid bones. [7]

Identification of sex is a very important opinion for establishing a partial identity of skeletal remains. Accuracy rate in Identification the sex from an entire skeleton is highest when compared to the accuracy rate from individual bones. However, there are situations when the experts have to opine about the sex from a bone or a small set of bones.

The anthropometric measurements of the hyoid in the present series (South India) were comparable with those of a French, Croatian and North Indian studies. [8-11] It is doubtful whether a gross examination of hyoid bone will help us in differentiating populations. The shape and size of the hyoid bone varies with the sex and hence they could be regarded as sex indicators. [10-14] Identification of sex from the hyoid bone is possible as per previous studies. [9, 15] The present study, although found a supporting trend, did not find any significant association.

There have been few studies that are based on indirect and sophisticated/radiological measurements of the size of the bones. [13]

Most of the criminal investigation scenarios are going to give an opportunity for direct measurement of the bone. Commenting on the shape of the bone should best be done by direct examination of the bone after its dissection during autopsy as in this present study because it will be practical, accurate and reliable. Majority of the males in this study had V shaped hyoid bones. Majority of the females in this study had U shaped hyoid bones. Both the types of bones could be found in any sex and this was matching with earlier reports. [14, 16]

Length, width and the thickness of the Greater horn of the hyoid bone were more in males when compared to females. All the previous reports are unanimous on this. [9-16] this greater size in males is a common feature observed in other bones as well.

The vulnerability of hyoid bone to fracture is better decided by incidences calculated from hanging deaths compared to strangulation deaths which are highly variable in terms such as force acting on the bone.

Incidence of fracture of hyoid bone in hanging is variable as per studies. [17] The Present study reports an incidence of thin greater horns as 17.7%, which closely matches with the average of incidence of fracture of the hyoid bone from the previous studies. Di Maio [18], Feigin [19], Nikolic et al [20] have found left greater horn fractured in more number of cases compared to the right greater horn. The present

study is matching with earlier reports which found higher vulnerability on the left side.

Female victims showed higher incidence of fracture compared to the male victims. [19, 21] Miller et al [14] found that the female hyoids had relatively long thin distal segments. Strength of the hyoid bone is less in females. [22] The present study found females to have higher incidence of thin greater horns compared to males and it is matching with reports which found higher vulnerability to fracture in females.

It can be concluded that a gross examination of a hyoid bone to know its shape and size alone will not be useful in determination of sex. However, if the shape and size of the hyoid bone is considered along with the measurements of other bones of the same individual, sex determination could be done with more accuracy.

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Table 1: Age and Sex Distribution of Study Subjects

Age (years)	Males	Females	Total
4	1	0	1
12-20	12	15	27
21–30	27	19	46
31–40	22	8	30
41–70	19	7	26
Total	81	49	130

Table 2: V Shaped and U Shaped Hyoid Bones in Males and Females

	Males	Females
V shape	45 (56%)	22 (45%)
U shape	36 (44%)	27 (55%)
Total	81 (100%)	49 (100%)

Table 3: Size of Hyoid Bone in Both Sexes with Advancing Age

Age	Males		Females	
	Average length ±SD	Average width ±SD	Average length ±SD	Average width ±SD
4	3.00	3.00	-	-
12-20	3.83±0.25	4.12±0.53	3.50±0.38	3.90±0.39
21–30	3.96±0.24	4.33±0.50	3.53±0.31	3.81±0.45
31–40	3.86±0.38	4.48±0.52	3.69±0.26	3.88±0.35
41–70	4.08±0.25	4.53±0.46	3.57±0.45	3.71±0.27

Table 4: Distribution of Thin Greater Horns in Males and Females

Thin Greater horns (%)	Males (n=81)	Females (n=49)	Both Sex (n=130)
Right	2.5	2	2.3
Left	4.9	6.1	5.4
Both	7.4	14.3	10
One or Both	14.8	22.4	17.7

Fig: 2: Incidence of Thin Greater Horns in Different Sex and Age Groups