

## Sexual Dimorphism with the Shape of Hyoid Bone

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### Abstract

Sex determination from skeletal remains is an important task for forensic experts in medicolegal cases. The present study was done to know the relationship of sex with the shape of hyoid bone. A total of 100 hyoid bones, 66 males and 34 females, in different age groups were studied. According to the study, hyoid bones were highly polymorphic in shape across the ages in both sexes. In adult males, V shape is more common (36.16 %) when compared to U shaped hyoid bone (35.29%) in adult females.

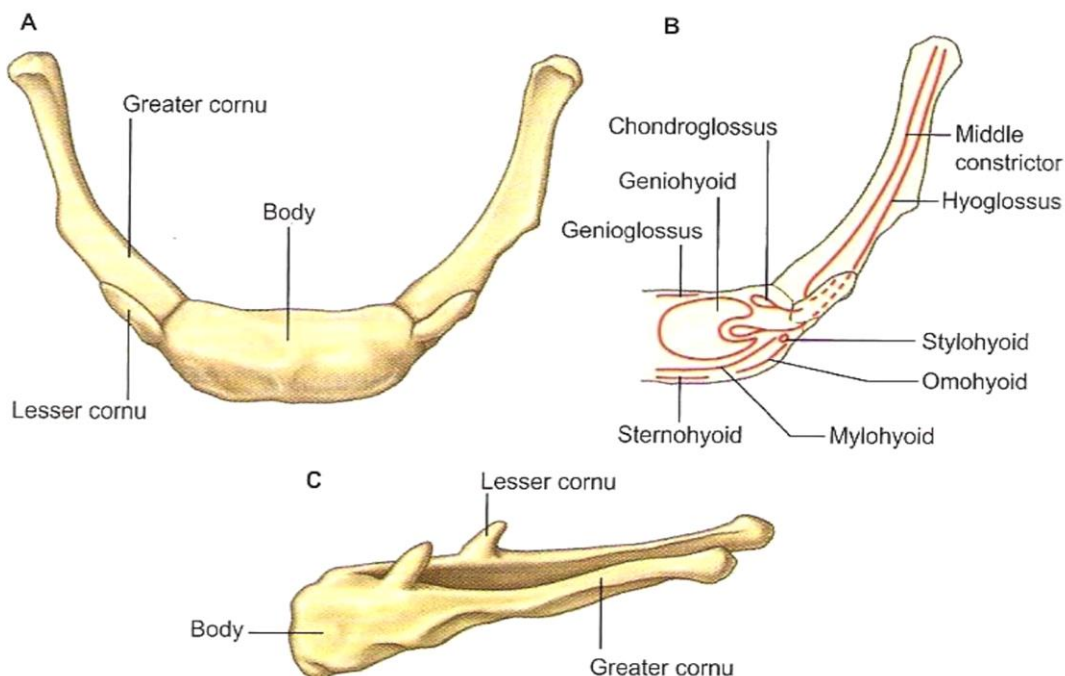
**Key Words:** Anthropometry, Cornua, Hyoid bone, Shape, Sex determination.

### Introduction

Identification is often a difficult task in many of the criminal cases due to the onset of decomposition by the time the dead body was found. Because of the difficulty for facial recognition and the loss of soft tissues in a putrefied body, sex determination has to be done with skeletal remains in many cases. Determining the sex is important in forensic practice. Studies have been done on establishing the sex from femur, sternum, clavicle, radius, ulna, scapula and

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

Hyoid bone is a 'U' shaped bone suspended from the tips of the stylohyoid ligaments<sup>1</sup>. It lies in the level of the second to third cervical vertebrae and about on a level with the lower margin of the lower jaw when the head is held in the natural position<sup>2</sup>. It has a body, two greater and two lesser horns or cornua (Fig. 1)<sup>1</sup>.



**Fig. 1: Hyoid bone. A – Antero superior aspect; B – muscular attachments; C – lateral aspect**

**Body (Basihyal)<sup>2</sup>:** It is Irregular, elongated and quadrilateral. Anterior surface is convex, faces anterosuperiorly and posterior surface is smooth, concave, faces posteroinferiorly, and is separated from epiglottis by thyrohyoid membrane and loose areolar tissue. Geniohyoid is attached to most of the anterior surface of the body, the medial part of Hyoglossus invades the lateral Geniohyoid area. The lower anterior surface gives attachment to Mylohyoid the line of attachment lying above Sternohyoid medially and Omohyoid laterally. The lowest fibres of Genioglossus, the hyoepiglottic ligament and the thyrohyoid membrane are attached to the rounded superior border. Sternohyoid is attached to the inferior border medially and Omohyoid is attached laterally. Occasionally the medial fibres of Thyrohyoid and, when present, of Levator glandulae thyroideae, are attached along the inferior border<sup>1</sup>.

**Greater Cornua (cornua majora/ Thyrohyal)<sup>2</sup>:** They project backwards from lateral ends of body. They are horizontally flattened, taper posteriorly, and each ends in a tubercle. Middle pharyngeal constrictor and, more laterally, Hyoglossus, are attached along the whole length of the upper surface of each greater cornu. Stylohyoid is attached near the junction of the cornu with the body. Fibrous loop for the Digastric tendon is attached lateral and a little posterior to Hyoglossus. Thyrohyoid membrane is attached to the medial border and Thyrohyoid is attached to the lateral border<sup>1</sup>.

**Lesser Cornua (cornua minora/ ceratohyal)<sup>2</sup>:** These are two small conical projections at the junctions of the body and greater cornua. The Middle pharyngeal constrictors are attached to the posterior and lateral aspects of the lesser cornu. The Stylohyoid ligaments are attached to their apices and are often partly calcified, and the chondroglossi are attached to the medial aspects of their bases<sup>1</sup>.

**Ossification:** Develops from cartilages of 2<sup>nd</sup> and 3<sup>rd</sup> pharyngeal arches, lesser cornua from 2<sup>nd</sup>, greater cornua from third and body from fused ventral ends of both. Chondrification begins in fifth foetal week and is completed in third and fourth months. Ossification proceeds from six centres i.e., a pair for the body and one for each cornu<sup>1</sup>. The body and great cornua may fuse after

middle life; the small cornu may join the greater, or in rare cases may fuse with the body<sup>2</sup>.

### Aim

To establish a method of sex differentiation by the shape of hyoid bone thereby helping the Forensic expert to come to a conclusion.

### Materials and Methods

A prospective study was conducted in the Department of Anatomy, Guntur Medical College, Guntur, on 100 hyoid bones collected from autopsied bodies as per the autopsy technique of Otto Saphir<sup>3</sup>. They were cleaned well without soft tissue, taking care to preserve the lesser cornu, and were fixated in 10% formaldehyde solution over 48 hours and thoroughly dried. Later, the shape of the hyoid bone was recognised.

Out of 100 hyoid bones, 66 males and 34 females in age group of 15-75yrs were studied. The sample was divided into different age groups (Table 1). The damaged hyoid bones, mainly of hanging and strangulation cases, were excluded from the study.

**Table 1: Age wise sample distribution**

Age	Male	Female	Total
0-10	0	0	0
11-20	4	5	9
21-30	6	6	12
31-40	8	10	18
41-50	25	11	36
51-60	17	2	19
61-70	6	0	6
71-80	0	0	0

### Methods

Hyoid bones were classified according to their shape into five types (Fig. 2) as done by Harjeet and Jit I (1996)<sup>4</sup> as follows

1. Hyperbolic (U shaped) (Fig. 3)
2. Parabolic (V shaped) (Fig. 4)
3. Boat shape (Fig. 5)
4. Horse shoe type (Fig. 6)
5. Deviated type (Fig. 7)

U Type	V Type	Boat Type	Horse Type	Deviated Type
It is half circle Anteriorly; the greater cornua are almost straight	It is triangular in shape and resembles 'V', body is bent upon itself with convexity forward.	It resembles a boat, the two greater cornua deviate from each other as if opened out	It is half circle anteriorly the greater cornua faces each other.	One greater cornua deviates more than the other making the cornu asymmetrical

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



Fig. 2: Different shapes of hyoid bone



Fig. 4: V shape



Fig. 3: U shape



Fig. 5: Boat shape



**Fig. 6: Horse shoe shape**



**Fig. 7: Deviated Type**

**Results and Discussion**

Modern sex determination techniques originated in traditional physical anthropology. Even today, every practitioner’s initial assessment of sex is based on a visual gauge of the width of the pubic bone and the subpubic angle or greater sciatic notch. However, since the pelvis is not always available, intact, or 100% diagnostic, more options were needed<sup>5</sup>.

The standards from classical studies like those of Pearson and Bell (1919)<sup>6</sup> on the femur,

Borovansky (1936) on the skull, and Washburn’s (1948)<sup>7</sup> ischiopubic index are still being used with success. Accuracy rate in Identification of sex from an entire skeleton is highest when compared to the accuracy rate from individual bone. Even with human pelvis alone and skull alone sex can be determined with 95% and 92% accuracy<sup>8</sup> only.

The present study identifies that V shaped hyoid bone is more common (36.16 %) in adult males followed by deviated type (25.72%), and least common is U type (13.6%) (Table 2). In females, U shaped hyoid bone is more common (35.29%) followed by V (20.58%) and deviated type (20.58%) and the least common type among females is boat shaped (8.8%) (Table 3). The results were collectively shown in Table 4.

The above results were similar with the study of Harjeet and Jit I (1996)<sup>4</sup> and were different from the study of Papadopoulos et al (1989)<sup>9</sup> (Table 5).

**Table 2: Various shapes of hyoid bones in adult males**

Shape of Bone	Males	Percentage
U Type	09	13.6
V Type	24	36.16
Boat Type	07	10.6
Horse Shoe Type	09	13.63
Deviated Type	17	25.72

**Table 3: Various shapes of hyoid bones in adult females**

Shape of bone	Females	Percentage
U Type	12	35.29
V Type	07	20.58
Boat Type	03	8.8
Horse Shoe Type	05	14.70
Deviated Type	07	20.58

**Table 4: Various Shapes of Hyoid Bone in Males and Females (15-75 Years) with their Percentage**

Shape of hyoid bone	Males	Females	Total
U Type	9 (13.6%)	12 (35.29%)	21
V Type	24 (36.36%)	7 (20.58%)	31
Boat Type	7 (10.6%)	3 (8.8%)	10
Horse Shoe Type	9 (13.63%)	5 (14.70%)	14
Deviated Type	17 (25.75%)	7 (20.58%)	24
Total	66	34	100

**Table 5: Comparison of Shape of Hyoid Bone of Present Findings with Previous Workers**

S. No	Name of Authors	V Shape Parabolic			U shape Hyperbolic			Boat shape			Horse shoe shape			Deviated shape		
		M (%)	F (%)	Total (%)	M (%)	F (%)	Total (%)	M (%)	F (%)	Total (%)	M (%)	F (%)	Total (%)	M (%)	F (%)	Total (%)
1	Papadopoulos et al (1989)	5.3	5.3	5.4	15.4	21.1	18.3	21.1	31.6	26.4	10.5	31.6	21.1	17.1	10.5	13.8
2	Harjeet and Jit I (1996)	33.5	18.0	25.8	20.5	33.0	26.8	14.0	19.0	11.5	10.1	12.0	11.1	22.0	18.0	20.0
3	Present Study	36.6	20.5	28.6	13.6	35.3	24.4	10.6	8.8	9.7	13.6	14.7	14.2	25.8	20.5	23.2

**Conclusion**

After studying different shapes of hyoid bone, the authors concluded that in males V-type and in females U-type of hyoid bone were the leading types. However, the study of hyoid bone alone 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.

**Conflict of Interest:** None

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