

## Sexual Dimorphism with the Shape of Hyoid Bone

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### Abstract

**Background:** Hyoid bone is of considerable forensic interest owing to its susceptibility to fracture during manual strangulation, hanging and other forms of neck compression. In road traffic accidents it may get injured leading to significant airway concerns. A hyoid bone's shape may influence its susceptibility to fracture and hyoid fractures are frequently confused with normal variations in both clinical and forensic medico-legal cases. Aim our study was to establish a method of sex differentiation by the shape of hyoid bone there by helping the forensic expert to come to a conclusion.

**Materials and Methods:** The study was conducted in the department of anatomy on 60 hyoid bones obtained from medico legal postmortems conducted in the department of forensic medicine, Government medical college Mysore.

**Results:** It is observed that the most common shape of hyoid is 'U' in male's and deviated type in female's. Least common types are 'V' shape in male's and boat shape in females.

**Conclusion:** The present study was conducted to know the relationship of the sex with the shape of the hyoid bone . The presence of a fractured hyoid bone is of great importance in cases involving badly decomposed bodies and skeletal remains lacking soft tissue evidence of neck injury. The present study was conducted to help forensic experts while diagnosing hyoid fractures and determination of sex from the skeletal remains.

**Keywords:** hyoid bone; shape; Fracture; sex determination; Forensic expert.

### Introduction

Hyoid bone is a 'U' shaped bone suspended from the tips of the styloid process by stylohyoid ligaments.<sup>1</sup> It lies at the level of the 2<sup>nd</sup> to 3<sup>rd</sup> cervical vertebrae and approximately at the level of lower margin of the lower jaw when the head is held in natural position.<sup>2</sup>

It has a body, 2 greater and 2 lesser horns or cornuae. Body is irregular, elongated and quadrilateral having anterior surface which is convex, faces antero - superiorly and posterior surface which is smooth, concave faces postero - inferiorly. Greater cornuae project backwards from the body and each cornua laterally ends in a tubercle. Lesser cornuae are 2 small conical projections at the junction of the body and greater cornuae.<sup>2</sup>

**Ossification:** All elements originate in the cartilaginous tissue of the pharyngeal (also known as branchial) arches. By a generally accepted concept of origin, the lesser horn's and superior part of the body above the horizontal ridge are derived from the 2<sup>nd</sup>, so called hyoid arch. While the rest of the body and greater horns differentiates from 3<sup>rd</sup> pharyngeal arch.<sup>3</sup>

Determination of the sex of the skeletal remains of an individual from an examination of a single bone, except hip bone is considered to be a most impossible task.<sup>4</sup>



Studies have been done on establishing sex from femur, sternum, clavicle, radius, ulna, scapula and other bones.<sup>5,6,7</sup>

The hyoid bone is a rather neglected structure of the human skeleton which has not been given sufficient attention.<sup>8</sup>

After going through the literature regarding the shapes of human hyoid bone, it is noticed that the work is limited to western population till 1988. The present study was conducted to know the relationship of the sex with the shape of the hyoid bone.

**Materials and Methods**

The material for the present study include 60 specimens (male: female, 30:30) of hyoid bones collected from the cadavers during autopsies (2013 to 2016) at Government medical college, Mysore. All specimens were aged between 19 to 80. The damaged hyoid bones mainly of hanging and strangulation cases were excluded from the study. The specimens were stored in 10% formaldehyde solution.

In these specimens laryngeal cartilages, thyroid gland, infrahyoid muscles and thyro hyoid membranes were dissected. First infrahyoid

muscles and thyrohyoid membrane were cut following from the down to 1 cm of hyoid bone, then muscular and ligamentous structures of bone were removed. During dissection care was taken to preserve the lesser cornua of hyoid bone and then each bone was completely dried in air. Later each hyoid bone was numbered, shape of each bone was recognized and tabulated.

Hyoid bones were classified according to their shape in to following 5 types as shown in figure 1, as done by Harjeet and Jit I 1996<sup>9</sup> as follows.

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

**Results**

Modern text books of anatomy do not provide adequate information about various shapes of hyoid bone which are important in identifying sex of the hyoid bone.

The present study shows that 'U' shaped hyoid bone is more common (33.33%) in adult males followed by Horse shoe shaped type (30%) and

U Type	V Type	Boat Type	Horse Shoe Type	Deviated Type
It is a half circle Anteriorly; the greater cornua are 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 Cornua asymmetrical

**Table 1:** Various shapes of Hyoid bone in males and females with their percentage.

Shape of hyoid bone	Male	Female	Total
'U' shape	10 (33.33%)	5(16.66%)	15(25%)
'V' shape	2(6.66%)	6(20%)	8(13.33%)
'B' shape	5(16.66%)	4(13.33%)	9(15%)
'H' shape	9(30%)	6(20%)	15(25%)
'D' shape	4(13.33%)	9(30%)	13(21.66%)
<b>Total</b>	<b>30</b>	<b>30</b>	<b>60</b>

**Table 2:** Comparision of Shape of Hyoid bone of present study with previous studies. (in %).

Name of authors	'V' shape			'U' shape			'B' shape			'H' shape			'D' type		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
Papadopoulos et al (1989) <sup>10</sup>	5.3	5.3	5.4	1.54	21.1	18.3	2.11	3.16	26.4	10.5	31.6	21.1	17.1	10.5	13.8
Harjeeth and Jit et al (1996) <sup>9</sup>	33.5	18	25.8	20.5	33	26.8	14	19	11.5	10.1	12	11.1	22	18	20
Mahima Srivastava (2016) <sup>5</sup>	36	20	28	14	34	24	10	8	9	14	16	15	26	22	24
Sayed Sadia Sameera (2016) <sup>4</sup>	36.36	20.58	31	13.6	35.29	21	10.6	8.8	10	13.63	14.70	14	25.75	20.58	24
Present study 2019	6.66	20	13.33	33.33	16.66	25	16.66	13.33	15	30	20	25	13.33	30	21.66



Fig. 1: Different shapes of hyoid bone.



Fig. 2: 'U' Hyperbolic shape.



Fig. 3: 'V' Parabolic shape.



Fig. 4: 'B' - Boat shape.



Fig. 5: 'H' - Horse shoe shape.



Fig. 6: 'D' - Deviated type.

least common is 'V' shaped type (6.66%) as shown in table 1.

In females, deviated type of hyoid bone is more common followed by 'V' shape (20%), Horse shoe shape (20%) and least common type is boat shape (13.33%) as shown in (Table 1).

## Discussion

Modern sex determination techniques originated in traditional physical anthropology, even today initial assessment of sex is based on 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>11</sup>

The standards from classical studies like those of Pearson and Bell 1919<sup>12</sup> on the femur, Borovansky [1936] on the skull and washburns 1948<sup>13</sup> ischio-pubic 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 only.<sup>14</sup>

The incidence of 'U' shape in males it is more than all other studies.<sup>4,5,9,10</sup> In females it is least in the present study compared to all other studies.<sup>4,5,9,10</sup>

The incidence of 'B' shape is more in both sexes when compared with all other studies<sup>4,5,9,10</sup> except in females it is less than incidence given by Harjeet and Jit I (1996).<sup>9</sup>

The incidence of 'H' shape is more in both the sexes when compared with other studies.<sup>4,5,9,10</sup> except in females it is less than incidence noted by Papadopoulos (1989).<sup>10</sup>

The incidence of deviated type is less when compared with other studies.<sup>4,5,9,10</sup> (Table 2).

in males and it is more when compared with other studies<sup>4,5,9,10</sup> among females.

The incidence of 'V' shape in males, it is almost same as that of Papadopoulos (1989)<sup>10</sup> and it is less than other studies<sup>4,5,9</sup> where as in females it is almost same as that of other studies<sup>4,5,9</sup> and it is more than that of Papadopoulos (1989).<sup>10</sup>

Newer investigative modalities have brought in to light the role of spatial inter - relationships of the hyoid to its neighbouring structures. Thus highlighting the anatomic basis of various clinical procedures. Hyoid suspension is a procedure designed to stabilize the airway behind the back of the tongue to correct obstructive sleep apnea. The hyoid bone is pulled forward in front of voice box either in conjunction with genioglossus for tongue advancement or isolated procedures.<sup>15</sup>

## Conclusion

After studying different shapes of hyoid bone it is concluded that in males 'U' shape and in females 'D' shape 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.

A hyoid bone's shape may influence its susceptibility to fracture and hyoid fracture is frequently confused with normal variation in both clinical and forensic applications. The present study was conducted to help forensic experts while diagnosing hyoid fractures and determination of sex from the skeletal remains.

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