

ORIGINAL ARTICLE**Investigation of hyoid bone fractures in cases of mechanical asphyxiation and its importance in forensic medicine**

Santosh Kumar

Assistant Professor, Department of Forensic Medicine, Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh, India

ABSTRACT:

Aim: Investigation of hyoid bone fractures in cases of mechanical asphyxiation and its importance in forensic medicine. **Material and Methods:** This study was conducted in the Department of Forensic Medicine as a cross-sectional observational study. There was a total of 50 occurrences of neck compression resulting from hanging and garroting. The police officers gathered comprehensive information on the site of the crime investigative findings and pictures, and thoroughly examined the pertinent documents generated. Each deceased individual involved in the research underwent a standardized autopsy process. Following the examination of relevant evidence about hanging, ligature strangling, or throttling, the hyoid bone was surgically removed to determine whether it had been fractured. **Results:** The research covered a total of 50 identified cases (n=50). The majority of instances were associated with those of low socio-economic level. In the current study, a total of n=10 cases of hyoid bone fracture and n=6 cases of thyroid cartilage fracture were found. In hanging cases out of n=4 hyoid fractures n=3, the right side and n=2 were left side and n=1, were bilateral. In garroting cases out of a total of n=6 hyoid fractures n=4 cases were on the right side n=2, were on the left side and bilateral fractures were found in n=1 case and body fracture was found in n=1 case. **Conclusions:** Hyoid bone fractures were more often seen in adults above the age of 50. The fractures of the hyoid bone are influenced by many variables, including the magnitude of force exerted on the neck, the age of the individual, the stiffness of the hyoid, and the morphology of the hyoid bone. **Keywords:** hyoid bone fractures, asphyxiation, hanging

Corresponding author: Santosh Kumar, Assistant Professor, Department of Forensic Medicine, Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh, India

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INTRODUCTION

The hyoid bone is a component of the viscerocranium. The structure is positioned in the space between the tongue and thyroid cartilage, and it is joined to the thyroid gland by the thyrohyoid membrane. The term is derived from the Greek word "hyooides," which means having the form of the letter U (upsilon). [1-3] Hyoid bone is of considerable importance in Forensic Sciences because of its susceptibility to fracture during manual strangulation, hanging, and other forms of neck compression. [4, 5] It has been found that the hyoid bone fractures in one-third of all homicidal strangulation. Postmortem detection of hyoid fracture often reveals the diagnosis of strangulation. [6] The hyoid bone is fractured by direct pressure on its greater horns or by indirect pressure on the thyrohyoid membrane.

[7] It is ossified at the age of about 40 years when it tends to become hard and inelastic making it more prone to fractures as compared to the younger age group where it is elastic and cartilaginous. [8, 9] Some reports have suggested that hyoid bone fracture increases with using of hard ligature for hanging and strangulation. Therefore, several factors are involved in fractures of hyoid bone which include the manner of constriction, level of application of ligature, the force of constriction, long drop or short drop suspension, age of the victim, sex, etc. In India strangulation has

been reported as the 4th commonest cause of medicolegal deaths accounting for 16.64% of the cases. [10] Kateri et al., [11] have shown that 14.7% of cases of hyoid bone fractures were present in victims of neck strangulations. Similarly, Charoonnate et al., [12] have reported 25% of cases with hyoid injury with strangulations. Nikolic et al., [13] have observed 68% of fractures of the hyoid bone in strangulations. Studies have evaluated the morphological peculiarities of hyoid bone fractures in terms of their susceptibility to fracture in cases of blunt injury or strangulations. [14] It has been reported that certain characteristics such as the length of hyoid bone or steepness of the greater horns can influence the rate of hyoid bone fractures. [15] The hyoid bone morphology implicating V-shaped hyoids were more prone to fractures in cases of violent deaths than U-shaped hyoid bone. Sometimes flexible joints between the hyoid body and its greater horn so elastic connections of the thyroid superior horns with thyroid body for fractures. [16] Therefore, the examination of the hyoid bone is of prime importance in cases where hanging or strangulation determine the cause of death. With this background, we in the current study tried to evaluate the patterns of hyoid bone fractures and their forensic significance.

MATERIAL AND METHODS

This study was conducted in the Department of Forensic Medicine as a cross-sectional observational study. There were a total of 50 occurrences of neck compression resulting from hanging and garroting. The police officers gathered comprehensive information on the site of the crime investigative findings and pictures, and thoroughly examined the pertinent documents generated. Each deceased individual involved in the research underwent a standardized autopsy process. Following the examination of relevant evidence about hanging, ligature strangling, or throttling, the hyoid bone was surgically removed to determine whether it had been fractured. The pertinent data was put into an MS Excel spreadsheet, and the descriptive statistics were collected using SPSS version 20.0 in the Windows format.

RESULTS

The research covered a total of 50 identified cases (n=50). According to Table-1, the majority of cases were in the age range of 21 to 40 years, as shown by the demographic profile. The average age of male participants in the research was 34.5 years, while the average age of female participants was 29.0 years. A higher proportion of men, accounting for 60% of cases, was noted. The majority of instances were associated with those of low socio-economic level. Due to a high concentration of impoverished tribal individuals, the Adilabad district exhibits a significant proportion of patients from rural/tribal regions. The distribution of age with the outcome variable is shown in Table-2.

Table1: Socio-Demographic Profile of the cases included in the study

Category	Male=30	Female=20	Frequency	Percentage
Age Group				
<20	3	7	10	20
21-30	8	4	12	24
31-40	11	5	16	32
41-50	5	2	7	14
>50	3	2	5	10
Economic Status				
Poor	28	18	46	92
Average	2	1	3	6
Good	0	1	1	2
Area				
Rural	26	18	44	88
Urban	4	2	6	12

Table2: Modalities of strangulation with Fracture of Hyoid

Age Group	Modalities of Strangulation					
	Hanging	%	Garroting	%	Throttling	%
<20	0	0	1	10	0	0
21-30	0	0	2	20	0	0
31-40	1	10	1	10	0	0
41-50	0	0	1	10	0	0
>50	3	30	1	10	0	0
Total	4	40	6	60	0	0

In the current study, a total of n=10 cases of hyoid bone fracture and n=6 cases of thyroid cartilage fracture were found. The age-wise distribution of cases is given in Table 3. In all the n=6 cases of garroting, there was both fracture of hyoid bone as well as thyroid cartilage observed. In hanging cases out of n=4

hyoid fractures n=3, the right side and n=2 were left side and n=1, were bilateral. In garroting cases out of a total of n=6 hyoid fractures n=4 cases were on the right side n=2, were on the left side and bilateral fractures were found in n=1 case and body fracture was found in n=1 case.

Table3: Hyoid bone fractures and thyroid cartilage fractures

Age Group	Hyoid bone fracture		Thyroid cartilage fracture	
	No	Yes	No	Yes
<20	9	1	9	1
21-30	9	3	10	2
31-40	14	2	15	1
41-50	6	1	6	1

>50	2	3	4	1
Total	40	10	44	6

The observation of the neck region revealed multiple abrasions and contusions caused by ligature or finger, thumb, and nails which are characteristics for all cases of strangulation depicted in table 4. The anatomical and distribution of level of application of constriction force in the neck found the majority of cases the constricting force 90% above the level of thyroid cartilage whereas in most of the cases of ligature strangulation the level of force was at the level of the thyroid cartilage. In one case the levels were below the level of the thyroid cartilage.

DISCUSSION

Laryngo-hyoid fractures may develop as a result of blunt force injury, either as a standalone trauma or as part of a more extensive damage to the head and neck tissues [18,19]. The occurrence of fractures in the laryngo-hyoid complex in instances of hanging is a subject that is controversial because to the varying rates recorded, ranging from 0% to 100%. [20] Godin et al., [21] in a meta-analysis have reported a mean incidence of 37% for laryngo-hyoid fractures in cases of hangings. Some authors have reported that the thyroid cartilage is more susceptible to fracture in cases of hanging as compared to hyoid bone or any other tracheo-laryngeal structures. In this study, we found the incidence of fracture of hyoid bone was 20% in various modalities of neck strangulation. Kumar N Set al., [22] found fracture of hyoid bone was in 20.7% of cases. Tazher et al., [23] in a similar study found an incidence of hyoid bone fracture of 11.9%. In the present study, hanging was found to be more common in 88% of cases and garroting was in 12% of cases. Sharma et al., [9] in their study similarly found 69% of cases of hanging. HK Afridi et al., [24] in their study found 52.23% cases of hanging followed by 25.37% cases of strangulation. Sheikh MI et al., [25] reported the incidence of fracture of hyoid bone 14.28% in cases of ligature strangulation, and Chormunge Patil et al., [26] reported the incidence of fracture of the hyoid bone in 12.5% cases. In the current study injury to thyroid cartilage was found in 12% of cases in all these cases the level of application of force was at the level of thyroid cartilage (Table 4). There was an insignificant male predominance of 60% versus a female of 40%. In the current study out of n=6 cases of thyroid cartilage fractures, all the fractures occurred at thyroid plates no case of involvement of superior thyroid horns was seen. Sharm et al., [9] found a higher incidence of thyroid plate fractures than thyroid horns.

CONCLUSIONS

Hyoid bone fractures were more often seen in adults above the age of 50. The fractures of the hyoid bone are influenced by many variables, including the magnitude of force exerted on the neck, the age of the

individual, the stiffness of the hyoid, and the morphology of the hyoid bone. In addition, it is important to thoroughly inspect the soft tissues around the hyoid bone for extravasation, since the presence of extravasation in these tissues indicates a genuine fracture.

REFERENCES

1. Khalil ZH, Naeem M, Adil M, Khan MZI, Abbas SH, Alam N. Asphyxial deaths : a four year retrospective study in Peshawar. *J Potgrad Med Inst* 28(1), 2014, 24-6.
2. Arif M. Ligature mark on the neck; How elucidative? *Professional Med J*. 22, 2015, 798-803.
3. Koebke J, Saternus k S. Morphology of the adult human hyoid bone. *Folia Morphologica* 1979; 84:7-18.
4. Pollanen MS, Chiasson DA. The Location of hyoid fracture in strangulation revealed by Xeroradiography. *J Forensic Sci*. 1995;40:303-05.
5. Miller KWP, O'Halloran RL. Age and sex related variation in hyoid bone morphology. *J Forensic Sci* 1998;43(6):1138-43.
6. Partha Pratim Mukhopadhyay. Predictors of hyoid fracture in hanging: Discriminant function analysis of morphometric variables. *Leg Med*. 2010;12:113-16.
7. Ajay K, Handan V, Rudresh YC, Govindaraju HC, Gouda S. Study of violent asphyxial deaths in Chitradurga district of Karnataka. *IJBAR*. 4(12), 2013, 868-871.
8. Godin A, Kremer C, Sauvageau A. Fracture of the cricoid as a potential pointer to homicide. A 6-year retrospective study of neck structures fractures in hanging victims. *Am J Forensic Med Pathol* 2012; 33 (1):4-7.
9. Sharma BR, Harish D, Sharma A, Sharma S, Singh H. Injuries to neck structures in deaths due to constriction of neck, with a special reference to hanging. *J Forensic Leg Med*. 2008;15(5):298-305.
10. Kumar R. Study of the pattern of homicidal deaths in Varanasi region of India. *J Evolution Med Dental Sci*. 2013;2(43):8393-418.
11. Kaheri GQ, Rikhasor RM, Aziz M, Khichi ZH, Memon MU. Hyoid fractures and strangulation. *Med Channel* 2001; 7:15-18.
12. Charoonnate N, Narongchai P, Vongvaivet S. Fractures of the hyoid bone and thyroid cartilage in suicidal hanging. *J Med Assoc Thai* 2010; 93(10):1211-16.
13. Nikolic S, Micic J, Atanasijevic T, Djokic V, Djonic D. Analysis of neck injuries in hanging. *Am J Forensic Med Pathol* 2003;24:179-82.
14. Pollard J, Piercecchi-Marti, Thollon L, Bartoli C, Adalian P, Becart Robert A, et al., Mechanisms of hyoid bone fracture after modelling: evaluation of anthropological criteria defining two relevant models. *Forensic Sci Int*. 2011; 212 (1-3):274.e1-274.e5.
15. Pollanen MS, Chiasson DA. Fracture of the hyoid bone in strangulation: comparison of fractured and unfractured hyoids from victims of strangulation. *J Forensic Sci*. 1996; 41(1):110-13.
16. Naimo P. The use of computed tomography in determining development, anomalies, and trauma of the hyoid bone. *Forensic Sci. Med Pathol* 2015;11: 177-185.
17. Green H, James R A. Fractures of the hyoid bone

- and laryngeal cartilages in suicidal hanging, *J. Clin. Forensic Med.* 2000; 7(3): 123–126.
18. Khokhlov V D. Injuries to the hyoid bone and laryngeal cartilages: effectiveness of different methods of medico-legal investigation. *Forensic Sci Int* 1997; 88(3):173–183.
 19. Taktak S, Kumral B, Unsal A, Ozdes T, Buyuk Y, Celik S, Suicidal hanging in Istanbul, Turkey: 1979–2012 autopsy results. *J. Forensic Leg Med* 2015; 33: 44–49.
 20. Hlavaty L S, Current analysis of hangings that deviate from recently published studies. *Am. J. Forensic Med. Pathol* 2016; 37:299–05.
 21. Godin A, Sauvageau, Fracture of the cricoid as a potential point to homicide: a 6-year retrospective study of neck structures fractures in hanging victims. *Am. J. Forensic Med Pathol* 2012; 33: 4–7.
 22. Kumar NS. Fracture of hyoid bone in cases of asphyxial deaths resulting from constricting force around the neck. *J Indian Acad Forensic Med* 2005; 27:149-53.
 23. Tariq Azher, Asif Jamil Ansari, Abdul Munaf Saud Frequency of Fracture of Hyoid Bone in Various Modalities of Strangulation of Neck (Hanging, Garroting and Throttling) in tertiary care facility. *PJMHS* 2016; 10(1): 154-56.
 24. HK Afridi, M Yousaf, Abdul Mateen, AR Malik, Khalid Aziz. In Strangulation Deaths: Forensic Significance of Hyoid Bone Fracture. *PJMHS* 2014; 8(2): 379-78.
 25. Sheikh M. I. Agarwal S. S. Medico-legal implications of hyoid bone fracture- a study paper. *Journal of Indian Academy of Forensic Medicine.* 2001; 23(4): 61 - 63.
 26. Chormunge Patil, Mahajan S. V, Bhusari P. A. Hanging vs. strangulation a comparative study. *Journal of Forensic Medicine, Science and Law.* Jul-Dec 2011; 20, (2): 1-5.