

A2 Fusion and Fracture: Forensic Implications of the Hyoid Bone

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Learning Overview: The goal of this presentation is to inform attendees of the relationship between the state of fusion in the hyoid bone and fracture patterns with regard to implications for autopsy practices.

Impact Statement: This presentation will impact the forensic science community by demonstrating that the thyroid cartilage and associated soft tissue are better indicators of trauma to the neck than the hyoid bone.

The structures of the neck often provide critical clues in determination of cause and manner of death in a forensic autopsy. Trauma to the hyoid bone has long been considered indicative of injury to the neck, and careful dissection and examination of the hyoid bone and laryngeal cartilages, along with overlying musculature and soft tissue, is a standard part of the autopsy examination. The hyoid bone and laryngeal cartilages fuse and ossify at variable rates, however, which may impact their susceptibility to fracture and the subsequent interpretations of trauma by pathologists and anthropologists.

This study examines the fusion of the body of the hyoid to the greater cornua along with the associated laryngeal cartilages in individuals submitted for examination post-autopsy in order to determine whether hyoid fusion is significantly correlated with evidence of trauma in the neck by asking: (1) whether fusion is related to risk of fracture, and (2) whether absence of fracture means absence of trauma. Further, the study examines the relationship between manifestations of trauma in the hyoid and those in the laryngeal cartilages to determine whether one structure is a better indicator of neck injury than the other.

The neck organs of 123 individuals (53 females, 70 males) removed at autopsy by forensic pathologists were photographed and macerated in the Forensic Anthropology Laboratory. Evidence of neck hemorrhage in the soft tissue was noted, as were suspected circumstances of injury (e.g., ligature strangulation, blunt force trauma). Factors potentially contributing to variation in rates of ossification/fusion and fracture patterns such as age at death and toxicology were also noted in the analysis.

Within the current sample, state of fusion of the hyoid bone is unrelated to sex. State of fusion is, however, dependent on age (Fisher's exact test with 10,000 replicants, p -value=0.007). These results demonstrate that fracture of the hyoid bone is related to its state of fusion, with unfused hyoid bones exhibiting fewer incidences of fracture than those with either unilateral or bilateral fusion ($\chi^2=7.077$, $df=2$, p -value=0.029). Fracture of the hyoid bone is independent of hemorrhage or bruising within the soft tissues overlying the larynx. In contrast, hemorrhage or bruising of the overlying soft tissues of the neck is significantly associated with damage to the laryngeal cartilages (Fisher's exact test, p -value= $2.42e^{-04}$).

These results suggest that the absence of trauma to the hyoid bone cannot be used to rule out strangulation or other forms of injury to the neck. Additionally, hyoid fracture is not statistically related to the presence of a ligature. In fact, only 8 of the 25 cases in which a ligature was present (32%) exhibited a fracture of the hyoid. The presence of a ligature is significantly related to the presence of hemorrhage or bruising in the soft tissue (Fisher's exact test, p -value=0.021), where 84% of the cases involving a ligature also exhibited bruising or hemorrhage. The presence of a ligature is even more strongly related to the presence of injuries to the laryngeal cartilage (Fisher's exact test, p -value=0.001), where 80% of the cases involving a ligature also involved damage to the cartilage.

The results of this study indicate that, when present, the laryngeal cartilages are a much better indicator of trauma to the neck than the hyoid bone as the state of fusion of the hyoid bone is directly related to the manifestation of trauma in that structure. Forensic pathologists suspicious of trauma to the neck are encouraged to remove the neck *en bloc*, without "opening" it, in order to allow for a complete dissection or maceration of the hyoid and laryngeal cartilages in order to fully document traumatic injury.

Hyoid Fusion, Trauma in Neck, Fracture Patterns