TAPHONOMY IN FORENSIC PRACTICE: A HITHERTO UNCHARTED FIELD

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Abstract
Putrefaction or decomposition is the last stage in the resolution of the body from the organic to the inorganic state brought about by two processes—autolysis and bacterial action. When tissues die, there is a rise in certain enzyme levels and enzymes are released from tissue cells that soften and liquefy the various tissues of the body. This process of autolysis commences 3-4 hours after death and continues steadily for 2-3 days, some times longer. Bacteria also produce a large variety of enzymes that assist in the decomposition. It is not unusual to receive the bodies in different stages of decomposition in medicolegal practice. However, careful examination always yields important information in all such cases. Taphonomy is one such science that deals with the decomposed and skeletonised bodies to extract the requisite information for forensic purposes.

Key Words: Forensic, post-mortem interval, taphonomy

Introduction to Taphonomy
Taphonomy implies the understanding of multiple factors that play a role in the disintegration and scatter of a dead body and its accoutrements until they have been environmentally recycled and incorporated into the earth, its waters, its air, and its inhabitants. This means the understanding of the events close to the time of death, events that transpired at the time of death, and events in the immediate or long-term period after death.

Taphonomy was coined by a Russian scientist Yefremov in 1940 to mean the study of death assemblages in the fossil record or the ‘laws of burial’. However, Olsen focused on the reconstruction of the life history of a fossil from the time of death to the time of recovery, while defining taphonomy. For him taphonomy includes all the aspects of passage of the organisms from the biosphere to the lithosphere. However, Bonnichsen extended the definition of Yefremov to include the “study of the accumulation and modification of the osteological assemblages from a site formation perspective”. It can also be defined as the study of various processes, which affect a) the preservation, observation or recovery of dead organisms, b) the reconstruction of their biology or ecology, or c) the reconstruction of the circumstances of their death. It can therefore provide a wide scope for forensic investigations. These definitions of taphonomy presume a multidisciplinary approach: biological, cultural and geographical. In practice, taphonomists have evolved from the sister disciplines of paleontology and archeology, as well as paleoanthropology. However, it is considered by many to be a part of forensic anthropology.

The main goals of a taphonomist are: a) reconstructing the paleo-environments, b) determining which factors cause differential destruction or attrition of the bone, c) understanding the selective transport of remains; and d) discriminating human from non-human agents of bone modification. Taphonomic models can assist with interpreting how a particular scene assemblage accumulated, how it came to have a specific spatial pattern, and how different types of bone elements came to be associated.

Forensic Taphonomy refers to the use of taphonomic models, approaches and analysis in forensic contexts to estimate the time since death, reconstruct the circumstances before and after deposition, and discriminate the products of human behavior from those created by the earth’s biological, physical, chemical and geological subsystems. It is intimately related to Forensic Anthropology—the application of the methods and theories of Physical Anthropology and Archeology to medico-legal investigations of death. However, due to the short postmortem interval, forensic anthropologists are also concerned with soft tissue changes, including decomposition rates and patterns, disarticulation,
dispersion of body parts, and modification of both soft tissue and bone.

It is a relatively new field, the interest in which started growing since the 80s\textsuperscript{11,12}. The first mention of the word “Taphonomy” in a Forensic journal was in the Journal of Forensic Sciences in 1989, though the same journal rejected ‘Taphonomy’ as a key word in a 1987 manuscript\textsuperscript{13}.

Even now, the world over, relatively little research has progressed in the taphonomy of human remains. The main reasons for this paucity are: a) the infrequency of opportunities for research due to the sanctity attached to the human death by the society; b) the almost negligible involvement of archeologists and physical anthropologists in forensic investigations, particularly the crime scene investigations; and c) the limited or negligible awareness of taphonomy on the part of main stream forensic investigators.

The sanctity, as per the religious/ethical/ or emotional dictates, accorded to the human remains, prohibits their use for research. Native Americans have been known to rebury their dead at a different place in order to stop any kind of research on them.\textsuperscript{14} Forensic death investigations limit themselves to determining the cause, manner, and time of death only. They are hence not conducive to any kind of research. Once the primary questions are answered, there may be little need, opportunity, or resources to pursue the investigations further.

Research areas within taphonomy that have forensic relevance are—reconstructing the scene (referred to as site formation in taphonomic literature), studies of transport and dispersal, including bone modification due to perimortem trauma, scavenging and diagenesis (the exchange of ions between the bones and their environment, leading to chemical weathering). Taphonomic models can assist with interpreting how a particular scene assemblage accumulated, how it came to have a given spatial patterning, and how different types of bone elements came to be associated. Taphonomists help us in understanding: a) what happens to bone and flesh in different environmental contexts; b) which modifications are the result of human vs. non-human agents or environmental factors; c) patterns of modification of certain scavengers; d) patterns of fluvial or other types of aqueous dispersion; e) patterns resulting from natural disasters; and f) patterns of immediate postmortem transport.

A forensic taphonomist can be of immense value in investigations, if included in the early stages, by a) locating and defining the scene; b) ensuring maximal recovery of the evidence at the scene; and c) more thoroughly addressing the issue of personal identity and the events surrounding and subsequent to death.\textsuperscript{15} With his expertise, he can effectively and efficiently locate the site, collect and document all relevant evidence, maximize the amount and quality of data retrieved at the scene and thus aid the analyses conducted by the law enforcement agencies.

Majority of the taphonomic data usually produced by the various medico-legal investigators and forensic anthropologists is limited to case-studies\textsuperscript{16}. Taphonomic studies involving surveys of large number of cases of human remains are few,\textsuperscript{17} some of the important exceptions being the decomposition studies at Knoxville\textsuperscript{18} and Project PIG in Colorado\textsuperscript{19}.

Many processes can alter the appearance of bone and related organic materials after death\textsuperscript{20}. Factors in the transport and dispersal of skeletal elements include animals, gravity, or water and fluvial processes. Animal-related processes include trampling, entrance fall, gnawing, and digestion. Physical factors include rock-fall, water transport, sandblasting, weathering, burial, diagenic movement, volcanic shock-wave, acid attack by roots, cryoturbation, release and breakup by bottom- fast ice, and mineralization by ground water.\textsuperscript{21} All of these can act independently or in unison to produce alteration of bones. Both animal and physical processes need to be understood in reconstructing the context of death and the sequences after death in forensic cases. Hence, taphonomic observations can be used not only to describe postmortem events but also their sequences.\textsuperscript{22} Understanding the mechanism of diagenesis helps in the interpretation of antemortem disease states, determination of bone age, and the reconstruction of dietary patterns from the skeleton.\textsuperscript{23}

Taphonomic assessment of human remains differs from that of non-human not only in the structural differences that may influence response to taphonomic forces, but specially in that human behavior frequently is involved normally in the postmortem of the dead. Thus, with the humans, postmortem interpretation includes not only the possible effects of weathering, trampling, etc., but also embalming, cremation, or other types of burning.\textsuperscript{24} Hence, forensic taphonomic consideration has come to
mean interpretation of all events affecting the remains between death and discovery.

**Conclusion**

Taphonomic interpretations have assumed a vital and unique place in the forensic investigative tool-kit. Consideration of taphonomic factors is essential in past environmental reconstruction, estimation of postmortem interval, reconstruction of postmortem events and the assessment of trauma and pseudo-trauma. However, the concept being new, experts involved in medicolegal work need to be appraised and further studies regarding the utility and acceptability of taphonomy need to be made, particularly in the Indian context.

**Reference:**