H85 Necessary Breaks With Conservator Standards: Cranial Reconstruction in Forensic Cases

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After attending this presentation, attendees will have a better understanding of the advantages of various methods used in the reconstruction of fragmentary skulls and teeth, when particular techniques are appropriate, and solutions to common problems that result from plastic deformation, missing fragments and taphonomy.

This presentation will impact the forensic community by differentiating between processes that are better suited for forensic settings as opposed to museum/conservation contexts. Special attention to also paid to adhesive variables, such as pH, solubility, flammability, tensile/shear strength, and reactivity/stability.

Most protocols used in skeletal reconstructions are rooted in methods created for museum curation and conservation laboratories where bone stabilization, preservation, aesthetic appeal, and future study are emphasized while timeliness and cost are less important. These latter

two factors are extremely vital to forensic investigations, however, where funding is limited and time is in short supply. Also in forensic settings and in contrast to museum/conservation objectives, the completed skeletal reconstruction does not need to be indefinitely stable and destructive procedures are often acceptable. As such, forensic practitioners have broken from some museum/conservation standards while still maintaining many of the basic procedures necessary to ensure that osteological analyses lead to victim identifications and establishing a profile of trauma. To this end, the step-by-step forensic process is presented for use in the successful reconstruction of cranial bones and teeth that have been fragmented from peri- and/or postmortem trauma.

This survey of conservator and forensic methods found that prior to cleaning and reconstruction, the standard procedures were markedly similar and included: the documentation of the fragmentary bones *in situ* (e.g., at the scene, transport containers, or soil matrix), radiography of the materials before processing, and localized evaluation of the bone to ensure it was structurally sound and therefore could withstand cleaning. Conservator and forensic methods also differed when the process of cleaning was surveyed. Cold water maceration, hot water maceration, and dry brushing were successful. Strong chemical regents (e.g., hydrochloric acid, hydrogen peroxide, ethyl alcohol, methylated spirits, household degreaser, or household detergents) were rarely used. While this method of cleansing the bone was fast, cost effective, and did not tend to warp the bone, the bones remained slightly greasy and fatty thereby requiring suitable adhesives for reconstruction.

Acid-free adhesive composed mostly of acetone and nitrocellulose (e.g., Duco™ cement) was ideal for forensic casework because it set quickly, was easily reversible (with acetone), and had moderate adhesive strength. On the contrary, conservators tended to use Acryloid B-72 or Polyvinyl Acetate (PVA) because long term strength and preservation was the main objective. Other factors that were considered when choosing an adhesive included: pH level, stability, solubility, and flammability. An adhesive that was pH neutral (or acid free) was imperative as an acidic or alkaline adhesive would damage bone. Selecting an adhesive that was stable under temperature and humidity fluctuations was also necessary in forensic contexts, but less important in museums, as humidity and temperatures were strictly controlled. Because forensic remains often retain some internal moisture through grease or fat, an ideal adhesive should be insoluble in water. Due to the adhesive properties necessary in forensic contexts, obtaining a flammable adhesive was sometimes unavoidable. However, practitioners should use caution and be aware of their adhesive's flammability rating.

Several cases are presented that sustained perimortem fractures via gunshot wound, burning, or blunt force trauma. Postmortem fracturing from removal of the calotte and jaw during autopsy was also present. Issues that arose from these types of trauma included disassociation of the teeth from their crypts, plastic deformation (e.g., a series of microfractures that causes warping), bone loss, and delamination. In order to ensure accurate cranial measurements and trauma analysis the vault and face were reconstructed separately. In addition, the vault and face were not fixed together with glue. Rather, inert dental wax was used allowing the calotte, basicranium or splanchnocranium to be moved in order to ensure the accuracy of the various measurements. In addition, replacing bone with dental wax along autopsy dissection lines increased our accuracy as the reciprocating saws removed from 2mm to 8mm of bone. As cases in point, this study presents examples in which classification of sex, ancestry, wound diameters, and numbers of impact sites changed based upon the reconstruction processes used.

Anthropology, Fragmentary Remains, Reconstruction

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