H102 Coming Unglued: The Use of Acrylic Resin Adhesives in Forensic Reconstruction

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After viewing this presentation, attendees will gain a greater appreci- ation for the use of polymer resin adhesives as an alternative to cellulose nitrate adhesives, such as Duco® cement, for reconstructing fragmented skeletal remains.

This presentation will impact the forensic community by demonstrating the advantages of using a non-destructive adhesive with reversible properties for reconstructing fragmented and/or burned skeletal remains.

Forensic anthropologists are often confronted with fragmented remains that require reconstruction. Adhesives are commonly used to refit bone fragments to aid in trauma analysis, identification of burn patterns on thermally-altered remains, the establishment of the MNI, and in the construction of the biological profile. Reconstruction is often a means to an end, thus, little attention has been focused on the long-term impact of different adhesives on bone. The use of a high-quality adhesive with reversible properties is beneficial in forensic reconstruction for a myriad of reasons. For example, if fragments are incorrectly refitted, the choice of adhesive will determine whether or not the process can be reversed, and also the degree to which fracture margins are chemically altered. This has medico-legal implications, as cases may need to be re-examined in the future by other specialists using new methods.

Acryloid B-72 (Paraloid B-72) is a common type of acrylic polymer resin used by practicing conservators for reconstructing archaeological materials. Chemically, it is a methacrylate ethylacrylate copolymer that can be used as both a consolidant and an adhesive by varying the amount of a solvent, such as acetone or ethanol. Acryloid B-72 is converted into an adhesive by allowing the solvent to evaporate over a period of hours, leaving the adhesive behind. By adding solvent, the adhesive can be reconstituted to varying degrees of thickness. The process can be easily reversed by applying acetone to the area where bone fragments are conjoined. Museum conservators currently favor acrylic-based adhesives due to their high stability, transparency, mechanical resistance, and reversibility (Koob 1986). The same features that have made acrylic-based adhesives attractive to the conservation community can also be used by those working in forensic anthropology. The resistance of Acryloid B-72 to brittleness, cracking and yellowing, while still providing strength and hardness make it ideal for use in forensic reconstruction. Conjoined fragments can later be separated by applying acetone to the fracture margins. This is critical if fragments are not reconstructed correctly the first time, or if there is a later need to examine fracture margins microscopically.

Acrylic resins are generally better alternatives to cellulose nitrate adhesives such as Duco® cement. Cellulose nitrate is a non-synthetic polyni- trate ester of polysaccharide cellulose (Selwitz 1988). Unlike acrylic-based adhesives, cellulose nitrate resins have been found to be unstable over time, and often shrink, become brittle, and turn yellow in color. The chains of polymers in cellulose nitrate resins will also eventually crosslink, making the adhesive irreversible. Moreover, if cellulose nitrate becomes brittle, it may also pull bone away from the conjoined bone fragments, causing permanent damage to the fracture margins. As a result, the conservation community no longer recommends cellulose nitrate for use adhesive joins and repairs. Yet, the use of Duco® persists in archaeology and forensic anthropology for reconstructing fragmented remains. Cellulose nitrate maintains popularity due to its low cost, accessibility, familiarity, and rapid drying time (Johnson 1994).

To better understand the effects on bone of using acrylic versus cellulose nitrate adhesives, chemical cross-linkage and damage to bone fragment margins were examined microscopically. Non-human bones were mechanically broken and rejoined using acrylic adhesive and cellulose nitrate resin. Acetone was later applied to the bone surface margins to reverse the adhesives. Using microscopic images, the degree of damage to fracture margins treated with acrylic versus cellulose nitrate adhesives was compared, as well differences in the degree of reversibility.

This study was conducted to provide the forensic community with a greater appreciation for the suitability of acrylic adhesives in reconstructing fragmented skeletal remains, especially in cases that may be subject to future examination. While acrylic adhesives may not be ideal in all conditions (e.g., wet bone, temperatures over 40º Celsius), they are better suited for forensic purposes than cellulose nitrate adhesives, due to their minimal alteration of fracture margins, and their greater strength, stability, and long-term reversibility.

References:

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3 Selwitz, Charles. 1988. *Cellulose Nitrate in Conservation* Getty Conservation Institute: Getty Publications. http://www.getty.edu/ conservation/publications/pdf_publications/nitrate.pdf.

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