A105 The Application of Consolidation Materials to Burned Bone: A Comparative Approach

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The goal of this presentation is to provide attendees with a better understanding of the utility of archival-grade consolidants for recovering human remains from a fatal fire scene.

This presentation will impact the forensic science community by quantitatively and qualitatively elaborating on previous research by comparing four consolidants' (e.g., Acryloid™ B-72, Acrysol™ WS-24, Rhoplex™ B-60A, and Butvar® B-98) ability to increase the strength and toughness of thermally altered bone and to identify the most appropriate consolidant and recommend best practices for usage when encountering burned bone.[1,2] It is expected that all materials tested will reduce continued sample fragmentation, mirroring previous researchers' results.

Taphonomic agents and post-depositional factors can significantly influence a bone's ability to withstand the stress of scene removal and analysis. Fire-altered bone presents a particularly unique challenge owing to its inherent friability. The Bridgeville Fatal Fire Recovery Protocols were developed to maximize recovery and mitigate fragmentation of human remains; however, they do not address stabilization methods that could reduce fragmentation resulting from handling at the scene or in laboratory or analytical settings.[3] A possible solution is the standardized use of consolidation materials *in situ* during recovery efforts. Although consolidant materials have been employed on friable bone in numerous contexts, there is little-to-no consensus regarding the most appropriate consolidant for burned bone.

An open fire cell was constructed and subsequently ignited. The sample population, consisting of domestic pig (*Sus scrofa domesticus*) femora (*n*=58) and skulls (*n*=5) subdivided into five groups, including a control group, was placed on the structure floor and allowed to extinguish naturally. Consolidant materials were prepared at a 10% concentration and applied to all visible surfaces of the bone samples *in situ* using a polyethylene squeeze bottle for a total of four applications.

Variables investigated in this research include ease of solution preparation and application, dry time, changes to the appearance of the bone surface, and mode of deformation during a loading event, as well as ultimate strength and toughness of the sample after consolidation. Mode of deformation was assessed through load-displacement curves produced by a nanoindentor. Drop weight impact testing and exposure to forced vibration were used to assess strength and toughness. A stratified random sample of relatively smooth and flat fragments was selected for nanoindentation (*n*=18) and drop weight impact testing (cortical samples: *n*=176; femoral head: *n*=43) to ensure accuracy by keeping the sample perpendicular to the applied force. Proximal femora and condylar epiphyses were selected for forced vibration testing. Samples in color stages IV and V were preferentially chosen for mechanical testing as a means of controlling degree of calcination, while anatomical region and bone type were considered to control sample anisotropy.[4]

Results indicated all materials increased the strength and toughness of burned bone compared to the unconsolidated control sample. While Acryloid™ B-72 was not found to be as strong as Rhoplex™ B-60A or Butvar® B-98, the quicker dry time and the lack of alteration to the bone's appearance make Acryloid™ B-72 the most suitable choice for on-scene use. Alternatively, if dry time could be significantly reduced using a more volatile solvent, Rhoplex™ B-60A would be recommended since the alteration to the bone surface after application was minimal. Future analyses should be performed to better understand consolidant influence on modification to bone surfaces and impacts to DNA sampling, as well as the degree to which consolidant increases the ability to establish the biological profile. Results of this research indicate that the dentition, frontal sinus, and other regions displaying biological indicators of sex, age, and ancestry should preferentially be consolidated due to their utility in skeletal analysis toward the identification of the fatal fire victim.

Reference(s):

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3. Dirkmaat D.C., Olson G.O., Klales A.R., and Getz S. The role of forensic anthropology in recovery and interpretation of the fatal-fire victim. In: *A Companion to forensic anthropology.* Edited by D.C. Dirkmaat, 113-135. West Sussex: Wiley-Blackwell, 2012.
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Burned Bone, Consolidant, Forensic Recovery

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