



Physical Anthropology Section – 2007

H100 Physical Matches of Bone, Tooth, and Shell Fragments: A Validation Study

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The goal of this presentation is to provide empirical support and validity for physical matches of bone, shell and tooth fragments. It provides the first documented error rates for physical matches for this class of material.

This presentation will impact the forensic community and/or humanity by meeting *Daubert* guidelines for a commonly used forensic technique.

Physical matches are routinely used in forensic investigations as a way to confirm that two or more pieces of evidentiary material (*i.e.*, glass, paper, metal, paint, plastic, wood, tape, fabric) were originally one piece of material. Bone fragments are often physically matched in the reconstruction of skeletal elements as part of forensic anthropological examinations, as well as in paleoanthropological and archaeological contexts. Although routinely performed and widely regarded as intuitively evident, the reliability and validity of physically matching fragments of bone, and other mineral-based biological materials, has never been empirically tested. In academic contexts, this may be of little concern; however, in the forensic arena a well-designed study would be beneficial given the *Daubert* guidelines of scientific testing and documented error rates. This study examines the reliability and validity of physically matching bone, shell and tooth fragments. Differences between individuals with varying levels of experience with physical matching and osteology are also examined.

The specimens used included human bones (femur, tibia, fibula, parietal), non-human bones (long bones, vertebrae, mandible, plastron), non-human teeth, and shells. Specimens were fractured using a combination of static and dynamic loading until structural failure. Each of the resulting fragments used in the study were labeled with a randomly assigned number between one and one-hundred. The assigned numbers of all pairs of physically matching fragments were recorded.

A matching exercise that consisted of 57 fragments containing a total of 40 correct matches and six fragments with no possible matches was devised. The exercise was administered to individuals with varying levels of education, experience and training in osteology and physical matching, including forensic scientists and anthropologists. Participants were instructed to identify, and affix together with tape, all physical matches they believed to be present among the fragments. In addition, participants were asked to answer questions pertaining to their area of expertise, materials with which they have previous experience performing physical matches, any education or training in osteology, and criteria used to identify the matches. They were also asked to record the time required to complete the exercise. Exercises were scored as a function of correctly identified matches compared to the number of false positive matches (incorrectly affixing fragments that do not match) and false negative matches (failing to affix fragments that do match).

Preliminary results suggest that bone, tooth and shell fragments can be validly and reliably matched. No false positive matches have been identified by any participant. False negative matches are not uncommon, but do not appear to be related to the individual's experience level. Anthropologists who can draw on their knowledge of osteology to correctly identify, anatomically orient, and re-fit bone fragments may be at an advantage in complex cases, but even inexperienced individuals are able to locate and identify correct matches without incorrectly matching unassociated fragments.

Forensic Science, Forensic Anthropology, Physical Match