H40 Using a Portable XRF to Detect the Transfer of Material from the Prior Use of a Saw in Cutting Bone

John A. Williams, PhD, Anthropology & Sociology, Western Carolina University, 101 McKee Hall, Cullowhee, NC 28723*

After attending this presentation, attendees will have a better understanding of how saw blades when used to cut bone can transfer evidence beyond typical saw class characteristics.

This presentation will impact the forensic science community by demonstrating that an XRF can be used to detect prior use of a saw in dismemberment.

The principle of transfer evidence is a fundamental tenet of forensic science. Within forensic anthropology the assessment of bone trauma often hinges on the transfer of tool or instrument characteristics to bone.

A protocol was designed to test whether a saw blade used to cut a copper pipe could transfer minute particles of copper when subsequently used to cut through bone. Copper was chosen to simplify the procedure by focusing on a single element and to reduce the likelihood of environmental transfer. Two saw blade classes were chosen: 18 teeth per inch raker set and 18 teeth per inch wavy set. Copper concentrations were measured using an Innov-X Systems handheld X-ray Fluorescence (XRF) unit. This XRF detects 23 elements between titanium and lead on the periodic table. The x-ray exposure is software driven, set by the manufacturer and was identical for each sample. A shielded test stand was used for testing ensuring that the distance from the XRF to the bone was the same for each sample. Each bone sample, control or test, received at a minimum of one XRF exposure session. Larger bones required multiple exposures to ensure that the complete surface had been exposed. This was performed for all cut surfaces. All non-human samples consisted of long bones of *Odocoileus virginianus*. Thirty-one uncut human and non-human bones formed one control set. These included contemporary and prehistoric elements. A second control of 25 non-human bones were saw cut using new blades without prior use. The test samples consisted of 31 non-human bones. Prior to each test cutting the saw blade was used to cut through a piece of 25mm copper tubing. Immediately after cutting the tubing each bone was completely cut through and then analyzed using the XRF. The saw blades, used and unused, were also tested for the presence of copper.

Among the non-cut controls no bone had a detectable copper level. The control cut group of 46 sample sessions from 25 bones yielded detectable copper in four samples in four bones (16.0%). Levels ranged from 62ppm to 129ppm, with an average level of 91ppm. The prior use test cuts consisted of 31 individual bones with 84 sample exposures. Copper was detected in 31 of the 84 sample sessions. This translates to 24 individual bones, or 77.4%. Copper levels ranged from 27ppm to 321ppm with an average of 100ppm. Detectable copper was present in each blade sample, used or unused. Levels were consistently high and ranged from 663ppm to 2,088ppm with an average level of 1,168ppm. A test of the average copper levels of the cut control and test cut groups, 91ppm and 100 ppm respectively, was not significant ($t = 0.2573$, *p-value* = 0.7896). However, in terms of absolute numbers the test cuts had a much higher total percentage of bones with detectable copper, 77.4% vs. 16.0%.

As no uncut bone had detectable copper the environmental transfer of copper can be ruled out as a possible source of copper presence. The transfer of copper from the prior use saw blades was confirmed microscopically. This demonstrates that copper was directly transferred from the copper tubing to the bone. It is assumed that the transfer of copper in the cut control samples was from the blade alloy. Therefore the true indication of prior use transfer cannot be ascertained using the XRF. While copper was transferred from the saw blade to the bone during the cutting process the XRF cannot distinguish between the prior use transfer and incidental transfer from the saw blade itself. The latter scenario may have equal utility in using an XRF in assessing saw cuts in dismemberment.

XRF, Dismemberment, Transfer

 ** Presenting Author*