A77 SEM Analysis of Saw Marks in Bone

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After attending this presentation, attendees will learn a useful technique to assist in the evaluation of saw marks found on large areas of bone or in cases where multiple saw blades from the same class need to be examined.

This presentation will impact the forensic community by assessing the capabilities of the forensic identification of saw mark patterns in bone as well as the impression technique using PVS and epoxy resin for SEM analysis. This information could be used to assist in the evaluation of saw marks found on large areas of bone or in cases where multiple saw blades from the same class need to be examined.

In situations in which a victim's body is mutilated in order to prevent identification after a murder, investigators are sometimes faced with the task of identifying dismembered remains. With advances in DNA analysis and forensic odontology, positive identification of dismembered remains is increasingly common, but it is of further interest for the investigator to determine what type of tool was used for such an act, in hopes of comparing tool mark patterns left behind in the bone with evidence found at a crime scene or in a suspects possession.

Although there are many types of saws or tools that are available for this type of act, one tool that is high powered, easy to use and accessible is the reciprocating saw, which is the focus of this study.

It has already been determined that reciprocating actions of saws tend to enhance rather than erase characteristics necessary for saw class identification, but it is of importance to be able to further categorize a saw used to commit a crime by type characteristics. This information is usually recorded in the object being cut, such as bone, and can help to determine if a particular questioned saw blade made a saw mark pattern so alike to a known saw blade pattern, that they can be considered a match.

It was one goal of this study to be able to determine whether or not 10 identical reciprocating saw blades from the same class would leave behind saw mark patterns that exhibit individual characteristics. In other words, if all 10 saw blades were worn in the exact same manner and then used to make a cut into bone, is it possible that each blade would possess uniqueness enough to identify which blade made a particular mark in the bone?

In order to determine if this was possible, cadaver skulls were cut into 1.5" by 1.5" sections, which were then labeled to coincide with each saw blade. A typical 14.2 volt cordless reciprocating saw with a 7/8" stroke and 2,700 strokes per minute was used along with ten 14 TPI, 6" bi-metal cutting blades in order to create saw marks in the bone.

Furthermore, there were several saw blades that were worn with a varying number of cuts, from several hand strokes to simulate hesitation cut marks, to many reciprocating saw cuts to mimic that of a severely worn blade. As the teeth on the saw blade were worn, the striation patterns left behind on the object being cut varied.

One common method of analysis for tool marks in bone is microscopy. Yet, whether or not a tool mark is said to match a particular tool is often subjective and left up to the discretion of the examiner due to the fact that there are many characteristics to be determined from a saw mark pattern including blade and tooth size (TPI), set, shape, power and cutting directions. Since there are currently no set standards or protocol as to how many aspects must coincide in order to determine a match between a questioned saw mark pattern and a known saw blade pattern, there has been an increasing lack of trust in the forensic field of tool mark examination and analysis.

Scanning Electron Microscopy (SEM) is a useful method for analysis of saw marks in bone due to its ability to produce images of high- powered magnification. This instrument allows one to take a closer look at the kerf, or sawed groove left behind in the bone and also makes it possible to identify striations and micro striae, which are patterns left behind on the kerf walls of the cut that record the blades stroke. With this information it is likely to determine if the questioned saw mark in the bone matches the saw mark from a known source. It is the unique characteristics that each saw blade retains that can drastically reduce the chances of any other blade making a particular cut.

However, there are disadvantages involved with using SEM for the traditional analysis of tool marks in bone. The instrument itself can only hold samples up to 3" in size, which poses a problem in situations where long bones or large saw mark patterns need to be analyzed. Additionally, the moisture in bone can cause problems with the sensitive closed vacuum chamber needed for the proper operation of SEM. In order to eliminate these potential problems, a negative-positive impression technique was used.

First, negative impressions were taken of each bone sample containing the saw marks using polyvinylsiloxane (PVS), followed by positive impressions using epoxy resin. This method allowed for a replica to be made of the bone and the saw mark pattern present in each sample and yet offered a practical

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use with SEM. SEM images were taken for each saw mark impression and for each saw blade sample. Digital and optical pictures of the samples were also recorded and used for comparison.

It was another goal of this study to assess the impression technique using these materials in order to determine if the saw mark pattern was completely preserved throughout the process. By comparing images of the saw mark patterns in the actual bone samples with the impressions made, it was possible to establish whether or not the type characteristics had changed throughout the duplicating process.

Forensic identification of saw marks in bone involves detailed steps of comparing a questioned piece of evidence to a known saw type in order to form an opinion as to whether the items are similar enough to be called a match. A forensic tool mark examiner must then evaluate to what extent those items are said to match by determining the probability that the questioned saw mark and known saw mark were derived from the same saw blade.

Both similarities and differences in the saw mark patterns from the various saw blades used in this experiment were expected. This study will impact the forensic community by assessing the capabilities of the forensic identification of saw mark patterns in bone as well as the impression technique using PVS and epoxy resin. This information could be used to assist in the evaluation of saw marks found on large areas of bone or in cases where multiple saw blades from the same class need to be examined.

SEM, Saw Mark Patterns, Impressions

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