H29 SEM Analysis of Mummified Skin: A Preliminary Study of Obsidian and Chert Induced Trauma

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The goal of this study is to identify the potential for mummified tissues to retain information involving soft tissue trauma to identify classes of stone tools based on kerf wall morphology. This research highlights the capability of mummified tissues to retain wound morphology, and the value of using Scanning Electron Microscopic (SEM) analysis for identifying class characteristics of weapons in soft tissue trauma.

This presentation will impact the forensic community and/or humanity by studying the microscopic analyses of stone tool trauma from mummified skin which provides two important contributions. First, this study shows that mummified tissues are capable of retaining information pertaining to soft tissue trauma. Thus, mummified tissues may represent an alternative source for analysis of trauma and for weapon identification. Second, the results have shown consistent class characteristics that can aide in the identification of stone tool-induced trauma. These class characteristics may be identified in soft tissue trauma from both pre-historic and modern forensic contexts. Future studies should examine the mummified kerf morphology produced by other weapon types, and the effects of distortion on kerf morphology.

While osteologists typically assess biological attributes from skeletal remains – such as age, sex, and population affininity - there is growing interest in biological anthropology to identify and interpret trauma. Differentiating perimortem trauma from postmortem artifacts provides information on scavenging, cannibalism, and episodes of homicidal violence. Recently, SEM has been used to identify key features of cut bone surfaces [1, 2]. These have provided an advantage over traditional analyses using light microscopy because the SEM offers the ability to capture the third dimension in trauma. The SEM combines high-resolution and increased depth of field to produce a three-dimensional image that enhances the topographical morphology. Thus, features invisible to the naked eye become observable, discernable, and available for analysis.

Previous SEM analyses of trauma have demonstrated that the morphology of kerf surfaces can indicate the class of implements that produced the kerf [2]. Thus, SEM analysis of skin trauma from pre-historic mummies or modern homicides should reflect the class of implements that produced the trauma. Although trauma can be caused by innumerable weapons, the present study will be limited to the analysis of mummified cut marks inflicted by chert and obsidian stone tools on fresh human skin.

The tissue media used for this study were skin samples harvested from fresh bodies donated to the Maxwell Museum of Anthropology at the University of New Mexico. To simulate trauma, obsidian and chert stones were knapped and used to induce trauma by striking the stone onto the intact and in situ skin. One-inch sections of the kerf were then harvested and prepared for SEM analysis.

Tissues were harvested from three different body donors, for a total of 9 samples. The obsidian-induced trauma samples consist of two naturally mummified samples and three silica-induced mummified samples. The chert-induced trauma samples consist of two natural and two silica mummified skin samples. Mummified skin samples were taken to the Department of Earth and Planetary Sciences at the University of New Mexico to obtain SEM images of the kerf walls.

Results from the SEM analysis show that of the skin samples retain information on trauma, although the naturally mummified tissues are less detailed when compared to the silica skin samples. Nevertheless, all of the obsidian-induced traumas have flat kerf surfaces and striations that are wide and smooth, while the chert-induced traumas are characterized by rugged kerf topography, deep and thin striations, and distinctive scratches that were produced when the stone was withdrawn from the tissues.

The results from this preliminary study suggest that 1) there are distinct morphological differences between tissues that are mummified naturally versus artificially; 2) the kerf morphology in mummified tissues is typically retained and class characteristics remain discernable; and
3) SEM analyses could allow for chert-induced trauma to be differentiated from trauma produced by obsidian. Class characteristics and SEM comparisons of the mummified tissues will be presented in detail.

Studying the microscopic analyses of stone tool trauma from mummified skin provides two important contributions. First, this study shows that mummified tissues are capable of retaining information pertaining to soft tissue trauma. Thus, mummified tissues may represent an alternative source for analysis of trauma and for weapon identification. Second, the results have shown consistent class characteristics that can aide in the identification of stone tool-induced trauma. These class characteristics may be identified in soft tissue trauma from both pre-historic and modern forensic contexts.

Future studies should examine the mummified kerf morphology produced by other weapon types,

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and the effects of distortion on kerf morphology.

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Scanning Electron Microscopy, Kerf Wall Morphology, Mummified Soft Tissue Trauma

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