H44 The Potential Diagnostic Value of Scanning Electron Microscopy in the Differential Diagnosis of Bone Lesions: A Pilot Study

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The goal of this presentation is to illustrate the potential diagnostic value of scanning electron microscopy in the differential diagnosis of bone lesions and the anthropological analysis of human remains in forensic settings.

This presentation will impact the forensic community and/or humanity by presenting microscopic skeletal lesion margin characteristics for three different types of neoplastic diseases and by introducing new terminology to describe the microscopic features observed in the SEM images.

The goal of this presentation is to illustrate the potential diagnostic value of scanning electron microscopy (SEM) in the differential diagnosis of bone lesions and the anthropological analysis of human remains in forensic settings.

The study of pathological conditions in skeletal samples is restricted to bony manifestations of disease; the differential diagnosis of bone lesions identifies certain pathological conditions as likely candidates, although none can be eliminated based on the standards currently available. While paleopathological analyses have the liberty to stop at this point, forensic investigations require more specificity, particularly in cases of unidentified individuals represented solely by skeletal remains.

Previous anthropological studies have demonstrated the necessity of multidisciplinary approaches for the most accurate study of pathological conditions in archaeological specimens. Current non-destructive methods for diagnosing disease from the skeleton include gross morphological examination and radiography of the lesions. This pilot study represents the initial phase of a research project that will test whether SEM contributes any additional diagnostic information to the identification of pathological conditions by examining the margins of lesions resulting from various disease processes in a modern documented sample. The hypothesis to be tested is as follows: SEM will illustrate differences in the margin morphology of bone lesions. The null hypothesis is that there is no difference in the data provided by gross morphology, radiography, and SEM. The alternative hypothesis is that significant differences exist among the morphological data provided by gross examination, radiography, and scanning electron microscopy. The criterion for determining if a difference exists is whether new terminology is needed to describe the microscopic morphological features observed in the SEM images. If the current descriptors are inadequate, then SEM is inherently contributing new information.

Three specimens with clinically diagnosed cancers (metastatic breast cancer, diffuse histiocytic lymphoma, and multiple myeloma) were drawn from the Maxwell Museum of Anthropology's documented skeletal collection. Gross observation, radiography, and SEM were used to examine bones with lesions. The skeletal elements were radiographed using a Hewlett Packard 43805N Faxitron X-ray machine, and the backscattered electron detector was utilized to gather topographic information from the bones in the low vacuum mode of the JEOL JSM- 5800LV scanning electron microscope (equipped with Oxford Isis 300 digital image capturing). To test whether scanning electron microscopy contributed information not available through current methods, all three images (digital photographs of gross morphology, radiographs, and SEM images) for each specimen were visually assessed and a written description of the observed morphology was generated.

The preliminary results of this research indicate that SEM—in conjunction with radiography and gross morphological examination—is a valuable tool for the recognition of neoplastic disease from skeletal remains in modern populations and forensic settings. Based on the specimens examined, scanning electron microscopy contributes additional data not previously available using traditional techniques; the microscopic features observed in the SEM images were not adequately described by standard gross morphological or radiographic terminology. Accordingly, feedback from the forensic community will be sought to refine new terminology that accurately and meaningfully captures the variation observed. However, a larger sample size (encompassing other pathological conditions) is necessary to strengthen this conclusion and determine whether SEM contributes diagnostic robusticity to the differential diagnosis of bone lesions in forensic anthropological contexts, as well as paleopathological and bioarchaeological research. Such diagnostic specificity would greatly benefit forensic anthropological investigations by contributing to the determination of cause and manner of death and/or the identification of unknown individuals.

Skeletal Lesions, Osteology, Scanning Electron Microscopy

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