Preservation and Degradation of Tool Marks in Burnt Bone
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BACKGROUND

• Symes (1992) demonstrated that saw marks can be interpreted to class characteristics (i.e. hacksaw versus ripsaw). Teeth per inch (TPI), tooth set, blade width and type can be determined.
• It has been demonstrated that sharp force trauma is preserved in burnt bone and can be differentiated from heat fractures (Herrmann and Bennett 1999, de Gruchy and Rogers 2002, Jackson 2005, etc.).
• Studies have been conducted on preservation of saw marks after burning (Eriksen 2005, Marciniak 2008), but these studies did not cover the range of temperatures applied here, nor were they as detailed.
• This experiment was conducted to investigate the effects of burning at different temperatures on potential analysis of tool marks, especially saw marks. This line of inquiry is significant to studies in bioarchaeology, zooarchaeology, and forensic anthropology.

HYPOTHESIS

Specimens burned at higher temperatures will, on average, be more visibly degraded and more difficult to analyze than specimens burned at lower temperatures, but tool marks will be retained even in bones burned at 1000°C.

MATERIALS AND METHODS

PREPARATION:
• 24 specimens were cut from 6 Sus scrofa forelimbs.
• Specimens (conjoined radii and ulnae) were transected using 3 saws:
  1. Stanley® Flush Cut Pull Saw (22 TPI) cross-cut
  2. Buck Bros. Miter Back Saw (15 TPI) rip saw
  3. Stanley® Sharp Tooth™ (8 TPI) cross-cut
• An RH Forschner by Victorinox 4” Utility Clamshell knife was used to deflesh specimens.

BURNING:
• Specimens were burned by 4 different means with 2 cut by each saw burned at each temperature.
• 6 in a bonfire (ranging from 299-770°C) for approximately 3 hours (Temperature was monitored every 10 minutes using a Wall Heat Spy® Digital Infrared Thermometer.)
• 18 in a Paragon High Fire Kiln at 600, 800, and 1000°C
• Ramp 999°C/HR: Holds 2 hrs. for the 600 and 800°C burns and 1 hr. 15 min. for the 1000°C burn

EXAMINATION AND ANALYSIS:
• Specimens were photographed before and after burning using a camera stand and a Canon EOS Digital Rebel XT and microscopically using a Leica MZ AP0 Stereozoom Microscope with camera attachment.
• Specimens were weighed on a digital scale (in grams) before and after burning to obtain an ash-weight ratio.
• Specimens were examined by myself and a forensic anthropologist using a blind testing method before and after burning. Features present (i.e. false start kerfs, pull-out striae) were noted, enumerated, and kerf widths were measured.
• Pre- and post-burning photographs and analyses were compared and degree of change was scored.

RESULTS

• Bonfire specimens: Preservation scores ranged from 0 (neutral) to –4. The mean was -1.667 and the median -1.5. Exfoliation and charring were mostly responsible for degradation. Exfoliation stripped away details and charring obscured them.
• 600°C specimens: Scores ranged from 0 (neutral) to -4; the mean was -1.33, median -0.5, and the mode 0 (3 specimens scored 0). Calcination presented a cleaner image than the bonfire specimens.
• 800°C specimens: Scores ranged from -1 to 2. The mean was -1.667, median -1.75, and the mode -2 (3 specimens scored -2). Notable shrinkage and warping.
• 1000°C specimens: Scores ranged from 0.5 to -5. The mean was -1, median -0.25, and the mode 0 (2 specimens).

DISCUSSION

Scoring alteration is necessarily subjective; burning always results in change, even if just to color, but it is clear that some of my specimens were significantly more degraded than others. The degree of destruction of tool marks is not well correlated to burn temperature. The significant result is that even after cremation at 1000°C it is still possible to analyze tool marks to a certain degree. Furthermore, tool marks on specimens burned at very high temperatures sometimes exhibited little or no notable alteration.

One must be cautious in analyzing tool marks on burnt bone, particularly regarding potential alterations in size of tool marks. Further confounding factors include melting/warping of features in bones burned at ≥800°C. Further investigation should be conducted into alteration of tool marks under more natural burning conditions and using statistically significant sample sizes to look into patterns of preservation based on temperature, time, and other factors.

BIBLIOGRAPHY AND ACKNOWLEDGEMENTS


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