# Examination of Chainsaw Tool Marks on Bone Using Digital Infrared Imaging[1]

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Chainsaw tool marks on bone have been reported in some dismemberment cases. When teeth on a chainsaw contact bone and the bone is not completely sawed into two parts, bone fragments are removed forming a channel or kerf. The kerf contains two kerf walls and a floor. Kerf marks are often adjacent to cuts due to false starts or skips in the cutting process. The purpose of this paper is to present the principles of tool mark identification and the results of a study analyzing chainsaw kerf marks on bone using digital infrared images enhanced with computer software. Random imperfections on the leading edge of the teeth may be transferred to the substrate when a material is cut using a chainsaw. When imperfections are transferred, they leave a series of fine lines referred to as striations. The striations vary in width on the cutting edge; therefore, they can be used as identification characteristics to match a tool to a tool mark.

For this study, 50 chainsaw cuts producing kerf marks on bovine bone were made with a Stihl® Model 290 chainsaw. This model is equipped with a 56.5 cc engine, a 50 cm (20 in) bar and chipper chain. The model 290 chipper chainsaw has cutting teeth assembled to form 40 cutting links along the chain with alternating left and right cutting teeth. As the chain rotates around the bar, the cutting links remove bone.

Bovine bone sections were prepared by drilling a pilot hole in each end of the bone, attaching them to a 13.97 cm (5.5 in) x 13.97 cm (5.5 in) x 76.2 cm (30 in) block of wood and anchoring them with screws to hold the bone in place before making the cuts. The cuts were made at approximately 90 degrees to the bone shaft using the same approximate chain speed. The kerf depth ranged from 1.27 mm (0.05 in) to 3.81 mm (0.15 in) in the cortical bone.

A Dino-Lite model AM-413FIT near infrared digital microscope mounted on a stand with a boom arm was used to photograph chainsaw teeth striations on the kerf floor in the bone. The kerf floor images were illuminated using infrared light emitting diodes in the 850 nm range. The infrared images were recorded and examined at approximately 30X to determine if sufficient individual characteristics were present for comparison purposes. The kerf floor images were then enhanced using Jasc software by splitting the color channels of the original image into percentages of black, yellow, magenta and cyan. The color separation feature did not alter the image but changed the contrast for each of the colors based on the original image.

The quality of striations on the kerf floor were evaluated and classified as +1, +2 or +3. A +1 score was assigned to kerf floor images with no striations, a +2 score was assigned to kerf floor images with some striations and a +3 score was assigned to images that contained sufficient striations for matching a tool to a tool mark.

In conclusion, 9 (18%) of the chainsaw cuts on bone were rated as +1, 27 (54%) of the chainsaw cuts were rated as +2 and 14 (28%) of the cut marks were rated as +3. Striations from chainsaw teeth are not always transferred to cortical bone; however, in this study the infrared imaging and computer imaging software did enhance the visualization of the transferred striations produced by the chainsaw cutting teeth.

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