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Contribution of Rodents to Postmortem Artifacts of Bone and Soft Tissue

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ABSTRACT: Postmortem disturbance of human remains by rodents extends beyond production of characteristic tooth mark artifacts in dry bones. Three case examples are presented that demonstrate a spectrum of rodent damage to dry and fresh bone and to fresh and mummified soft tissue. In one case, human remains are used for nesting purposes. Rodents are also noted to be vectors of bone transport. Rodent activities can affect bone recovery, human identification, and interpretation of artifacts to bone and soft tissue. Guidelines to differentiate soft tissue artifacts caused by rodents and carnivores are suggested.

KEYWORDS: physical anthropology taphonomy. postmortem artifacts, rodents, bone modification, tooth marks

Animals pose problems for forensic death investigators because of their abilities to scatter and destroy body parts, create postmortem artifacts, alter scenes, and alter or destroy indicators of identification as well as cause of death. It is not surprising that the ubiquitous "chisel-toothed" mammals, the rodents, rank among the most common scavengers of human remains.

Archaeologists and paleontologists who study taphonomic phenomena have focused on the part rodents play in bone accumulation [*1,2*], and tooth mark modification to bone [*3,4*]. The most noted accumulators of bone are porcupines (*Hysterix africaeustralis*) [*1*]. Woodrats or packrats (*Neotoma sp.*) of the American southwest often hoard "treasures" that include bone [*5,6*]. Rodents cited as gnawers of bone include the African porcupine (*H. africaeustralis*) [*1*], gerbil (*Desmodillus sp.*) [*7,8*], mouse (*Peromyscus manaculatus*) [*9*], and various squirrels, mice, and rats [*4,10,11*].

Brain [*1*] attributes rodent gnawing on bones to their need to provide attrition to their continuously growing incisors to keep them at a "usable" length. Rodent tooth marks on bone surfaces have been variously described as channels or striae [*12,13*], windows [*14*], straight parallel grooves [*15*], and flat-bottomed grooves [*16*]. A characteristic of gnawed cross sections of long bone shafts is their uniform pitch, extending from the outer to inner surfaces. In contrast, damage from carnivores is less regular and often rounded with no uniform pitch from the inner to outer surface [*17*].

Distinct parallel stria are not always found. In cancellous bone or skeletal elements of smaller long bones such as metacarpals, metatarsals, and phalanges where the shaft cortex thickness is extremely thin, telltale parallel stria may be absent. Patterns produced by

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suites of rodent gnaw marks vary dependent upon chewing behavior, number of chewing bouts, overchewing, and character of the bone being modified; whether it is fresh, weathered and degreased, cancellous, or compact. Multiple gnawings may present as a series of parallel marks, fan-shaped patterns, or totally disorganized striae overlying each other [*16*]. A common site of damage to subadult skeletons gnawed by rodents are the epiphyseal cartilages and adjacent areas of long bones. This leaves a thin stem of gnawed bone connecting the articulating ends to the shaft [*17*].

Miller [*18*] cautions that the incisors of canids such as coyotes (*C. latrans*) and wolves (*C. lupus*) can cause hollow grooves that may mimic the gnawing marks of rodents. This occurs when canids gnaw with their incisors transverse to the longitudinal axis of long bones.

Some authors writing about ancient bones suggest that rodents favor bones that are somewhat weathered and free from fat and sinew [*1,19*]. This impression may have to do with these researchers limited experience with soft tissue. It may also, in part, reflect the arid climatic regimes from which such observations have been made. Other authors suggest rodents prefer spongy portions of fresh bones [*20*]. Rodent damage to soft tissue has received mention in the forensic literature [*21*]. Crenulated edges delineating margins of damage to soft tissue have been noted [*22*]. The potential for confusing antemortem, ulcerated skin lesions with gnawing by mice and rats has also been discussed [*23*].

The following three cases, with postmortem intervals ranging from three days to twenty years illustrate various involvements of rodents with human remains.

Case 1

Twenty years following discovery and identification of the postcranial remains of a homicide victim, a cranium, suspected to be that of the victim, was discovered. Lack of antemortem skeletal or dental records reduced identification efforts to superimposition. Rodent damage to the supraorbital margin (Fig. 1) and destruction to other areas such as the zygomatic arch compromised superimposition efforts.

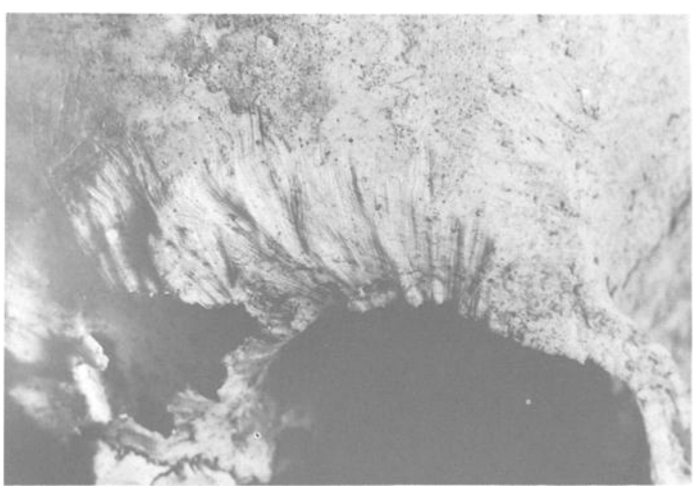

FIG. 1—*Left supra-orbital margin of a weathered cranium, classic rodent tooth mark damage.*

Case 2

This 33-year-old victim of a suicidal hanging was discovered in a secluded, wooded area 7.4 months following his death. The deceased was fully clothed in winter apparel and suspended by a rope from a tree limb with knees bent and feet touching the ground. Two adult rats were observed leaving the body at the scene.

When the body was undressed a nest composed of pine needles, newspaper, and down and fibers from the deceased's clothing was found occupying the entire thoracic cavity. Nine live, juvenile common rats (*Rattus norvegicus*), were extracted from the nest (Fig. 2*a*).

The anterior chest was nearly completely skeletonized. Tissue of the face was mummified with rodent damage to the nasal aperture (Fig. 2*b*). The right forearm and hand were completely skeletonized. Distal phalanges of the second through fifth fingers were absent. Remaining skin and soft tissues were mummified. Margins of damage to skin were finely scalloped. Chewed edges of dried muscles were frayed. Tightly circumscribed circular defects were present in areas covered by integument, and a tunnel from the posterior aspect of the left shoulder connected the right axilla to the nest in the thoracic area.

Case 3

A 27-year-old male was discovered in a dilapidated wooden shack approximately 3 days following his death. The deceased was fully clothed. His head and thorax were inside a plastic garbage sack that was tucked into his belt. Both upper extremities were entrapped inside the plastic bag. Nestled in the deceased's left arm was a small propane tank with the valve in the on position (Fig. 3*a*). At the time of discovery, the plastic bag had been rent open by rodents allowing them access to the upper portion of the body. There were rat droppings on the chest and inside the bag. Rodent hairs adhered to exposed muscle tissues. All soft tissue of the face and neck was absent. Also absent were both eyes and the soft tissue of the left temporal, frontal, and parietal areas. Both forearms were completely skeletonized. The metacarpals of the right hand were completely exposed

FIG. 2a—*Rat nest in thorax of deceased.*

FIG. 2b—*Rodent gnaw marks to mummified tissue of nasal border.*

FIG. 3a—*Overview of suicide victim scavenged by rats.*

and the majority of digits were absent. The bones of the left hand were completely absent. Damage to the thin cortical layers of bone of the fingers demonstrated no telltale parallel stria. Margins between rodent damaged areas and nonaffected areas of soft tissue of the forearm exhibited scalloped edges giving a finely serrated appearance. Damage to soft tissue took place in a layered fashion with distinct, differential destruction to the skin, and including underlying adipose tissue and muscle (Fig. 3*b*).

Discussion and Conclusions

These preceding three cases demonstrate a spectrum of rodent damage to human tissue that includes dry and fresh bone, fresh and mummified soft tissue, and shows rodents as

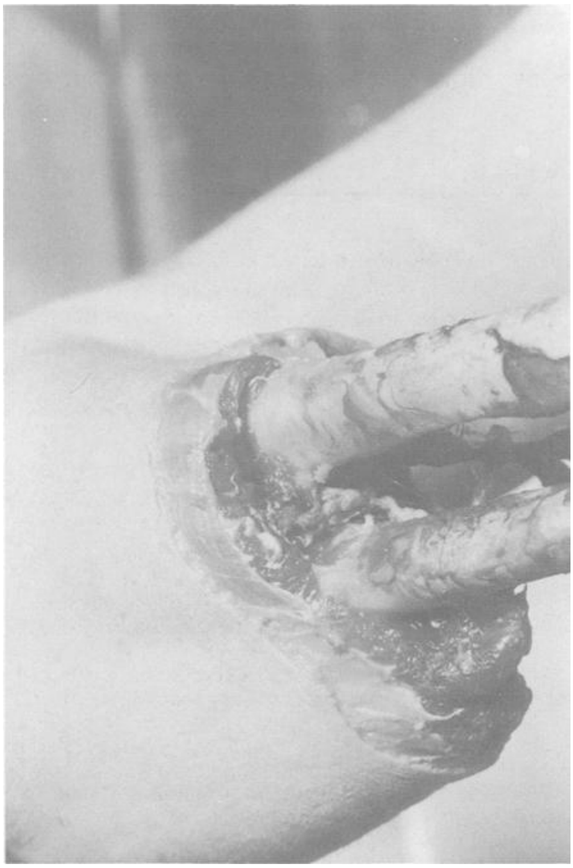

FIG. 3b—*Layered rodent damage to soft tissue.*

instruments of bone transport. Occasionally rodents may use human remains for nesting purposes.

Bone gnawing by rodents can often be distinguished from that of carnivores by a characteristic parallel series of furrows created by the incisors. Rodent damage to soft tissue is illustrated by layered destruction of tissue layers. Case 3 shows margins that are marked by a series of crennulations and an absence of scratch marks beyond damaged areas (Fig. 3*c*). By contrast canid damage to soft tissue is often accompanied by claw induced, linear scratch-type abrasions or puncture marks from canine teeth beyond consumed margins. These marks are frequently v-shaped. Margins of carnivore-damaged soft tissue tend to be relatively more ragged [*24*]. Table 1 summarizes features which often distinguish postmortem artifacts of rodents from those of carnivores.

Dispersal of skeletal elements by rodents was not observed in the above examples, but has been observed in other cases by the author. Small bones of the hands and feet have been found in rodent burrows. In another case, two lumbar vertebrae were found in a length of PC pipe.

Although determination of rodent species from gnaw marks in bone is unreliable, species identification may be aided by associated rodent scat or hair. Rodent species identification and knowledge of seasonal behaviors may, especially in instances of hi-

TABLE 1—*Features distinguishing soft tissue damage by rodents from carnivore scavenging.*

Characteristics	Rodent	Carnivore
Defect shape	Tight, circumscribed	Irregular
Defect margin	Relatively smooth or Crennulated	Irregular
Undamaged area beyond margin	No damage	Scratched or bruised

bernating species, assist investigators in determining the season of rodent induced damage. Recent gnawing activity on bony surfaces previously discolored from long exposure, may also enable investigators to make inferences relative to the postmortem exposure interval.

Activities of rodents can affect skeletal element recovery, human identification, and interpretation of antemortem artifacts. Postmortem gnaw marks of carnivores and rodents can usually be readily distinguished.

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