

TECHNICAL NOTE**ANTHROPOLOGY**

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A Method for Defleshing Human Remains Using Household Bleach

ABSTRACT: Medical examiners and forensic anthropologists are often faced with the difficult task of removing soft tissue from the human skeleton without damaging the bones, teeth and, in some cases, cartilage. While there are a number of acceptable methods that can be used to remove soft tissue including macerating in water, simmering or boiling, soaking in ammonia, removing with scissors, knife, scalpel or stiff brush, and dermestid beetles, each has its drawback in time, safety, or potential to damage bone. This technical report using the chest plate of a stabbing victim presents a safe and effective alternative method for removing soft tissue from human remains, in particular the chest plate, following autopsy, without damaging or separating the ribs, sternum, and costal cartilage. This method can be used to reveal subtle blunt force trauma to bone, slicing and stabbing injuries, and other forms of trauma obscured by overlying soft tissue. Despite the published cautionary notes, when done properly household bleach (3–6% sodium hypochlorite) is a quick, safe, and effective method for examining cartilage and exposing skeletal trauma by removing soft tissue from human skeletal remains.

KEYWORDS: forensic science, forensic anthropology, physical anthropology, human remains, human skeleton, macerating remains, bleaching remains, human bones, chest plate

Medical examiners and forensic anthropologists are often faced with the difficult task of removing soft tissue from the human skeleton without damaging the bones, teeth and, in some cases, cartilage. Preserving the condition of the skeleton without introducing “cleaning damage” or altering evidence of perimortem trauma is critical in police and medical examiner cases. Choosing the most appropriate method for defleshing remains and exposing underlying trauma therefore is something that must be done with care. The purpose of this technical report is to present a safe and quick alternative method for removing soft tissue from human remains, in particular the chest plate, following autopsy, without damaging or separating the ribs, sternum, and costal cartilage.

The most commonly used forensic methods for removing human soft tissue from remains include simmering in hot water, dish detergent with or without enzymes, diluted household bleach under a vented fume hood, or dermestid beetles (family *Dermestidae*). Tissue can be removed by soaking/macerating in large water-filled containers for weeks or months, or manually removed with a knife, scissors, or scalpel. Remains may also be allowed to decompose/putrefy naturally (e.g., the “Body Farm” at University of Tennessee, Knoxville). A combination of one or more of these methods may be used, or the remains may be soaked in household bleach straight from of the bottle (3–6% sodium hypochlorite). While the method of choice depends on many variables, including the extent of bodily decomposition, and time constraints associated with the case (police and medical examiner), whether to use bleach or not is a controversial topic among practitioners (1–7).

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Experience has shown that each defleshing and maceration method has its inherent strengths and weaknesses. For example, macerating remains in water-filled jars for weeks or months, although a safe and effective method, is a slow process that causes the soft tissue to fall away from the bones, but still requires an amount of cleaning with scissors, scalpel, or brush to remove small amounts of adhering soft tissue. Cuts placed on bones during processing can be confused as pseudo-trauma and may require explanation in a judicial setting. Simmering or otherwise heating remains without boiling in a crock-pot or a hot plate, in comparison, is quick and safe, but must be done carefully and monitored to prevent overcooking. Anyone who has rendered remains by cooking them has probably witnessed the ill effects of over cooking—the ends of long bones and other spongy bones such as vertebrae, ribs, and hips become extremely soft and absorbent. In fact, overcooking bones may not only distort and warp them, but may permanently damage, remove, or mask evidence of trauma such as cut marks.

During the 1980s, the senior author worked at the University of Tennessee (Knoxville) Anthropological Research Facility (ARF) where he regularly removed soft tissue from donated bodies and homicide victims to compile a biological profile of the decedent’s age, race, sex, stature, and trauma. Rendering the body to bone (a process handed down from Dr. William Bass, the ARF’s curator and founder, and from one graduate student to the next) often took from 2 and 4 days and was accomplished in several steps. First, the body was disarticulated at the joints, and the soft tissue was cut away using scalpels, scissors, and forceps. The soft tissue was either retained and refrigerated pending further analysis, or disposed of as biological waste. The body parts were then immersed in a double-jacketed steam kettle at a nearby veterinary school and simmered for several hours. The water was removed, and more soft tissue was cut or pulled away from the bones before re-immersing them in the steam kettle for 2 or 3 more hours. This process was

repeated until the bones were nearly free of adhering soft tissue. The bones were then immersed in undiluted household bleach (5.5% sodium hypochlorite) for 15–30 min to remove the grease and odor. Throughout the process, the remains were carefully monitored for the slightest evidence of “whitening” or the formation of chalky patches, deposits of hydroxyapatite on the surface, indicating that the bleach was beginning to alter the outer cortex of the bone. Prior to the presence of any whitening, the bones were removed from the bleach and rinsed in tap water to stop the bleaching action. The final steps were to rinse the remains under tap water and allow them to dry on paper towels.

Less common, but just as effective and less time consuming, is the chemical removal of soft tissue by immersing remains in undiluted household bleach, without having to first go through the longer process of simmering in water, or removing the bulk of the soft tissue with a scalpel. Bleach, which attacks and oxidizes the protein bond in bone causing the hard tissue to break apart, is particularly effective for removing soft tissue such as muscle, tendons, and ligaments from small sections of bone such as the clavicle and pubic symphysis. The remains may then be put in a closet, plastic container, or room with dermestid beetles, also known as carrion, larder, and hide beetles, that meticulously remove even the smallest fragments of adhering dried soft tissue (8–10) (<http://www.lab.fws.gov/beetles>).

While removing a decedent’s chest plate is an integral part of an autopsy, removing the soft tissue to obtain the underlying bones is not something that forensic pathologists or forensic anthropologists do on a regular basis, as gross examination and X-rays usually suffice. There are, however, occasions when removing the soft tissue can reveal subtle nuances of trauma that may otherwise be obscured or masked by the soft tissue. Removing soft tissue from a chest plate while maintaining its shape, however, is beneficial in that it (i) is ideal for revealing stab wound location and some blade/implement characteristics at autopsy, (ii) allows for the removal of soft tissue without damaging the costal cartilage or ribs, (iii) maintains the ribs, costal cartilage, and sternum in their precise sequence and anatomical order, and (iv) allows one to photographically document and compare the location and morphology of traumatic wounds to the chest without running the risk of altering the sequence of the ribs or misaligning them.

The first step in defleshing the chest plate is to place it in a shallow (2–4 in. deep) stainless steel or plastic pan filled with undiluted (out of the bottle) household bleach (Fig. 1). If the remains are carefully monitored, there is no need to dilute the bleach with water. The bleach will quickly begin to bubble and heat up indicating that the soft tissue is being chemically removed. While wearing gloves, occasionally lift the chest plate out of the bleach to see whether there is still any adhering soft tissue. The bleach should be changed every 15–20 min or when a heavy film forms on the surface of the water. Carefully monitor the process and remove the chest plate before there is any sign of “chalkiness” of any of the bone surfaces or cut ends. After removing the chest plate, immerse it in tap water for 5–10 min to stop the chemical reaction. The chest plate can then be placed on a flat surface to dry. The arch of the chest plate can be maintained by placing the internal surface rib cage over balled up paper towels. The chest plate should be allowed to dry overnight before being handled, as the costal cartilage may be brittle. The location of each stab or gunshot wound can then be measured and photographed (Fig. 2).

Removing soft tissue by bleaching is a method that some oppose because it can potentially damage bone and inhibit DNA extraction. The authors have found that if used correctly, bleach is a safe and effective method for removing soft tissue when skeletal elements are not going to be subjected to DNA analysis, when identity of



FIG. 1—Chest plate removed at autopsy and prior to immersing in bleach to remove the soft tissue (circles indicate stab wounds).

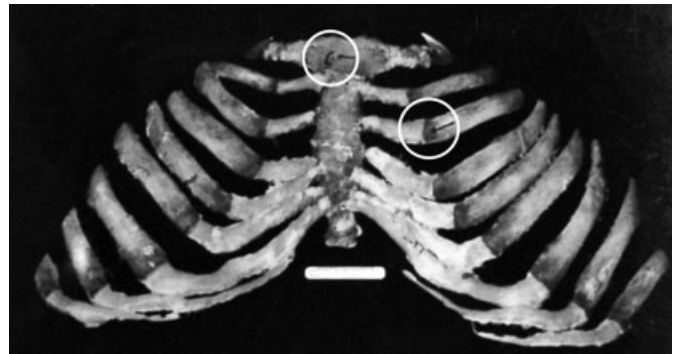


FIG. 2—Articulated chest plate after immersing in household bleach to remove the soft tissue and reveal the underlying stab wounds (circled) in bone.

the decedent is not in question, when removing soft tissue from isolated body parts, or when interpreting skeletal trauma. This method has also proven to be a safe, quick, and effective way to examine cartilage and remove soft tissue from delicate bones such as the hyoid, turbinates, and fractured maxilla without having to use force (e.g., forceps). Last, the speed associated with bleaching provides a means to examine and document skeletal evidence at autopsy in cases where the specimen cannot be retained but must be released with the body.

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