BRIEF COMMUNICATION

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Post-cremation Taphonomy and Artifact Preservation*


ABSTRACT: Contemporary commercial cremation is a reductive taphonomic process that represents one of the most extreme examples of postmortem human alteration of bone. The thorough reduction and fragmentation of cremated human remains often leaves little biological evidence of diagnostic value. Instead, non-osseous artifacts often provide the best evidence of the origin of the cremated remains, the identity of the decedent, and commingling of the remains of more than one individual. Once human remains have been cremated they are most commonly placed into a processor and reduced into small fragments and fine ash suitable for inurnment or scattering. The type of processor determines the size and utility of the particulates and artifacts available for analysis. The newest type of processors have changed the manner and degree of postmortem bone modification and altered the preservation of diagnostic bone fragments and cremation artifacts. This paper addresses the impact of the newest cremation procedures on forensic analysis of cremated remains.

KEYWORDS: forensic science, forensic anthropology, cremation, cremation artifacts

Introduction

The number of people choosing cremation over burial has been increasing and will continue to increase over the next decade. At present, over 25% of deaths in the United States result in cremation. The Cremation Association of North America projects that by 2010 this number will increase to greater than 35% (1). As more people choose to be cremated we can expect a concomitant increase in the number of cases that forensic anthropologists are asked to examine. Litigation and subsequent forensic examination of cremations usually involves inappropriate disposal of human remains, questions about the identity of the decedent, and commingling of the remains of one individual with those of another. A small number of case histories and methodological papers, most presented at professional meetings, have addressed many of these issues (2–8) and provided forensic investigators with excellent descriptions of the commercial cremation process (9,10). This brief communication addresses relatively recent changes in cremation practice and their impact on the analysis of cremated remains.

Three sources of information are used to identify cremated human remains: a) bone and tooth fragments, b) weights and volumes, and c) artifacts.

Bone and tooth fragments can be used to determine if the cremated remains are those of a human; establish whether or not the decedent had dentition; reveal the developmental stage of the dentition and, therefore, the age of the individual; and finally, help detect the presence of various age-related pathologies.

Cremation weights, and to a lesser extent volumes, can provide limited baseline information. Weights exceeding the ranges established by researchers may suggest the presence of more than one individual. Weights less than expected may point to remains that are either incomplete (i.e., some portion of the remains have been removed prior to examination), or the cremated remains of a juvenile or nonhuman. All things considered, the weight of the cremated remains should correspond with published values for the sex and general skeletal robusticity of the decedent (11,12). Occasionally, calcined atherosclerotic blood vessels can be found among the cremated remains. Since atherosclerosis is an age-related pathology, the presence of these calcined vessels provides a clue that the decedent was most likely a mature adult (13).

Cremation artifacts provide contextual clues that may be as important as the biological clues. We have assembled a reference collection of artifacts collected after cremation, but prior to processing, from over 100 individuals. The collection is used to aid in the identification of artifacts recovered in subsequent cases and also to provide reference hardware for cases involving severely burned or decomposed bodies. As outlined by Ubelaker, this hardware can be exceedingly useful for the purpose of establishing identity (14).

For purposes of classification, we divide artifacts into five categories: medical, dental, mortuary, personal, and miscellaneous.

The largest, most obvious medical and/or dental artifacts are removed prior to processing. However, many medical artifacts are not removed and may be discovered among cremated remains. Most are relatively small in size and are manufactured from nonferrous surgical alloys. Examples of these types of artifacts include surgical staples used for skin closure and vascular clips used to ligate blood vessels during surgery. We also commonly see fragments from sternotomy sutures as well as pacemakers leads. Occasionally, pacemaker components are recovered even though it is recommended that the pacemaker be removed prior to cremation (14).

Similarly, several types of dental artifacts are recovered in processed remains including fragments from metallic crowns, posts, bridgework, and porcelain crowns and caps.
Two mortuary artifacts are almost invariably found in cremated
remains. These are the injector needles that are inserted into the
maxilla and mandible to “set the features” and prevent the mouth
from opening during visitation, and various staples that are used to
construct the wood and cardboard cremation caskets in which the
cremations take place. We have recovered complete staples from
wooden cremation caskets. However, we generally do not recover
complete staples from cardboard caskets, but rather staple frag-
ments, which are readily identifiable.

We refer to remnants of jewelry, clothing, and other personal
effects as personal artifacts. For example, we commonly recover
zipper fragments, bra clasps, and jewelry chain fragments. In addi-
tion, it is also relatively common to recover artifacts that were
added to the cremated remains after they are processed. Examples
we have seen include a small silver metallic cross, the ignition
key of a decedent’s boat, and a wedding band. Miscellaneous ar-
tifacts are fragments that are not readily identifiable. Most of the
metallic artifacts that are recovered fall into this category. Non-
diagnostic wire fragments are common and may be due to any
number of sources, including sternotomy sutures, flower arrange-
ments that are added prior to cremation, or wood and cardboard
casket staples.

Processor Types

After the cremated remains are removed from the retort there are
many large diagnostic fragments. Once the remains have cooled,
the cremationist removes large medical and dental prosthetics and
runs a magnet over the remains to remove ferrous metallic objects.
The cremated remains are then reduced by means of a processor, or
pulverizer, to decrease their volume for inurnment and/or scatter-
ing. The type of processor determines the size of bone and tooth
fragments and the survival of cremation artifacts.

We have analyzed cremated remains that have been processed
by three different methods: hand processing, ball/hammer mill pro-
cessing, and rotary blade processing. Hand processing is used in
Europe and other areas. In the United States, cremated remains
from neonates and infants are often hand processed to preserve suf-
ficient volume for memorialization. We have observed the use of a
cremation magnet or some other blunt object such as a piece of
wood to pulverize cremated remains. This processing method pro-
duces relatively large fragments.

Ball or Hammer Mill processors are an older type of mechanical
processor. Cremated remains are placed in a perforated steel drum
in which contains a number of metal balls or cylinders. The drum
rotates causing the hammers to crush the remains into smaller and
smaller fragments until they are small enough to fall through the
perforations into a collection bin at the bottom of the machine.
The cycle is over after all of the cremated remains have passed
through the perforations. The circular perforations are approxi-
mately 4 mm in diameter. Although fragments can be no longer
than 4 mm along one axis, they can be longer than 4 mm along an-
other axis. This reducing method results in diagnostic tooth and
bone fragments, and often complete ear ossicles that identify the re-
 mains as human. There can also be excellent survivability of small
cremation artifacts.

These older types of processors are not time dependent (i.e.,
longer processing times do not affect the degree of pulverization).
Fragments produced by this type of processor are therefore fairly
consistent in size—most slightly less than 4 mm in one plane. In
addition, commingling could also be introduced if fragments got
cought in the perforations and were not removed prior to process-
ing another set of cremated remains. A large quantity of metallic
fragments can be recovered after ball mill processing.

Larger fragments result in a larger volume of cremated remains
because the fragments pack less efficiently. Cremationists will oc-
casionally have difficulty in reducing the remains to a small
enough volume to place in a standardized urn. The purpose
of processing the remains into smaller fragments is to facilitate
inurnment. A recurring problem in the industry was the occa-
sional situation in which the volume of the remains exceeded the
capacity of the industry standard-sized urn. We have been told by
a number of cremationists that families did not receive the portion
of the cremated remains that did not fit in the urn. In 1987, an in-
dustrial engineering firm in Florida introduced the newest type of
processor (personal communication, Kenneth Robinson). The
manufacturer refers it as an electric cremains processor. The ma-
jority of crematories in the United States and Canada now use
similar rotary-blade type processors. When cremated remains are
placed into the processor the top pan rests on the pot. The cre-
ma ted remains are placed in the pan and brushed into the pot. The
pan is lifted and placed in the present position and the lid is
placed over the pot. There is a 60 s timer on the machine. The in-
side of the pot, which looks like a food processor, has blades that
are hinged on both sides with ends angled upward to help facil-
itate mixing of the remains.

The rotary blade processor is capable of reducing cremated re-
main s to minute non-diagnostic bone fragments and ash. Due to the
efficiency of these new processors, it may be difficult, or impos-
sible in some cases, to determine if the processed remains are human
based on the osseous material alone.

The manufacturer asserts that they were trying to produce a pro-
cessor that would consistently reduce human remains to a volume
of less than 200 cubic in.—the size of the industry standard urn. A
secondary benefit is that the processor reduces osseous elements to
non-diagnostic fragments. Forensic anthropologists may be under-
standably skeptical about the purpose of the new processor. In his
recent chapter on the forensic implications of the growing popular-
ity of cremation, Murhad states that “it is believed that such a re-
duction will hinder an anthropological/morphological analysis of
cremated remains and thus limit an investigator’s ability to deter-
mine completeness or commingling. Simply, many in the crema-
tion industry are taking steps to curb the frequency and the success
of future litigation” (10). Whatever the reason for the development
of the newer processor, it has resulted in a more challenging exam-
ination for the forensic investigator.

We have observed that the condition of the blade, and not the
length of the processing cycle, has the greatest effect on the size of
the osseous fragments. As the blade decreases in length with use, it
becomes less efficient in reducing the cremated remains to a small
enough quantity to fit in a standard sized urn (Fig. 1). As a result,
smallest blades may produce diagnostic osseous fragments that are
larger than those generated by the older type processors.

One of the services offered by the manufacturer is replacement of
the blades. The manufacturer asserts that a 30 s cycle is all the
time needed to reduce cremated remains to fit in a standardized urn.
The original processors did not have a timer and as a result,
the blades were prematurely wearing too quickly because cremation-
ists were processing remains for a longer time period than was rec-
ommended. The timer was later added by the manufacturer to de-
crease the cremation time and increase blade life.

During a consultation with a funeral director, we were asked to
observe their cremation procedure and to make recommendations
for improvements. We also analyzed cremations to understand
more about the differential survival of fragments produced by
time cycles of varying lengths using rotary blade processors. We
allowed the operator to perform her normal routine, which con-
sisted of processing the remains for two 30 s cycles. The blade on
the processor was in good shape and the two cycles were more
than enough time to reduce the cremated remains to fit in a stan-
dard sized urn. This particular cremationist felt that two 30 s cy-
cles were more efficient than one 60 s cycle. There were no
recognizable osseous fragments present in this cremation, how-
ever, there was unbelievable preservation of cremation artifacts.
Figure 2 displays the artifacts, which include a complete ster-
notomy suture, large sternotomy suture fragments, complete den-
tal crowns, pacemaker components, and surgical gown snaps. We
asked the cremationist to increase the length of the processing cy-
 cle on the ensuing cremations. The operator ran a 1 min cycle fol-
lowed by an additional 30 s cycle. Even after the increased length
of the cycle, we were still able to recover identifiable cremation
artifacts.

Conclusions

Rotary hinge blade processors have made forensic analysis of
cremated remains a more challenging task. Blades with minimal or
absence of wear will produce non-diagnostic osseous fragments
that may not be recognizable as human. In addition, there may be
excellent survivability of cremation artifacts with only minimal
wear on the processor blade. However, the condition of the blade is
directly related to the survivability of osseous fragments. The size
of the fragments appears to increase as the wear on the blade in-
creases and it becomes shorter in length (losing lift). In other
words, in certain instances, there may be better presentation of os-
seous fragments and cremation artifacts in the newest processors
since fragment size is not restricted by the aperture size of the
filtering perforations in the older ball mill type of processors. Ob-
viously, the more osseous material and artifacts available for anal-
ysis, the more likely the investigator will find evidence of the iden-
tity of the deceased.

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