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Two Sasanian ossuaries from Bushehr, Iran
Evidence for exposure of the dead

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Abstract: *Since first discovered in the early 19th century, the ossuaries from Bushehr, Persian Gulf, have attracted attention as possible archaeological evidence for ancient Zoroastrian burial practice. This practice involved exposing cadavers to birds before the surviving remains were gathered for deposition in an ossuary. In this paper, the human remains recovered from two ossuaries at Bushehr are described. Specifically, several bones were missing, others were damaged on their surfaces, were stained, or broken, all of which can be interpreted as resulting from exposure, carrion feeding, as well as being placed in an ossuary. An overall lack of tooth marks on surviving bones and the observed differential pattern of limb and torso survival suggest that bones from the ossuaries had been exposed to bird carrion feeding.*

Key words: Bushehr; Iran; secondary burials; ossuary; carrion feeding; Zoroastrian burial rite

Introduction

Since first discovered in the early 19th century, the ossuaries from Bushehr, Persian Gulf, have attracted attention as possible archaeological evidence for ancient Zoroastrian burial practice. Little is known of early Zoroastrian funerary rites in which cadavers were exposed and any remaining bones were gathered and deposited in ossuaries (cf. *Vendidad* 6:44-51; Hansman & Stronach 1970:153). The practice is believed to have gained ground during the Parthian Period during the 4th century BC and became more or less obligatory under the Sasanians. Kartîr was the virtual founder of the Zoroastrian Church in the 3rd century AD and it can be assumed that he was the first to institutionalise excarnation in Fars. Kartîr reformed the old Magian customs according to which the bones were not collected after decomposition but remained *in situ* (Trümpelmann 1984:329). The Bushehr bones had been placed in ossuaries and, if Zoroastrian, must date later than the 3rd century.

The human remains from Liyan (a quarter of Bushehr) recovered from a stone ossuary (British Museum BM 91933) and from a re-used torpedo jar BM 91952 are described below. They were examined with their archaeological context as well as what is known of funerary customs of Sasanians who did not inter but rather exposed their dead. In addition, an attempt was made to reconstruct the taphonomic history of the skeletal material recovered from the ossuaries, paying particular attention to the findings of Binford (1981), Brain (1981), Duday et al. (1990), Lyman (1994), and Molleson (2000). Age and sex assessment of the remains followed the *Recommendations for age and sex diagnoses of skeletons* (1980) and Brothwell (1981).

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Stone ossuary from Liyan (BM 91933)

The ossuary is carved from a single block of stone, with a separate stone lid. There is no drainage hole. When examined it was clean and devoid of sediment. The bone fragments, which are kept separately, were hand-picked from a small quantity of associated sediment. Because some bones were duplicated, an attempt was made to sort the bone fragments into two units based on age and morphology. These units consisted of the fragmented and incomplete skeleton of a mature or old adult male designated as Individual 1, as well as the cranium and some post-cranial fragments of a younger individual designated as Individual 2. Most of the bone fragments of Individual 1 are generally a darker colour than those of Individual 2.

Individual 1

The fragmented remains of a mature to old adult (**Figure 1**). The bones are thin and gracile. The cranial bones are broken into straight edged fragments. Both the glabella and the frontal sinuses are small, barely reaching the line of the top of the orbit on the left. There is a sinus in the basioccipital. The nasal bones are united; the coronal and sagittal sutures are obliterated internally. Both occipital condyles are present and the articulations are double facetted. Only a small fragment of the maxilla survives with the alveoli for roots of two molars, one of which appears to have had an abscess around the buccal root. Two teeth, an upper central incisor and a second molar with large long roots, probably belong to this individual. Cranial sutures, teeth, and alveolar margins, together with the evidence for degenerative changes on the vertebrae, suggest that the individual is a mature adult. The bodies of the cervical vertebrae (C2-7) are present. The superior articular facets of C1 are bipartite, and because of this it was possible to match it with the cranium of Individual 1. The uncinate processes are well developed; those of C5 show evidence of degenerative change. The bodies of about eight thoracic vertebrae are present; some have eroded surfaces indicating some disc damage. None have Schmorl's nodes or Scheuerman's asymmetry.

Fragments of a clavicle are present; the medial end shows moderate degenerative change; midshaft maximum diameter is 11.3mm. Scapular fragments were also recovered including both a left and a right joint region. These fragments do not appear to be the same size; the right coracoid is larger and the joint surface seems slightly larger but is too eroded to measure. In addition, there are two possible acromial processes, the smaller of which has a partially united epiphysis. The hyoid bone is present.

Fragments of the pelvis include part of the acetabulum, which may, however, belong to Individual 2 based on colour. The iliac rim, the sacro-iliac joint with moderate to severe degenerative change, and the pubic symphysis whose worn surface is characteristic of a mature adult. The morphology of the pubic surface and the narrow sub-pubic angle are indicative of a male.

A distal end of a humerus, two radial head fragments, femoral condyle fragments, as well as the patella and the proximal end of the tibia were noted. The hand bones, which are corroded or worn, comprise four carpals (scaphoid, lunate, triquetral and capitate) and ten phalanges. The joints have cystic areas around the articular margins. The distal ends of a few of the middle phalanges are extremely thin. The terminal phalanges are normal. Foot bones comprise cuneiform fragments, and the fused middle and terminal phalanges of two fifth toes.

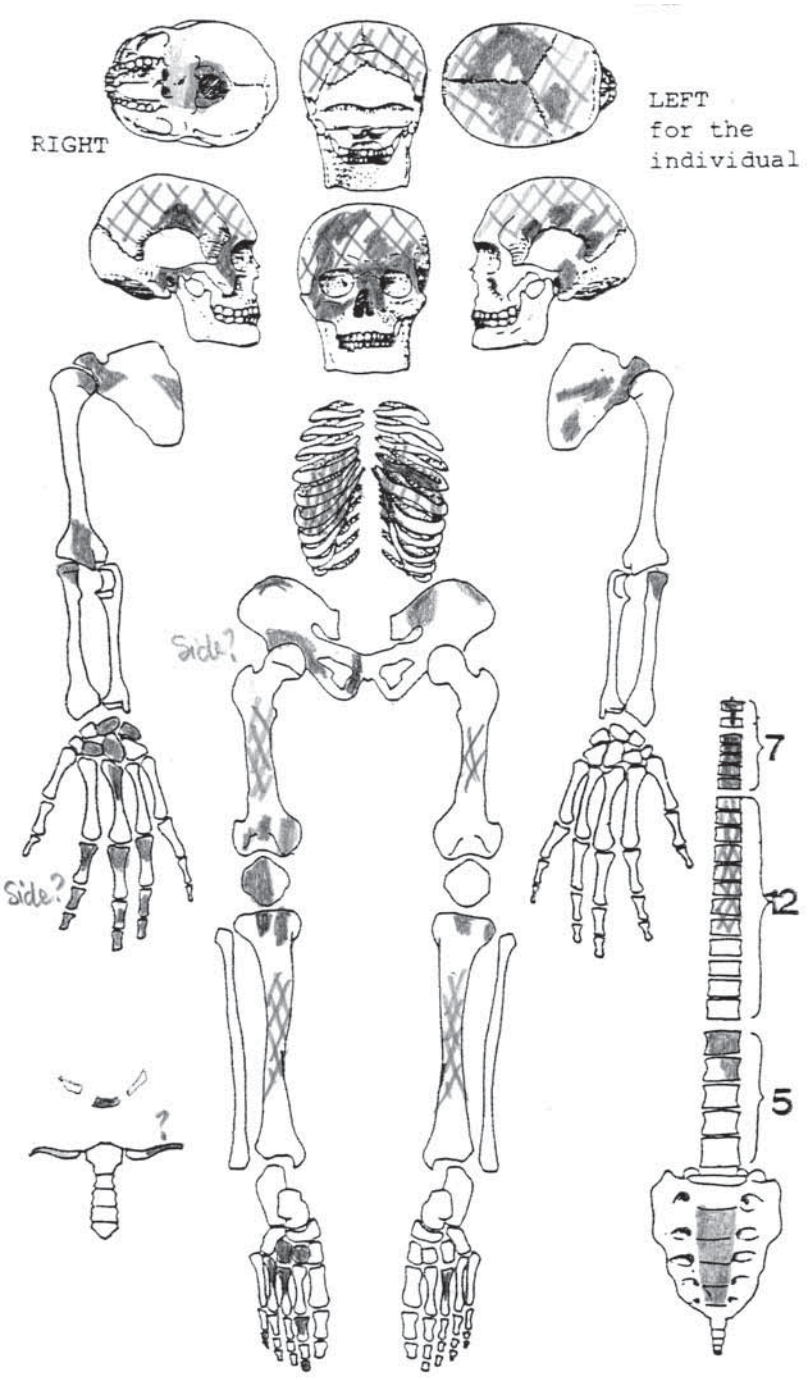

Figure 1. Individual 1: a mature adult male from the limestone ossuary, distribution of surviving bones. The fragments could be from either of the two individuals in the ossuary.

Bone modification of Individual 1

There is a dark stain on the external surfaces of cranial fragments (**Figure 2**). This stain penetrates the outer cortical bone, the diploë and, to a lesser extent, the inner cortex, except for an area towards the base of the skull including the basioccipital. The surface is weathered or abraded. The frontal bone has a very thin deposit of fine grey-green silt on the surface over the brown stain, and covers the interior of the skull around the orbit. The fragmentation of the skull took place after staining and weathering. Both crania were possibly largely intact at the time of burial since large pieces (up to 65.6×49.5mm) could be reconstructed. The maxilla fragment was stained as well as most of the vertebrae. Although none of the vertebrae are intact, none of the bodies show signs of scavenging marks. Rib fragment sizes are less than 56.8mm. The pectoral and pelvic bones are fragmented, and their maximum length is 52.8mm. The epiphyses of long bones were rarely recovered.

The distal end of the humerus lost most of its epiphysis; the broken edge has a number of small notches that could possibly be puncture marks. The radial head has three or four narrow grooves across the articular surface. The carpal bones are eroded and stained dark. The phalanges are damaged, and one has a puncture hole. The remaining phalanges are thin (most likely pathological). The terminal phalanges are intact although one is broken and they are all stained. A distal femoral condyle has a small puncture mark and a patella has a 'gutter' medio-laterally, with a possible puncture behind this. The head of a metatarsal shows both breakage and the corrosive pitting that is seen around the articular margins of many of the bones. The shaft is hollowed.

In summary, Individual 1 was a mature adult male. Most of the postcranial bones have been attributed to this individual. All parts of the skeleton are represented although very incomplete, including vertebrae, long bone epiphyses, and the pelvis. There are some degenerative changes to the vertebrae, notably C5. There is also some degenerative change to the sacro-iliac joint. The hand bones display a pathological condition, probably systemic. The cranium is fragmented, but not while the bone was fresh.

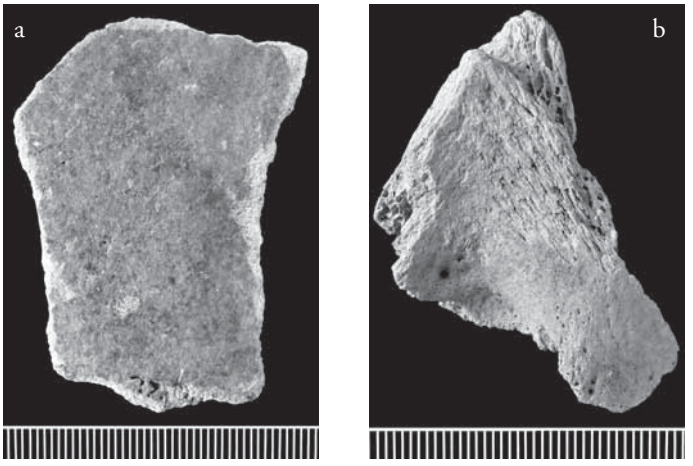

Figure 2. Individual 1 taphonomy: (a) Cranial fragment with superficial staining; (b) Distal end of a humerus fragment with surface damage, interpreted as being the result of insect gnawing or possible weathering. The epiphyses have also been removed.

Figure 2 (continued). Individual 1 taphonomy: (c) Radial head showing a loss of surface bone and scratches from possible gnawing; (d) Distal femoral condyle showing the removal of surface bone. The shallow depth of removal and scalloped pattern, particularly around the edges, is suggestive of insect gnawing; (e) Two hand phalanges with damaged ends and possible perforation; metatarsal, (i) manal phalanx, damaged ends; (ii) manal phalanx, damaged ends, cystic areas on proximal end and possible perforation; (iii) metatarsal, proximal end with cystic areas and removed cortical bone.

Individual 2

The skull of a young adult was designated as Individual 2 (**Figure 3**). Some of the postcranial fragments in the assemblage may belong with this individual. The bones of Individual 2 show less staining than those of Individual 1. In addition, the cortical bone is thicker than that of Individual 1.

The frontal sinuses are well developed and extend above the orbits. The left mandibular glenoid fossa is large. The coronal suture is open indicative of a young age. The occipital condyle has a single articulation. The basioccipital has a large sphenoid sinus. There are small fragments of maxilla and of a mandibular body including the gonial angle and some teeth (14 crowns plus fragments and roots) **(Table 1)**. The crowns of some of the premolars and a molar remain intact. The teeth show very little wear suggesting a late adolescent or young adult age.

Table 1. Individual 2: measurements of teeth (mm).

	ULI1	ULC	ULP1	URP1	ULP2	ULM3	LLP1
BL	7.0	8.1	9.3	9.4	9.6	11.5	7.1
MD	8.6	7.3	6.7	6.9	6.7	9.5	6.8

Bone modification of Individual 2

The cranium of Individual 2 is generally unstained. There is a light deposit of greenish grey sediment on the exterior surface and a deposit of fine greenish grey sediment on both the inner and outer surfaces of the left side—the side that may have been in direct contact with the burial environment (**Figure 4**). The sphenoid sinus was filled with greenish grey sediment in layers, which implies repeated episodes of water deposition and drainage in still conditions. The flooding did not reach the top of the cranium. The outer surface of the bone is abraded. Fragment size is variable (up to 88.1×59.6mm). The only possible, although unlikely, puncture marks are two indentations along the line of the sagittal suture, the distance between the two impressions measures 15.5mm; and surface damage resembling a 'pecked out' area on a parietal bone. Many of the cranial fragments show the edge of a gutter in the diploë running parallel to the outer and inner tables. The surface of the outer cortical table has been patchily removed in places and channelled. The lower border of the mandible fragment is damaged but the bone is too abraded to determine whether there are any tooth or peck marks. Of the dental remains, often the crowns and roots were broken apart, and only the crowns of some of the premolars and a molar remain intact. Most of the teeth are stained, especially the enamel, and have a fine deposit of sediment.

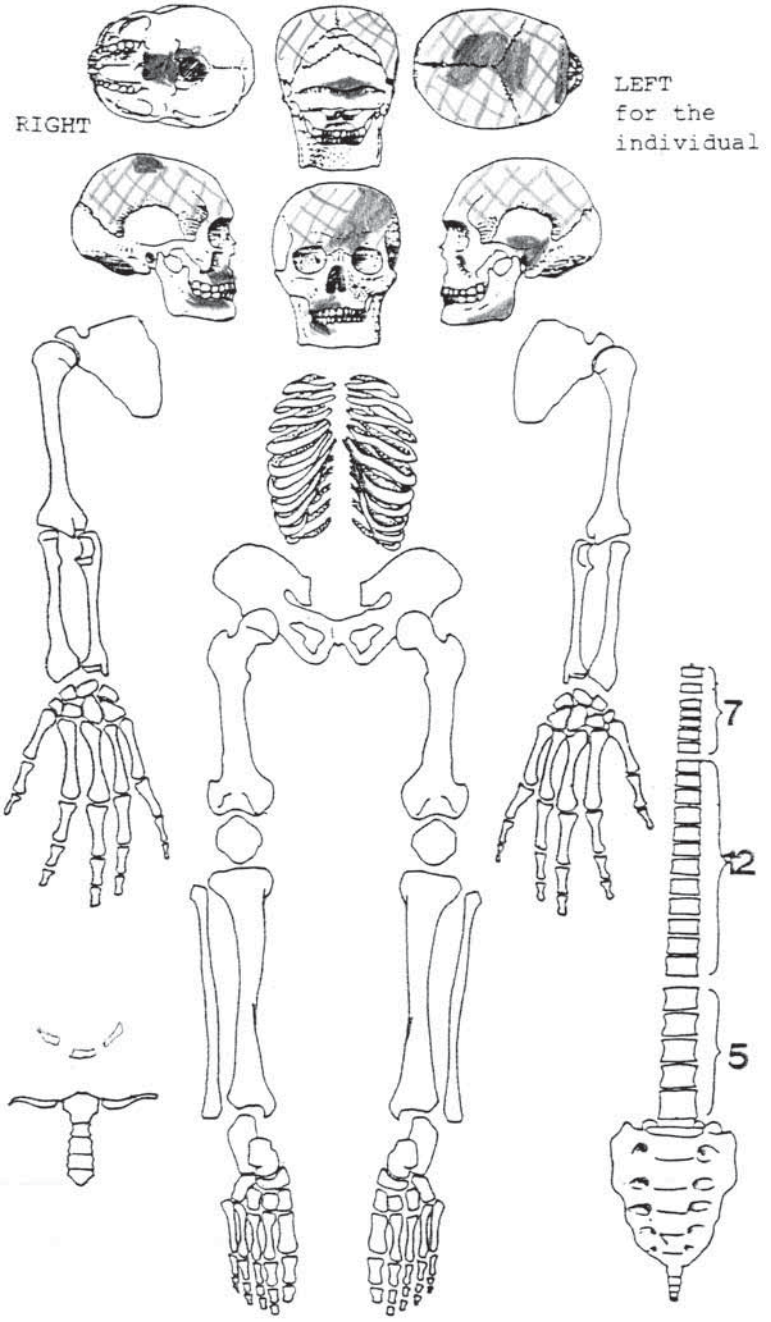

Figure 3. Individual 2: a young adult from limestone ossuary. Only skull bones have been attributed to this individual although a number of postcranial fragments may belong to this individual.

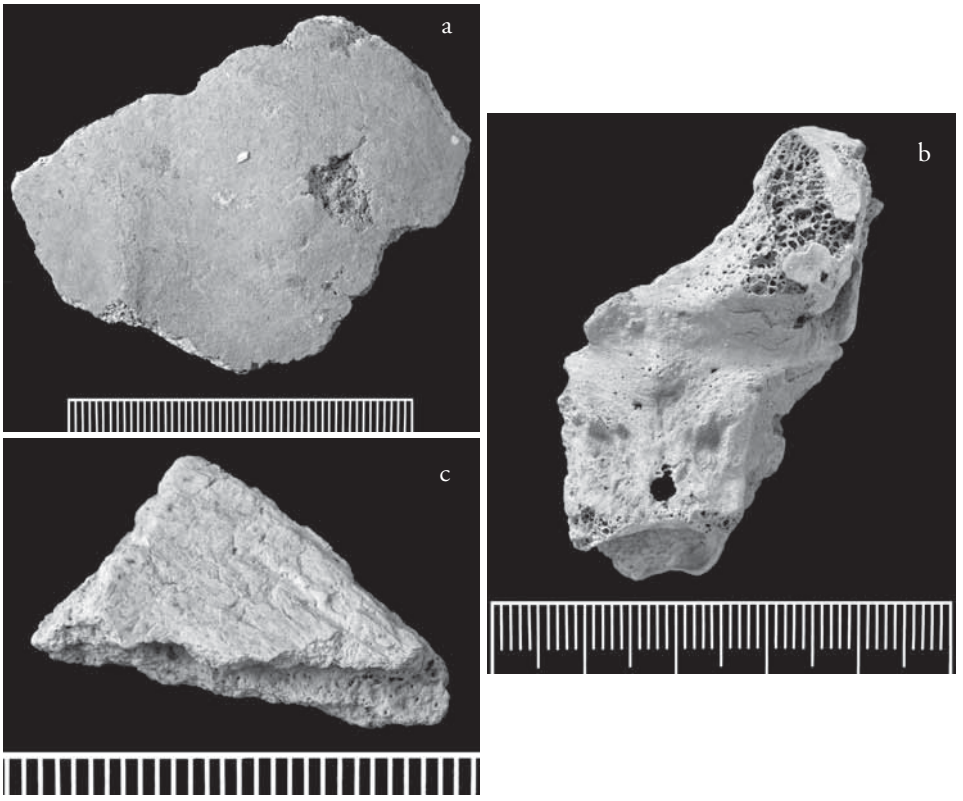

Figure 4. Individual 2 taphonomy: (a) Cranial fragment, part of a larger piece showing surface greenish sand and light staining of the bone where the outer surface has been removed, possibly by pecking; (b) Basioccipital with large sinus. The bone is lightly stained and there is a surface deposit of greenish sand. The sinus was filled with layers of this sand indicating that the sand was water laid and that it had accumulated from several episodes of flooding; (c) Cranial fragment showing a channel in the diploë parallel to the inner and outer tables. The bone is unstained.

Reused torpedo jar ossuary (BM 91952)

The contents of this jar **(Figure 5, Table 2)** were hand-picked from ochre-brown sand. They consist of the fragmented and weathered remains of a single individual, a mature adult female. All parts of the skeleton are represented with the exception of the left forearm and the hand.

The cranium is represented by ~six small fragments. The nuchal crest is well developed. There are two small fragments of the right mandible and two teeth, both premolars, one of which (P1) has a mesio-distal groove and is very worn in contrast to the other (P2) that exhibits little wear.

The vertebrae are generally abraded and fragmented. There is evidence of load bearing in degenerative changes to the vertebral bodies and joints of the lower back. The sacral vertebrae (S1/2/3) are not united. The ribs are thin.

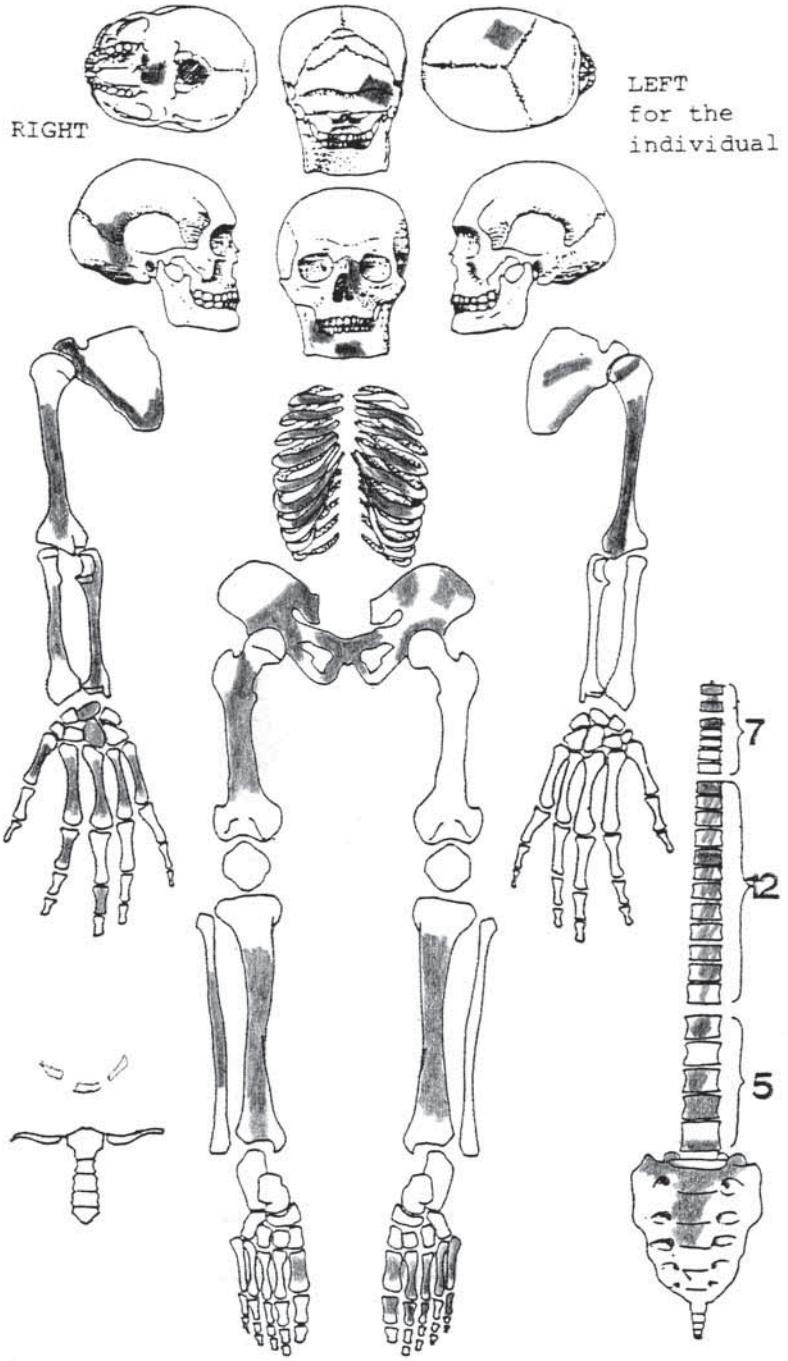

Figure 5. Individual 3 from the reused torpedo jar, the distribution of the surviving bones of the skeleton.

The glenoid of the scapula exhibits degenerative change as well as post-mortem erosion. The clavicles (fragments) are gracile. The pelvis is reasonably complete although fragmented. The sub-pubic angle can be reconstructed and is wide, which is a feature of the female pelvis. Both sacro-iliac surfaces are present and have slight osteophytic lipping. The preauricular sulcus has a number of ligament pits, a feature that has been associated with multiple pregnancies, which is also suggested by a well developed inguinal tubercle on each of the pubic rami (Ullrich 1975). The degenerative changes suggest a mature adult.

The humeri are D-shaped in cross-section and have well developed deltoid tuberosities. The right ulna (the left is missing) has a well developed supinator crest and a moderately developed pronator. There is some degenerative osteophytic change to the joint surfaces. The hand bones include the scaphoid, first metacarpal, and ~four other metacarpals.

The femora have moderately developed linea aspera, spiral lines, and gluteal tuberosities. The tibiae are gracile. The metatarsals are compressed medio-laterally. The distal articular surface of the first metatarsal is extended onto the upper surface; a condition linked to kneeling with the toes curled under (Ubelaker 1979; Molleson 1989:356). A proximal pedal phalanx has an everted proximal end.

Table 2. Adult female from the torpedo jar: summary of measurements (mm).

Measurement	Left AP	Left ML	Right AP	Right ML
Scapula: left glenoid 32.7×22.4				
Humerus: midshaft diameter	17.0	13.5	17.5	14.2
Femur: subtrochanteric diameter	21.8	28.1	22.8	29.3
Femur: midshaft diameter	21.2	24.8	21.5	24.0
Metatarsal I: midshaft diameter	9.6	11.4	9.4	11.3

Bone modifications

The bones from within the jar ossuary are generally fragmented but do not appear to have been deliberately broken as often happens with cremations where the bones are subsequently placed in an urn. In support of this, the shafts of many of the long bones are fairly complete, measuring up to 190mm in length, although none has an attached epiphysis. Although the bones are not stained and do not present surface cracking caused by sub-aerial weathering, they are extensively damaged, especially the trabecular bone of the vertebrae and epiphyses and the diploë of the cranial bones. The few cranial fragments are deeply abraded on the inner surfaces. In some parts the diploë is channelled and tunnelled. The edges of the ribs were removed, especially along the lower border and some appear to have been penetrated and channelled. Some of the ribs have a crystalline (perhaps gypsum) deposit on the sternal ends. The inner surfaces of the ilium and the ischium are more abraded than the outer surfaces.

The epiphyses of the long bones have mostly been removed. There is a groove or furrow across the proximal end of the femoral head. There are ambiguous puncture marks on both sides (10.5mm apart) of the proximal end of the fifth metatarsal and on the lateral side (38.7mm apart) of the fibula (**Figure 6**).

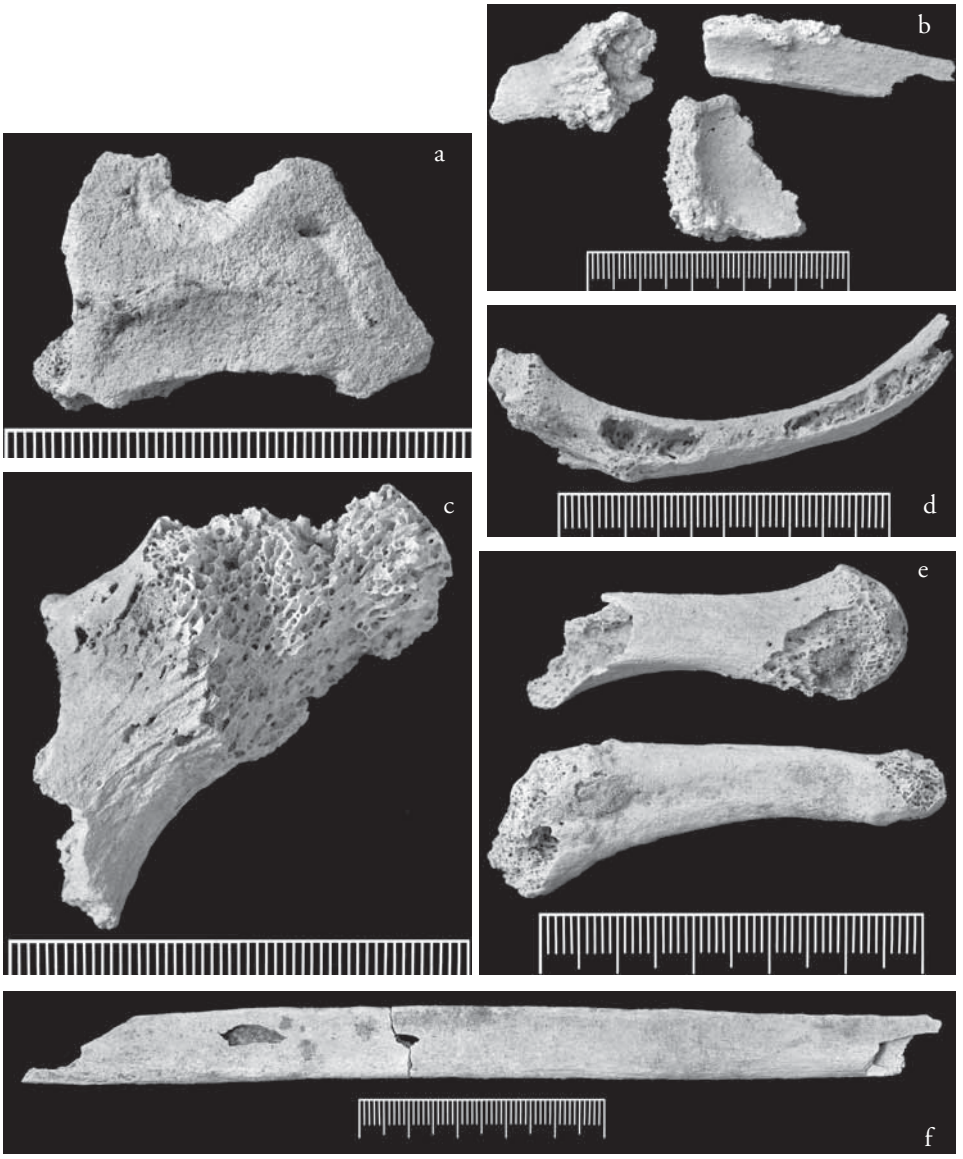

Figure 6. Individual 3 taphonomy: (a) Fragment of occipital bone, showing indeterminate breakage, surface weathering, and a lack of general (water) staining; (b) Crystalline growth on ribs; (c) Femoral head with damage and deep grooves across the neck. This is the only possible example of gnawing by a mammal; (d) Rib fragment showing the patchy removal of bone from the lower border; (e) Damage to the ends of a first and fifth metatarsal. Sand has penetrated the bone in places; (f) Fibula with perforations. These are questionable examples of carrion bird activity.

Discussion

There are inherent difficulties in trying to infer post-mortem practices from excavated human remains. Bone will have lost most of its organic component, especially in tropical conditions, and will have become dry and friable, therefore easily breaking and thus obscuring any original modification. Human bone does not fracture or fragment in the same way as animal bone, and the survival of certain bones from the hand or the foot, for example, can be quite different in situations where there is scavenging by carnivores. Nevertheless, it is possible to define criteria by which exposure, defleshing, scavenging, burning, and reburial can be identified. These are quite different from the random preservation and staining (from soil, dyes, or metal and so forth) of bones recovered from even adjacent graves of a cemetery (Farwell & Molleson 1993; Molleson et al. 1993; Mays 1998). In such cases it is generally impossible to reconstruct the sequence of events.

The bones of Individual 1 are superficially weathered and stained light to dark brown, which looks like charring but is likely humic staining from exposure to wet conditions (G. Cressey, pers. comm.). The differential survival of bones of the torso, notably the hyoid, scapula, and patellae, together with loss of most of the long bones, suggests little disturbance but is consistent with scavenging by carrion feeders who will drag a limb away from the carcass; the loss of hand bones also could be due to removal by scavengers. The bone is too abraded to determine whether there are any tooth marks. A limited number of puncture marks were noted but evidence that these may be due to vertebrate carnivore activity is weak.

The widespread evidence for superficial damage to the bones from the torpedo jar suggests that the jar was exposed on the surface and was not out of the reach of carnivores. The general loss of epiphyses, most of the vertebrae and the left forearm may be due to carnivore scavenging. Attack by carnivorous insects may account for much of the superficial damage to the skull and postcranial skeletal material. No clear tooth marks were observed perhaps excluding dogs as the carnivore but these might not be visible in weathered bone. The lack of superficial cracking along the length of the long bones suggests that the bones, although exposed, were sheltered from periodic wetting and drying.

Patterns of bone survival have been established by zoo-archaeologists (Binford 1981; Brain 1981; Haglund et al. 1989; Lyman 1994; Berger & Clarke 1995; Reeves 2009) and the same criteria may be cautiously applied to the analysis of human remains if one is aware of the inherent structural differences between bone of human and animal origin.

Because the present study is based on only three individuals from two different ossuaries, it is not possible to conduct a case control analysis, yet we can look for similarities and differences with bone assemblages of known circumstances of accumulation. Binford (1981) carried out controlled studies for butchered, killed, scavenged, and den accumulations of mammal bones. He defined a number of diagnostic criteria for these, based on the relative frequencies of surviving elements. Mammal kill sites were characterised by a high frequency of skulls, more pelves than ribs, low frequencies of the proximal humerus and the distal radiocubitus, and low frequencies of the femur relative to the tibia. The front limb is typically the first to become dismembered and is therefore subject to early scattering (Binford 1981:276). When compared with these criteria, the skeletal material from Bushehr appears to have been exposed and scavenged, although the crania survived (**Table 3**). The vertebrae, ribs, and pelves survived more often than long bones.

Table 3. Survival of skeletal parts after excarnation and burial (comparative data after Molleson 2000 and Binford 1981). The Bushehr assemblage is more like a large kill site relative to the carnivore scavenger. Legend: (Cr)anium, (M)andible, (V)ertebrae, (P)elvis, (R)ibs, (S)houlder, (H)umerus, (R)adius-(U)lna, (C)arpals, (Met)acarpals, (F)emur, (Ti)bia, (Ta)rsals, (Met)atarsals, (Ph)alanges.

Assemblage type	Cr	M	V	P	R	S	H	R-U	C	Met	F	Ti	Ta	Met	Ph
Primary inhumation	100	100	4	24	82	58	86	80	40	59	100	100	45	43	32
Large kill site	51	78	76	77	36	52	39	31	0	28	30	42	28	36	18
Small kill site	38	84	46	98	21	56	40	32	0	20	68	40	18	40	6
Torpedo jar	•	•	✸	✸	✸	✸	✸	✸	•	✸	✸	✸		✸	•
Ossuary individual 1	✸		✸	✸	✸	✸	•	•	✸	•	✸	✸	•	✸	✸
Ossuary individual 2	✸	✸													

mented, they are known to tear the flesh off bones leaving the periosteum for insects. Evidence for this is seen in Individual 1 from the limestone ossuary and in the bones from the torpedo jar. Insects that attack carcasses suggest delay between death and burial. A carcass can be completely skeletonised by flies within five days of death during the summer (Lyman 1994:135). Grooves can be created by the gnawing activities of arthropod larvae. Reeves (2009:Fig. 5), for example, illustrates the scapula of a pig showing the non-penetrating linear scratches created by vultures. In addition, the photograph shows a maggot on the edge of the upper border near the medial edge. The insect appears to have cut a groove along the ventral surface of the bone. The grooves noted on the bones from the limestone ossuary appear to be insect channels, they are too long to be tooth marks and there is no associated crushed bone. Holes bored or eaten through bone by insects can be distinguished from the punctures made by carnivore teeth by their larger size and the absence of crushed bone in the bottom. Termites also gnaw bone (Lyman 1994:393).

Brain (1981:108, Tables 53-54) described the food remains left by black eagles in South Africa. "The remains of dassies [hyrax] are mainly cranial parts, together with pelves and a few of the larger limb bones. The skulls show very characteristic damage: in most instances the braincases have been opened from the back or the side to remove the brain. The damage to the skulls has been inflicted by the points of the black eagle's sharp bills." Hyraxes are obviously smaller than a human body but the type of damage from this form of predation should be similar: the occipital bone from the back of the skull has a distinctive morphology but only one or two fragments from the torpedo ossuary were recognised. An important feature of scavenging by raptors is that after they have torn away the flesh, the partially dismembered skeleton is finished off by insects. The effects of this process can be seen on the bones from Bushehr.

Brain does not present any data for bone survival after scavenging by dogs but bone accumulations associated with hyena were composed of about 50% bone flakes, 10% vertebrae, 9% long bone, 4.9% jaws or teeth, 4.5% articular ends, and only 2% skull, pelvis, or foot bones (Brain 1981:293, Table 35). These proportions contrast with the black eagle debris, which is dominated by skull and pelvic bones and lacking in long bones.

The Bushehr assemblages most closely resemble scavenged profiles presented by Brain (1981) and Binford (1981) despite having been placed in an ossuary, excavated in the 19th century, and subject to transport and museum curation over the intervening century. The pattern of bone survival from the stone ossuary, with poor survival of long bones, hand and foot bones, contrasting with the survival of cranial and vertebral bones, most resemble assemblages that have been scavenged by carrion feeders. As a result, it appears as though all three individuals were not buried immediately after death but were left exposed. There is evidence for scavenging by carrion feeders, possibly bird; and the bones may have also been stripped clean by insects. Finally, the bones had been placed in ossuaries and subjected to periodic inundation in the case of the limestone ossuary.

Conclusion

The results presented here suggest that the skeletal material from Bushehr represents possible evidence for Zororastrian burial practice. The strongest evidence derives from differential bone survival rather than from specific bone damage.

The cadavers must have been skeletonised before they were placed in the ossuaries because these areas are too small to accommodate a fleshed adult body. Some of the staining as well as the distribution of superficial sediment must have occurred after the bones had been placed in the ossuary. The brown staining and the layering of the sediment in the basi-occipital sinus of the cranium from the stone ossuary are consistent with repeated flooding.

Surface cracking of the bone, which is characteristic of sub-aerial weathering, is superficial and minimal. It may have occurred either before or after the bones had been placed in the ossuary.

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