

## Evidence of Surgery in Ancient India: Trepanation at Burzahom (Kashmir) over 4000 Years Ago

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**ABSTRACT** The article describes a neolithic skeleton with multiple-trepanated skull found in Kashmir, the archaeological circumstances of the find, the dating, the background, the skeletal evidence, the details of the trepanation and possible affiliations of the Indus civilization. It speculates briefly about possible medical grounds for the surgery. Copyright © 2001 John Wiley & Sons, Ltd.

*Key words:* trepanation (trepanning, trephination); India; Neolithic; Indus civilization

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The surgical practice of trepanation (also known as or trephination or trephining) is the craniotomy or drilling/cutting through the skull vault of a living or recently deceased person. As a surgical operation, it was widely established in many ancient societies of the Americas, Europe, Africa and Asia (Brothwell, 1994). Squier (1863–1865) and Broca (1867, 1876) were among the first to draw attention to the antiquity of this practice in Peru. Piggott (1940) thought that it had begun in Europe around 5000 BP. In Asia, trepanation is evident around 4000 BP in the Bronze Age of Jericho in Palestine (Parry & Starkey, 1936; Giles, 1953). Brothwell (1994) stressed the need for reconsidering the origins and diffusion of this ancient practice which he thought had probably begun 4000 to 5000 years ago. He thought that the techniques of trepanation were similar across all continents, and that they could throw new and useful light on the prehistoric movements of people and the transfer of surgical skills from one society to another.

The present paper wants to draw attention to trepanation in prehistoric India, in general, and

to a multi-trephined skull from the Neolithic pit-dwellers of Burzahom in the Kashmir Valley of the northwestern Himalayas, in particular.

Trepanation is known from the Bronze Age Harappan (ca. 4300 BP) people of the Indus Valley Civilization. Sarkar (1972) attributed a squarish hole on the right temporal skull of a child of 9–10 years' skull found at Lothal, a Harappan site. Roy Chowdhury (1973) also believed that evidence of trepanation was present in Harappan skull No. H 796/B and H 802/B, from Cemetery R37 and possibly in a Kalibangan skull (another Harappan site) in western India. A megalithic skull (M30) from Maski (Karnataka) in south India also showed evidence of trepanation (Sarkar, 1972): it has two circular holes of 22 mm and 15 mm, respectively, on the either side of the sagittal suture of the vertex. However, the authors are of the opinion that the Burzahom skull presents a better, unequivocal case for multiple trepanation in India. It is this skull that we shall discuss below.

### The Site

Burzahom is located about 10 km northeast of Srinagar in the Kashmir Valley, on a terrace of

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Late Pleistocene–Holocene Karewa deposits. The site was excavated over six seasons, between 1961 and 1968, and has yielded ten human skeletons of different cultural stages: Neolithic, Neolithic–Megalithic, and early historic cultures. The early Phase I of the Neolithic at Burzahom has not yielded any human skeletons; C14 dating has yielded an earliest possible date of  $4375 \pm 120$  BP. The Neolithic Phase II has yielded seven human skeletons in burials (Basu & Pal, 1980) including the trephined skull (SKL 7, BZH-3), known here as the *Burzahom skull*. The remaining three skeletons belong in the later Neolithic–Megalithic cultural complex.

The burials of Burzahom are of a type called pit burials. The burial of the trephined Burzahom skull had animal bones, antler/horn pieces and a circular stone-soap disc associated with it. The skeleton was in its primary articulation and in a crouching position, oriented northeast–southwest and was found at a depth of 7 feet 4 inches (2.24 m) from the surface level. It was earlier reported to have been covered with red ochre, but one of us (Sankhyan) has found no trace of this. The trephined side of the skull was lying upwards, towards the surface.

The seven skeletons of the Neolithic Phase II were excavated from different burials of varying depths, ranging from 3 feet 9 inches (1.15 m) to 10 feet 7 inches (3.22 m) from the surface. Four were in primary articulation and three in secondary articulation or partially articulated, nearly in northeast–southwest orientation, some with and some without grave furnishings. One burial contained an earthen pot, two had barrel-shaped carnelian beads, and one had a circular stone bowl. One burial of the Neolithic–Megalithic Phase had a dog skull associated with the human skeleton. Burying a dog with a human is said to have been a practice among early Chinese (Roy Chowdhury, *ibid.*).

## Dating

The C14 dates by Agrawal & Kusumgar (1965) and Agrawal *et al.* (1966)<sup>1</sup> suggest ca. 4300 to 2000 BP dates for the various burial sites. The Neolithic Phase II burials—including the

trephined Burzahom skull—fall into the 4300–4000 BP time bracket.

## Age, Sex and Skeletal Features

Among the ten Burzahom skeletons, five are of adult males, three of adult females, one of a juvenile and one of a child. The trephined Burzahom skull is of a female aged 26–30 years. All crania are markedly dolichocranic with great calvarial heights and with cranial capacities ranging between 1469 and 1493 among adult males and 1353 and 1413 cc among adult females. Average stature is 169.6 cm. The dental condition of all skeletons is good.

The trephined Burzahom skull has a cranial capacity of 1353 cc. It is longish, ovoid, cryptozygous, and lacks basal crania, including part of the occiput, the greater wing of the sphenoid, the nasal bones and part of the right maxilla. The cranium shows left haemihypertrophy and asymmetry with the left mastoid, orbit and parietal eminence exaggerated, and some deformity of the prelambdaid region. The forehead is low, slightly receding and with a distinct post-glabellar depression. The nasal aperture is pyriform. Occipital squama is protruding and the occiput narrows and converges downward with lambdaid ossicles present at the left lambdaid suture. The cranium is hyperdolichocranic with L/B index 68.7 and hypsicranic with length/auricular height index 64.3. The face is very narrow, with medium height, hyperlepten with superior facial index 57.1. The skull has a gracile look.

## The Affinities of the Burzahom People

The skeletons represent a homogeneous population. Greater proximity is shown towards mature Harappans (Cemetery R37) and towards the modern Punjabi people of northwest India, particularly in the marked dolichocrany and calvarial height, stature and in 'Charles facet' and a 'squatting facet', present, respectively in the distal femora and tibiae.

### The Trepanation at Burzahom

The trepanated skull was first noticed by Alichin & Alichin (1968), but later studied by Roy Chowdhury (1973) and Basu & Pal (1980). The two studies come to different conclusions, the latter questioning the trepanation for medical surgical purposes claimed by the former. The present study is a re-examination of the skull and the arguments of these authors.

Our detailed observations are as follows. The skull shows unambiguous evidence of multiple trepanation. In all, 11 attempts at trepanation are evident on the cranium. Barring a minor depression on the top of the right parietal (no. 11 in Figure 1), all attempts are on the left parietal bone. Depending on the nature and depth of the depressions and holes, we have distinguished at least four successive attempts or stages/sittings in the trepanation of this cranium. There are six completed perforations (nos. 1–6) which represent the final stage of trepanation. All holes are nearly circular or oval in outline, ranging in maximum diameter from 5 to 14 mm. Trepanation was probably begun at the postero-inferior (no. 7) end of the left pari-

etal and at the top of the right parietal (no.11). These depressions are very shallow and elongated where only the outer table of the bone has been removed, probably for the initial treatment of the patient. Then trepanation was attempted (probably in a second sitting) at sites nos. 9 and 10, where the depressions are deeper with the outer table of the bone removed into the diploic space, leaving the inner table intact. The next attempt was made at site no. 8, where a much deeper depression was created, yet a hole was probably not intended as another minor stroke here would clearly punctured the skull. In the final attempt at actual trepanation, six holes were made, apparently in a triangular fashion, three on the inferior and three on the superior parietal region (Figure 2).

Probably, nos. 2, 3 and 5 were made first, followed by nos. 1, 4 and 6. This sequence is speculative, but may be deduced from the nature of the holes: the first three are very neatly and very carefully made, and are almost of the same size and outline. They were, most likely, made by the same instrument, and there are no fracture lines emanating from them. The holes nos. 1, 4 and 6, on the other hand, are bigger



Figure 1. Photograph of the trepanated Burzahom skull, Kashmir, India.

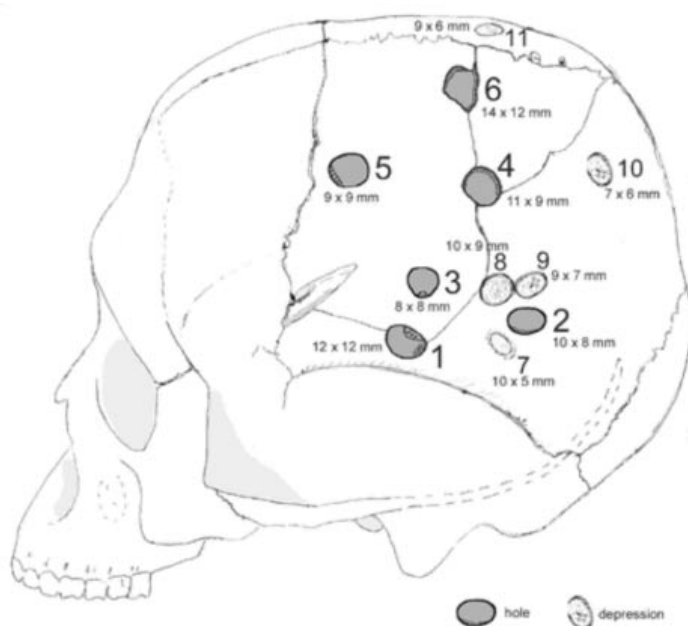


Figure 2. Sketch of the trepanated skull of Burzahom showing the attempted and trepanated sites, 1 to 11.

and were, most likely, made with a different single instrument. It is probable that the later holes were created at the terminal stage, with less care and more force, even blows—the vault was fractured, as is seen from the fracture line connecting the three.

No instruments that could have been used in trepanation were found at the Burzahom site. However, other flint and bone instruments (but no bronze instruments typical of the roughly contemporaneous Indus civilization to the south) have been recovered. It is likely that drills of various diameters were used on the skull, cutting or scraping is less likely. It is an attractive, but purely speculative, thought that at least some of the trepanation on this skull could have been performed by an Indus civilisation surgeon with his own bronze instruments.

It seems that the whole series of operations was performed in quick successive stages of short duration. No clear evidence of osteogenesis and sclerosis is visible inside or outside the punctured holes. Roy Chowdhury, however, believed that there is evidence of a ring of sclerosis (callous) around one hole, unfortunately failing to specify the hole. Basu & Pal (1980) did

not recognize any evidence of sclerosis, and came to the extreme conclusion that it was not a surgical operation either *antemortem* or *post-mortem*. Bone healing or callous formation is expected in an *antemortem* operation if the patient survived for a sufficient time to allow the process of osteogenesis to take place. But, as argued above, the patient probably did not survive the last traumatic operation. Alternatively, the ring of sclerosis which Roy Chowdhury reported, but of which we have found no trace, could have grown during a relatively brief period between operations, and so, be slight enough for its existence to become a matter of opinion. Positive evidence for a surgical operation may be taken if the left hypertropy of the skull is interpreted as an anomaly or cranial disease. We need not necessarily accept the argument of Basu and Pal (*ibid.*) that such anomaly is within the normal range of cranial variation. No similar case has been found in other Burzahom crania. If even the very existence of cranial disease cannot be established without doubt, it is still less likely to establish what symptoms the afflicted owner of the skull would have exhibited. As it is, we can only speculate that the

Burzahom woman with the, at least, slightly abnormal skull may have been insane, epileptic, or otherwise 'different', and such people were regarded with awe and fear in most early societies. As it is, we simply do not know. This is unfortunate, as it would have allowed some general conclusions to be reached on the reasons for this and other trepanations.

Basu & Pal (1980) believe that trepanation at Burzahom was done with a sole purpose of taking out roundels for cranial amulets, to be used for ritual or other votive offerings or magico-religious practices. They draw this inference from parallels in Oceania (Morgan, 1924) and Michigan (Gillman, 1882) and, further, argue that the left portion of the trepanated side of the skull was facing upward and that the skeleton was treated with red ochre. The present authors contest these arguments. Firstly, there is evidence of red ochre treatment in most of the Neolithic Phase II skeletons at Burzahom, not only of humans, but also of animals. As Basu & Pal (*ibid.*, p. 3) themselves note 'a distinctive feature of the human burials of phase II was the use of red ochre on bones of both human and animals'. Another relevant point is that the skeleton of the trephined Burzahom skull SKL7 was in primary articulation, i.e. not disturbed by any agency after burial. Why were six holes cut, and five more left as depressions? Neither the figure 6 nor 11 is known to have had any religious significance in the area, then or now. Not much care is needed for cutting roundels from the skull of a dead person, nor have other trepanated crania been found at Burzahom. If roundels were desired, we would find deep cuts around the circumference of incomplete holes which is not what we find in nos. 7–11. Finally, there is no evidence of prehistoric or contemporary tribal or non-tribal people of northwest India, or of India in general, using cranial roundels as amulets or for other purposes.

The very carefully performed trepanation at Burzahom, with the strong likelihood of several different stages/sittings on a possibly anomalous skull, does, in the opinion of the present authors, argue for a clear case of surgery performed for predominantly medical reasons on a

living person who has not survived the procedure. It should be borne in mind, however, that most primitive societies regard disease as an invasion of spirits, which are usually, but not invariably, thought to be evil. Also, medical and surgical procedures in such societies are so closely intertwined with belief, ritual and magic that they cannot neatly be separated. Cases of mental illness, epilepsy and suchlike are also widely regarded as messengers of the Gods, with the afflicted often given a very special, even sacred, position in society. Trepanation in the case of the Burzahom skull and elsewhere could merely represent the surgical part of a much more elaborate medico-ritual ceremonial procedure of which only the trepanated skull has come down to us.

The skull of the long-suffering Burzahom woman cannot solve the riddle of how the centres of prehistoric trepanation came to use such remarkably similar techniques and procedures, despite the enormous gaps in space and time separating them. But she can, through careful analysis of her skull, help to throw a little bit more light and bring an old scientific question a little closer to a solution.

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### Notes

1. Seven charcoal samples from Burzahom, analysed at Tata Institute of Fundamental Research, Mumbai.

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