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Short Article

Surgical Instruments in the Taxila Museum

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There is substantial historical evidence to support the prevalence of surgical practice during ancient times in the subcontinent of India. However, in contrast to the contemporaneous Greek and Roman periods, there is a notable absence of any archaeological finds in the form of surgical instruments. Inquiries to major museums and personal contacts have not been fruitful. This lack of relevant archaeological evidence of surgery in this part of the world is surprising. It cannot be explained by climatic conditions alone, since museums are full of metal objects that were excavated in a reasonably preserved state. Girindranath Mukhopadhyaya has commented, "as far as I have been able to trace, our museums contain no finds supplying us with any information".[1] Acknowledging a complete absence of any archaeological finds, his monograph relies on numerous illustrations of surgical instruments and compares these with modern instruments copied from various catalogues of the period. This paper reports on one exceptional archaeological site where surgical instruments and other medical equipment have been discovered; it was also a known seat of medical education.

Taxila is one of the most important archaeological sites in the subcontinent. It is situated about 20 km north of Pakistan's capital, Islamabad. The original archaeological survey and excavations were carried out before the Second World War by Sir John Marshall (1876–1958), who meticulously recorded the discoveries and historical details in three volumes.[2] The excavations continue, yet even such prolonged activity has not uncovered all that is still hidden under the earth. The archaeological sites comprise three main townships and many smaller ruins, scattered in a radius

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[1] G Mukhopadhyaya, *The surgical instruments of the Hindus with a comparative study of the surgical instruments of the Greek, Roman, Arab, and the modern European surgeons*, ed. J B Khanna, New Delhi, R K Naahar, 1977, p. iv.

[2] J Marshall, *Taxila: an illustrated account of archaeological excavations*, 3 vols, Cambridge University Press, 1951. Vol. 1 deals with the history of the region and the discovered towns, vol. 2 with archaeology, and vol. 3 contains pictures of the sites and the excavated objects. See vol. 2, pp. 570, 577, 595, 599, and 601, for the quotations and objects discussed in this article.

of about 10 km. The earliest site is Bhir Mound, which, as revealed by recent excavations, was built on a Stone Age settlement. The second is a Greek town called Sirkap, and the third only partially excavated site is a Kushan settlement called Sirsukh.

Taxila gained importance and prosperity because of its strategic position on the main trade routes. It is mentioned in the ancient texts with its original name Takṣāśilā.[3] The Greeks gave it the present name of Taxila. When Cyrus expanded his empire, around 560 BC, Taxila came under Persian control. Herodotus tells us that it was the twentieth and richest province in the empire of Darius I.[4] In 326 BC Alexander came to Taxila, received a lavish welcome, and stayed to rest and replenish supplies for his army. Within a decade of his death, Taxila was under the Mauryan dynasty, and Aśoka made it a great centre of Buddhism, which was exported to China and beyond. After the decline of Mauryan power, Taxila remained under the Bactrian Greeks, Parthians, Sakas and Kushans, respectively for more than 400 years. According to legend, the Apostle Thomas brought his mission to the court of Gondophares, king of Taxila.[5] In the early fifth century AD, Taxila was sacked, burnt and thoroughly destroyed by the Huns, probably the descendants of Hsiung-nu people from Central Asia. Earthquakes caused further extensive physical damage that buried the city until its discovery in the late nineteenth century.

Some Buddhist sacred books have described Taxila as a place of learning or a university town.[6] Its standing as a centre of excellence for medical education is well documented.[7] Among the legendary medical personages associated with Taxila, Ātreya and his pupil Jīvaka are frequently mentioned in ancient medical literature.[8] A number of jātakas pay homage to Jīvaka, who rose to become physician to the Buddha.[9] Another renowned figure is Caraka, who is best known as the compiler of *Caraka Saṃhitā*.[10] According to modern medical historians, the *Caraka Saṃhitā* tradition has been associated with Taxila.[11] Caraka flourished during the reign of Kanishka, who ruled from 100 to 126 AD, and is also known to have laid the foundations of Sirsukh, the third settlement in Taxila. The discovery of surgical instruments at this ancient seat of medical education offers additional and unequivocal validation of its standing in surgical practice.

All the metal objects discovered in Taxila were analysed and the results recorded. The instruments that are the subject of this paper were made of almost pure copper.[12] Copper smelting was known in the region and, according to Marshall, "metallurgical

[3] H Raychaudhuri, *Political history of ancient India,* Delhi, Oxford University Press, 1996, pp. 54–9.

[4] Herodotus, *The history*, tr. D Grene, University of Chicago Press, 1987, Bk 3, p. 94.

[5] J N Farquhar, 'The Apostle Thomas in North India', *John Rylands Library Bulletin*, 1926, pp. 80–111.

[6] T W Rhys Davids, H Oldenberg, *Sacred books of the east*: *The Mahavagga*, Oxford, Clarendon Press, 1882, pp. 184–7.

[7] R K Mookerji, *Ancient Indian education*, London, Macmillan, 1947, pp. 468–78.

[8] G J Meulenbeld, *History of Indian medical literature*, 3 vols, Groningen, Egbert Forsten, 1999, vol. 1A, pp. 126–7, 693.

[9] V Fausbøll, *The Jātaka: together with its commentary, being tales of anterior births of Gotama Buddha*, 7 vols, tr. T W Rhys Davids, London, Trübner, 1877–97, p. 175.

[10] Meulenbeld, op. cit., note 8 above, vol. 1A, pp. 120–3.

[11] R Porter, *The greatest benefit to mankind*, London, HarperCollins, 1997, p. 138.

[12] Marshall, op. cit., note 2 above, vol. 2, p. 577.

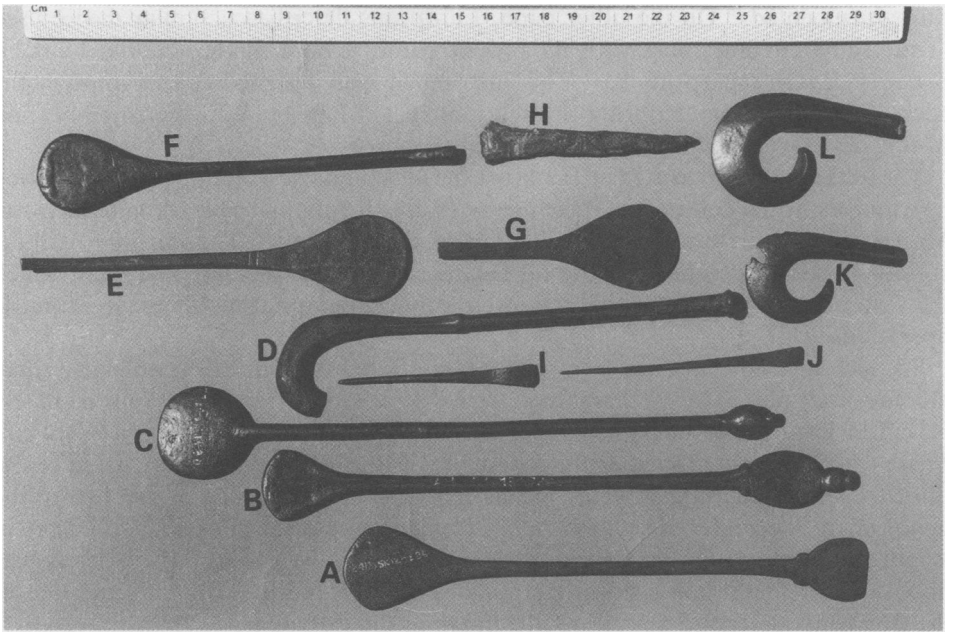

Figure 1: Group of instruments exhibited at the Taxila Museum.

skill had reached a high level".[13] A large number of other copper objects were also excavated, which are exhibited in the Taxila Museum. This small museum, rich in the quality of its exhibits, is the only place in the subcontinent where we can see excavated surgical instruments.

Probably the earliest surgical instruments ever discovered belong to the Aegean civilization (1400 BC) and were made of bronze.[14] Many copper-alloy and iron instruments of Greek origin, and much more refined and complex Roman instruments, may be seen in a number of European museums; some of these will be compared with the instruments discovered in Taxila.

In all, thirteen objects are displayed in the Taxila Museum under the heading of surgical instruments, twelve are illustrated in Figure 1. The one not included is the fragment of a handle of some unknown object. Another of the exhibits (Figure 1: C) is not a surgical instrument, but a device used during offerings to the gods.[15] An account of the remaining eleven instruments follows.

Decapitators

A "decapitator" is a modern term, introduced by British authors during the nineteenth century; their descriptions of and modifications to this instrument are

[13] Ibid., vol. 2, p. 570.

[14] R Arnott, 'Surgical practice in the prehistoric Aegean', *Medizinhist. J.*, 1997, **32**: 249–78.

[15] Marshall, op. cit., note 2 above, vol. 2, p. 595.

fully documented.[16] On the other hand, Europeans described a similar device used in the same circumstances with its ancient name, a hook knife, embryo hook or *Scharfer Haken* (sharp hook).[17] This instrument was designed to cut through the neck of the dead foetus during severely obstructed labour. A further modification of this device is a saw-tooth edge at the inner border.

The decapitators excavated in Taxila are the most important, unique and interesting instruments in the collection. Their use as such is highly plausible, despite Sir John Marshall's own archaeological evaluation of these objects: "The purpose of these curious-looking instruments is by no means certain, but the accepted view, which the writer does not share, is that they were surgical decapitators for use in obstetric operations".[18]

Six such instruments were excavated and are listed in Marshall's catalogue; three are not on display. Two of these three were discovered as fragments, approximately 5.5 cm in length, and made of copper sheeting strengthened with copper-wire rib. These fragments were found at the oldest site of Bhir Mound and were dated to the third to second century BC. This means that such a device was in use before the invasion of Alexander. The third was excavated complete, measuring 17.5 cm in length, and made of solid copper with a round handle ending in a disc. It was discovered at the Sirkap site and pertains to the first century AD. This and one of the fragments described above are illustrated in the catalogue.

Of the other three in the display, two lack handles (Figure 1: K and L), although both are shown in Marshall's account with handles, which must have been lost at some later stage. Including the handles, their length was recorded as 16.5 cm, without them, they measure about 6 cm and 7.5 cm respectively. They were discovered at two different sites in Sirkap. Both of these blades appear to be distorted, presumably due to ageing and metal stress. One clearly shows a crack at the outer edge in the line of stress (Figure 1: K) and was dated to the early first century BC; the other slightly bigger one was found in layers of the first or second century AD (Figure 1: L).

The sixth decapitator is almost complete and is a robustly constructed instrument of solid copper (Figures 1: D, and 2). It was discovered in the second stratum at Sirkap, dating to the first century AD. This distinctive instrument is 16.5 cm long, with a strong round handle, terminating in a disc; its curved blade is sharp inside and blunt outside. The blade shows considerable damage and loss at the end (Figure 3), it also differs slightly in shape from the two fragments discussed above. The handles of all such instruments, irrespective of their period, have some unique common features: they are made of solid copper, uniform in length, round in cross section and terminate in a disc.

There is abundant historical evidence to support the use of a sharp embryo hook knife or decapitator in specific circumstances. The following statement is found in

[16] B Hibbard, *The obstetrician's armamentarium*, San Anselmo, CA, Norman Publishing, 2000, pp. 254–9.

[17] W Kuhn, U Tröhler (eds), *Armamentarium obstetricium Gottingense*, Gottingen, Vandenhoek and Ruprecht, 1987, p. 119.

[18] Marshall, op. cit., note 2 above, vol. 2, pp. 599–601.

Figure 2: An embryo knife or a decapitator excavated at Taxila.

the *Suśruta Saṃhitā*, where a full chapter is devoted to the management of obstructed labour and surgical removal of the dead foetus.

An intelligent physician should not waste a single moment in drawing out the foetus, as soon as it would be found to be dead in the womb, since neglect in such cases leads to the instantaneous death of the mother, like an animal dying of suffocation. An erudite physician, well versed in anatomy, should use in such cases a mandalāgra instrument for the purpose of cutting out (the foetus), since a sharp-edged vṛddhi-patra may some times hurt the mother during the operation.[19]

The "maṇḍalāgra" has been described as a decapitator by a later author.[20] Caraka mentioned an operative procedure for extracting the dead foetus, in the chapter *Śārīrasthāna* of the *Caraka Saṃhitā*, but without naming a special instrument.[21]

In his book *De medicina*, the Roman medical writer, Aulus Cornelius Celsus (early to mid first century AD), described a sharp hook knife and the use of such an instrument to sever the neck of the dead foetus:

[19] K K Bhishagratna (ed. and tr.), *Suśruta Saṃhitā*, 3 vols, Varanasi, Chowkhamba Sanskrit Series Office, 1981, vol. 2, p. 407. The reference is to *Surśuta Saṃhitā*, *Cikitsāsthāna*, ch. 15, verse 16.

[20] K Das, *Obstetric forceps: its history and evolution*, Leeds, Medical Museum, 1993 (first published in 1929), p. 9. See also Mukhopadhyaya, op. cit., note 1 above, p. 174.

[21] A C Kaviratna, P Sharma (eds and trs.), *Caraka Saṃhitā*, Delhi, Sri Satguru Publications, 1996, p. 524. The reference is to *Caraka Saṃhitā*, *Sārīrasthāna*, ch. 8, verse 31.

Figure 3: The same embryo knife or decapitator as in Figure 2, showing corrosion at the end of the blade.

The remedy then is to cut through the neck, in order that the two parts may be extracted separately. This is done with a hook, which resembles the one mentioned above, but has all its inner edge sharp. Then we must proceed to extract the head first, then the rest.[22]

Soranus of Ephesus (AD 98–138), the earliest writer on obstetrics and gynaecology, recommended embryotomy and the use of hooks to extract the dead foetus.[23] Paul of Aegineta (seventh century AD), who followed Aetius of Amida (sixth century AD), also recommended embryotomy in a similar situation, without mentioning a special instrument.[24] During the tenth century AD, Albucasis gave details of a hook and a variety of special knives for embryotomy during obstructed labour when foetal death had occurred.[25]

Archaeological evidence of comparable Roman instruments is useful in evaluating those found at Taxila. An embryo hook discovered at Pompeii was first described

[22] W G Spencer (ed. and tr.), *Celsus De medicina*, London, William Heinemann, 1938, pp. 459–60.

[23] O Temkin (tr.), *Soranus' Gynecology*, Baltimore, Johns Hopkins University Press, 1956, pp. 189–96.

[24] F Adams (tr.), *The seven books of Paulus Aegineta*, 3 vols, London, Sydenham Society, 1844–47, vol. 1, p. 648.

[25] M S Spink, G L Lewis (tr.), *Albucasis on surgery and instruments*, London, Wellcome Institute of the History of Medicine, 1973, pp. 492–3.

and illustrated by Vulpes in 1847.[26] Its handle was of copper alloy, its hook of iron, and it was originally 17 cm long; its present length after damage is 7.7 cm. Bliquez lists the same instrument along with five other embryo hooks in his catalogue of Roman surgical instruments.[27] All are exhibited at the National Archaeological Museum of Naples. Unfortunately only their handles have survived and none retains the hook. These Roman instruments are all blunt type embryo hooks and it seems that no sharp embryo hook of Roman origin as described by Celsus has ever been identified. A mysterious illustration of a sharp hook is a source of confusion due to the ambiguous account by Milne, "a knife on this principle is in the Bibliothèque Nationale".[28] The legend under the illustration reads, "after Védrènes". This is a reference to the French translation of *De medicina* by A Védrènes, published in 1876.[29] The book contains many pictures of Roman instruments from Pompeii, including the embryo hook Vulpes listed, but no sharp hook similar to Milne's illustration is depicted anywhere.

The German scholar, Ernst Künzl, has illustrated an instrument from the Byzantine period, in the collection at Jena, labelled *Großer Haken*.[30] It is not a sharp hook, though it appears remarkably similar to the instrument from Taxila.

Some of the references and quotes discussed above clearly suggest that embryotomy was practised in ancient times, and, in desperate circumstances, a hook knife, sharp inside and blunt outside, was employed to facilitate delivery of a dead foetus. The instrument from Taxila appears to fit the description (Figure 2).

Decapitators have been used even in modern obstetrics and were listed in British surgical instrument catalogues until the middle of the twentieth century under the names "Ramsbottom's Decapitating Hook" and "Jardine's Decapitating Hook" (Figure 4).[31] These modern 30 cm long instruments were sharp inside, blunt outside, and strongly made. It is astonishing that this device remains virtually unchanged, and has been used and repeatedly mentioned by surgeons of different civilizations for almost 2000 years.

Probes

Three objects displayed in the Taxila Museum may have a surgical application as probes (Figure 1: H, I and J). Although they show no striking similarities with documented Greek or Roman probes, they still resemble them.[32] Two are finely made and in good condition (Figure 1: I and J), about 9 cm and 7 cm long. The third is

[26] B Vulpes, *Illustrazione di tutti gli strumenti chirurgici scavati in Erolano e in Pompei*, Napoli, Stamperia Reale, 1847, p. 81.

[27] L J Bliquez, *Roman surgical instruments and other minor objects in the National Archaeological Museum of Naples*, Mainz, Verlag Philipp von Zabern, 1994, pp. 129–30.

[28] J S Milne, *Surgical instruments in Greek and Roman times*, Oxford, Clarendon Press, 1907, p. 154.

[29] A Védrènes (tr.), *Traité de médecine de A.C. Celse*, Paris, G Masson, 1876.

[30] E Künzl, *Medizinische Instrumente aus Sepulkralfunden der römischen Kaiserzeit*, Cologne, Rheinland, 1983, p. 52.

[31] C F Thackray, *Catalogue of surgical instruments and appliances*, Leeds, C F Thackray, 1935, p. 117.

[32] L J Bliquez, *Roman instruments and minor objects in the university of Mississippi*, Götenborg, Paul Åstroms, 1988, p. 74.

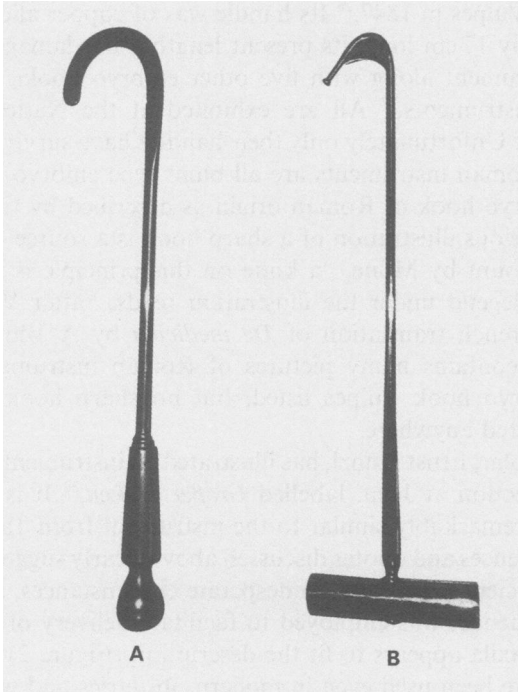

Figure 4: Modern decapitators. A: Ramsbottom's decapitating hook; B: Jardine's decapitating hook (Thackray Medical Museum, Leeds).

thicker and badly damaged (Figure 1: H), measuring 6.5 cm, and may not have a surgical application. All are made of pure copper and may have had wooden handles. The date and site of excavation of these probes cannot be ascertained as they are not included in Marshall's catalogue and were probably discovered after the original excavations. It has been suggested that the puncturing or lancing of boils is alluded to in the *Vedic* literature.[33] It is a reasonable assumption that pointed probes were developed later for various surgical uses.

Spatulae

Marshall listed five spatulae under surgical instruments.[34] All bear a decoration of typical Buddhist design at the end of the handle. One illustrated in his catalogue has a heart shaped hole in the blade, the other two are missing. The remaining two in the display are similar (Figure 1: A and B), having flat, oval blades measuring 22 cm and 20 cm respectively. All the spatulae were found at Sirkap, in layers associated with the first or second century AD. In size and shape, items A and B are

[33] K G Zysk, *Religious medicine: the history and evolution of Indian medicine*, New Brunswick, Transaction Publishers, 1993, p. 227.

[34] Marshall, op. cit., note 2 above, vol. 2, p. 600.

comparable with Roman spatulae, excavated in large numbers and seen in many museums and collections.[35] However, their use in some religious rites cannot be ruled out.

There are another three objects among the exhibits (Figure 1: E, F and G), these are not listed, dated or described in the catalogue, and must have been discovered during later excavations. Two are similar in shape and size (Figure 1: E and F) about 13.5 cm and 14.5 cm in length, the third (Figure 1: G) has a shorter handle of 9 cm. All three are made of copper, and have rounded blades of equal size. Their handles are plain and lack any features or decoration, and are square in cross section, quite unlike those of the decapitators and spatulae. They resemble an 11 cm long instrument, listed by Milne as a tongue depressor.[36] In shape, design and weight they are totally different from many domestic appliances exhibited in the museum and it is difficult to imagine these had any domestic or trade application. One can only speculate that these esoteric objects may have been used as ointment applicators, tongue depressors or retractors.

Among those objects not on display (many are kept in the depository) but included in the catalogue, a few may have a surgical application. A copper forceps about 8 cm long looks similar to Greek or Roman forceps. This is made from a single long strip of copper, which is bent in the middle giving a springy quality, a ring below the loop further strengthens its stability. It was found in stratum II (early first century BC), in the Greek town of Sirkap. The surgical use of this forceps cannot be established with certainty, but it is listed under surgical instruments, while others made of iron are described as tweezers and listed elsewhere.

Under the heading "iron objects", the catalogue shows a few badly damaged knives, which might be razors or domestic knives. Razors, however, were used for surgical operations. A French team of archaeologists excavated, among other medical artefacts, a scalpel at a site in Afghanistan contemporary with Taxila during the reign of Kanishka.[37] This object is not similar to a typical Roman surgical knife, but, since it has a blade at one end and an olivary probe at the other, it could have been used in ancient surgery.[38] If it had a surgical application then it is the only scalpel ever discovered outside the Greek and Roman civilizations. Its existence in the same period as some of the instruments discovered in Taxila offers convincing evidence that surgical instruments were designed and manufactured in the region.

Needles for suturing wounds were used in antiquity.[39] In Taxila, needles for domestic use were excavated, but Marshall has catalogued under surgical instruments three needles that were discovered at the earliest township of Bhir Mound in stratum

[35] R Jackson, 'Roman doctors and their instruments: recent research into ancient practice', *J. Roman Archaeology*, 1990, **3**: 5–27.

[36] Milne, op. cit., note 28 above, p. 79.

[37] O Guillaume, A Rougeulle, *Fouilles D'Aï Khanoum*, Paris, De Boccard, 1987, Pl. XI (6).

[38] R Jackson, curator of Romano-British collections, British Museum, London, personal communication, Jan. 2002.

[39] T A Wise, *Commentary on the Hindu system of medicine*, Calcutta, The Baptist Mission Press, 1845, p. 171. See also *Suśruta Saṃhitā*, *Sūtrasthāna*, ch. 8, verses 3–4, on needles.

IV belonging to the third or second centuries BC.[40] They are 5 cm to 7 cm in length, and made of copper with a rounded eye.

In addition, there are many implements such as weighing pans, pestles and mortars, medicine jars, condensers, and a peculiar looking pottery object with four spouts, which may be an inhaler. Some of these must have been used to weigh, manufacture, store or dispense pharmaceutical agents. These objects deserve further investigation.

[40] Marshall, op. cit., note 2 above, vol. 2, p. 601.