1

Surgery in prehistoric times

The word 'surgery' derives from the Greek cheiros, a hand, and ergon, work. It applies, therefore, to the manual manipulations carried out by the surgical practitioner in the effort to assuage the injuries and diseases of his or her fellows. There seems no reason to doubt that since Homo sapiens appeared on this earth, probably some quarter of a million years ago, there were people with a particular aptitude to carry out such treatments. After all, there is an innate instinct for self-preservation among all mammals, let alone man, so that a dog will lick its wounds, limp on three limbs if injured, hide in a hole if ill and even seek out purging or vomit-making grasses and herbs if sick.

We are talking about times many thousands of years before written records were kept and, indeed, evidence of disease or injuries to soft tissue of that period has long since rotted away with the debris of time. Palaeopathologists (students of diseases in the long distant past) have, however, uncovered abundant evidence in excavations of ancient skeletons that fractures, bone diseases and rotten teeth tortured our oldest ancestors. Of course, animals were also subject to all sorts of diseases. Indeed, a bony tumour was obvious in the tail vertebrae of a dinosaur that lived millions of years ago in Wyoming. Other excavations also reveal that injuries were inflicted by man upon man (Figures 1.1, 1.2) and, as we shall see, that broken bones were splinted and skulls operated upon.

We can make a reasonable guess at what primitive healers may have done from studies carried out by anthropologists and ethnologists (students of primitive tribes) who, at around the beginning of the 20th century, carried out detailed studies of communities as far apart as West and Central Africa, South America and the South Pacific who had never had contact with 'modern' man. It is surely reasonable to surmise that treatments found in such communities, often amazingly similar in very different parts of the world, might well match the care given by our prehistoric ancestors in man's fundamental instincts of self-preservation. The assumption might be wrong but it would require a great deal more research before a distinction between 'modern' primitive and prehistoric medical and surgical treatments could be made. It goes without saying that these early studies are immensely valuable to us today since few if any primitive communities nowadays remain untainted by Western civilisation.

Injuries inflicted by falls, crushings, savage animals and by man upon man, demand treatment; among primitive tribes in the aforementioned studies, open wounds were invariably covered by some sort of dressing. This might take the form of leaves, parts of various plants, cobwebs (which may well have some blood-clotting properties), ashes, natural balsams or cow dung (Figure 1.3). Indeed, even in recent times, the use of dung as a dressing for the cut umbilical cord in West African village babies still took place and was responsible for many cases of 'neonatal tetanus' – lockjaw in babies – from the tetanus spores that are almost invariably present in faeces.

Among the Masai of East Africa, wounds were stitched together by sticking acacia thorns along

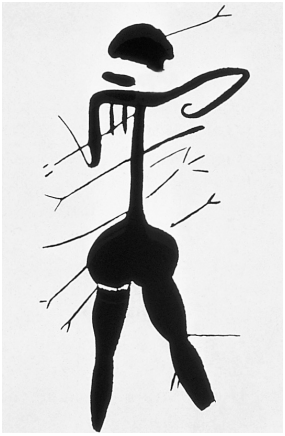

Figure 1.1 A warrior pierced with eight arrows. Drawn from a rock painting in eastern Spain, and probably the first portrayal of wounding.
Reproduced from Majno G: *The Healing Hand*. Harvard University Press, 1975.

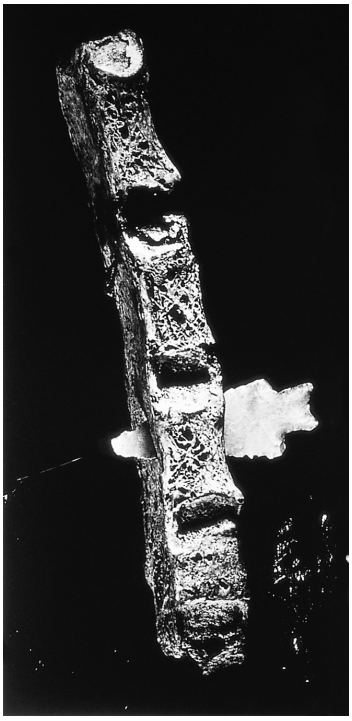

Figure 1.2 A flint arrow head embedded in the human sternum. From the Chubut Valley, Patagonia. Musée d'Homme, Paris.

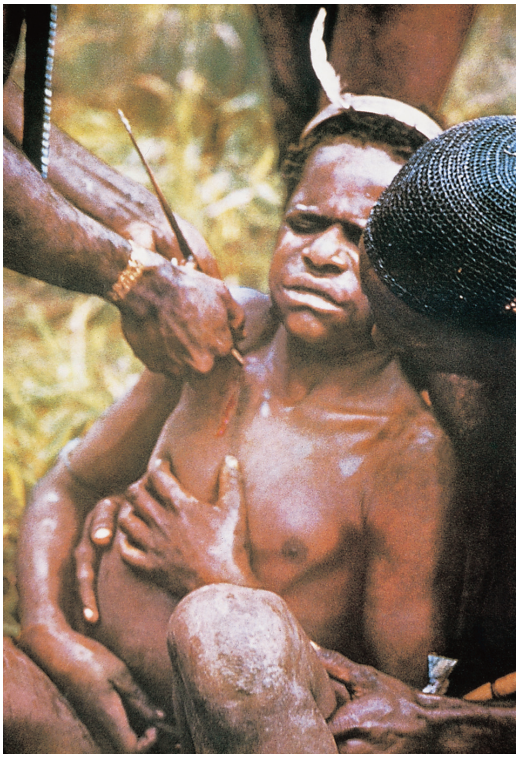

Figure 1.3 A warrior in Borneo, hit in the chest by an arrow, is treated by a healer. This photograph was taken some 30 years ago.

the two edges of a deep cut and then plaiting the thorns against each other with plant fibre. In both India and South America termites or beetles were employed to bite across the edge of the wound whose lips were held together by the surgeon. The bodies of the insects were then twisted off, leaving the jaws to hold the laceration closed, remarkably like the metal skin clips employed in operating theatres today. Splints of bark or of soft clay (which was then allowed to set) were used to immobilise fractured limbs, and such bark splints have been excavated from ancient Egyptian burial sites (Figure 1.4).

Apart from dealing with wounds and fractures, early surgeons carried out three types of operative procedure, namely cutting for the bladder stone,

circumcision and trephination of the skull. Cutting for the stone is such a fascinating and important topic in the history of surgery that it merits a chapter of its own (see Chapter 12).

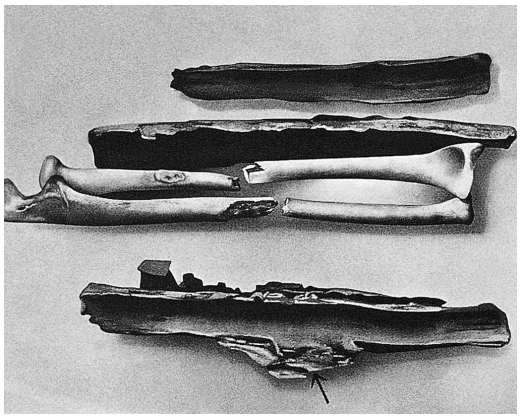

Figure 1.4 Fractured forearm bones with bark splints, from Egyptian excavation and dated about 2450 BC. Note the blood-stained lint dressing (arrowed), the oldest specimen of blood.
From Majno G: *The Healing Hand*. Harvard University Press, 1975.

Circumcision

Circumcision might well be claimed to be the most ancient 'elective' operation and was practised in Ancient Egypt by assistants to the priests on the priests and on members of Royal families. There is remarkable evidence for this carved on the tomb of a high-ranking royal official which was discovered in the Sakkara cemetery in Memphis and is dated between 2400 and 3000 BC (Figure 1.5). This represents two boys or young men being circumcised. The operators are employing a crude stone instrument. While the patient on the left of the relief is having both arms held by an assistant, the other merely braces his left arm on the head of his surgeon. The inscription has the operator saying 'hold him so that he may not faint' and 'it is for your benefit'.

The ancient Jews may have learned the art of circumcision during their bondage in Egypt and, indeed, circumcision is the only surgical procedure mentioned in the Old Testament, the practice of circumcision among Jews being attributed to Abraham. In the book of Genesis (17;1–2), probably written about 800 BC, we read: 'This is the covenant

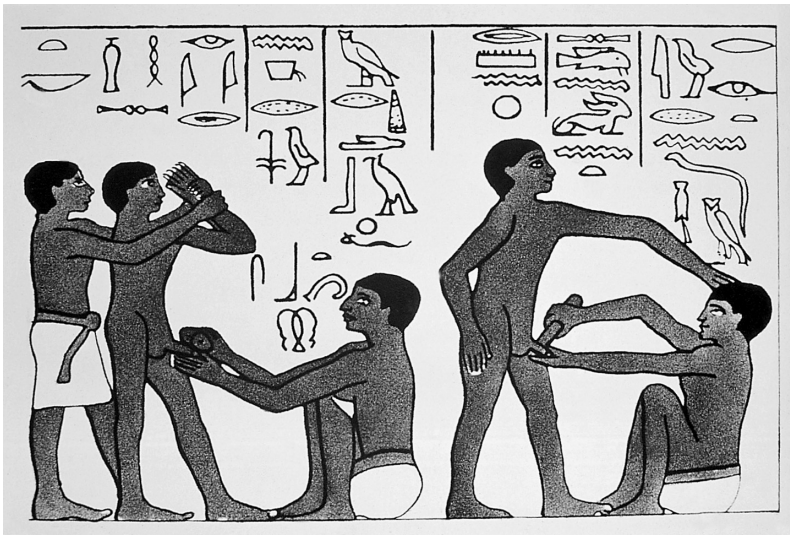

Figure 1.5 Drawing of a tomb carving of a circumcision scene. Sakkara cemetery at Memphis, Egypt, c. 2400–3000 BC.

between me and you and your seed which you must obey; all males among you shall be circumcised.' Again, in the second book of Exodus, Zipporah, the wife of Moses, 'took a sharp stone and cut off the foreskin of her son'.

Early ethnological studies revealed that circumcision was practised very widely among primitive communities, including those of equatorial Africa, the Bantus, Australian Aborigines and in South America and the South Pacific, as well as being traditional among Jews, Muslims and Copts. We can only guess at its origins, perhaps as a fertility or initiation rite or possibly for cleanliness or hygiene. Its traditional basis is confirmed by the fact that in many communities, even though metal instruments were available, the operation was still performed with a flint knife.

Trephination of the skull

Undoubtedly the most extraordinary story in the history of surgery is that, long before man could read or write, as long ago as 10000 BC, surgeons were performing the operation of trephination or trepanning – boring or cutting out rings or squares of bones from the skull – and, just as remarkably, their patients usually recovered from the procedure.

Although the words 'trepanation' and 'trephination' today are interchangeable in common practice, trepanation comes from the Greek trypanon, meaning a borer, while trephination is of more recent French origin and indicates an instrument ending in a sharp point, so that this implies using a cutting instrument revolving around a central spike. Trepanation thus connotes scraping or cutting, while trephination describes drilling the skull, as in modern neurosurgical operations.

Different techniques of trepanation in ancient times, and in recent primitive communities, involved scraping away the bone, making a circular groove so that a central core of the bone would loosen, boring and cutting away the bone, or making rectangular intersecting incisions in the skull (Figures 1.6, 1.7).

This story begins in 1865 when a general practitioner, Dr Prunires, who was also an amateur archaeologist, discovered in a prehistoric stone tomb in Central France a skull which bore a large artificial opening on its posterior aspect. With it, he found a number of irregular pieces of bone which might have been cut from another skull.

Figure 1.6 Trephined skull, from an Anglo-Saxon skeleton excavated in East Anglia.

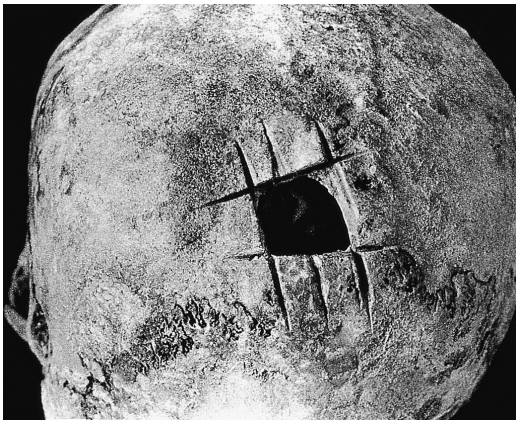

Figure 1.7 Trepanned skull from ancient Peru. The operation has been performed by means of a series of incisions placed at right angles to each other.

He postulated that the skull had been perforated so that it might be used as a drinking cup. Soon after this, a number of other holed skulls were found in other parts of France and Professor Paul Broca (1824–1880), a distinguished French physician, suggested that these openings were the result of an operation of trepanation and that the instrument employed was a flint scraper. Broca suggested that survivors of the operation were endowed with mystical powers and that, when they died, portions of their skulls, especially those that included a part of the edge of the artificial opening, were in great demand as charms.

Following these discoveries, thousands of such specimens have been discovered from many parts of the world: the United Kingdom (Figure 1.6), Denmark, Spain, Portugal, Poland, the Danube Basin, North Africa, Palestine, the Caucasus, all down the Western coastline of the Americas and, especially, in Peru (Figure 1.7), where more than 10000 specimens have been excavated.

Two questions immediately come to mind: why was the operation performed, and how? In many cases it seems that trephination was carried out on patients following a head injury. We can see an obvious fracture line on many specimens, often coinciding with, or near, the site of the trephine defect. We can be sure that many such patients recovered because numerous specimens show clear evidence of healing of the fracture and of the edges of the trephined defect. The frequent use of stone clubs and sling stones among ancient warring Peruvians may account for the large numbers of specimens recovered from that country; in one collection of 273 skulls from Peru, 47 had been trephined in from one to five places. We can only guess at the frequent use of trephination in skulls with no obvious evidence of injury. In many of these, indeed, the operation had obviously been performed several times at intervals. Intractable headaches, epilepsy or an attempt to confer mystical powers on the subject are all possible motives, and there seems little doubt that the fragments of bone removed were themselves often regarded as possessing magical powers.

Of course, the operation was performed without the benefit of anaesthesia, although authorities have surmised that an extract of the coca plant might have been used by the ancient South American practitioners. The instrument would originally have been a sharpened flint or piece of obsidian, (a hard black laval stone), fastened by cord to a wooden handle. These were later replaced by a copper or bronze blade. Techniques varied from place to place: a circular cut through the skull bone, a series of circular drill holes which were then joined together, or triangular or quadrangular cuts through the skull bone. Professor Broca, who we have mentioned above, using an ancient flint instrument, showed that he could produce such a defect in a skull in 30 to 45 minutes. Even more remarkably, in 1962, Dr Francisco Grana of Lima operated on a 31-year-old patient, paralysed after a head injury, and evacuated a blood clot from beneath the skull using ancient Peruvian chisels to trephine the bone. The patient recovered.

Our knowledge of prehistoric trephination would remain mainly a matter of conjecture if it were not for the fact that the operation was still being performed by primitive races in some widely separated parts of the world, the South Pacific, the Caucasus and Algeria, at the end of the 19th and in the early 20th century. From New Guinea and the surrounding islands of Melanesia many skulls have been collected which show perforations very similar to those found in stone age specimens. Writing in 1901, the Reverend J A Crump noted that in New Britain the operation was only performed in cases of fracture, which was a common injury in tribal warfare. The instrument employed was a piece of shell or obsidian and the wound was dressed with strips of banana stalk, which is very absorbent. The mortality was about 20%, but many of the deaths resulted from the original injury rather than from the operation itself. In other islands, the operation was performed to cure epilepsy, headache and insanity, while in New Ireland, an island north of New Guinea, a large number of natives had undergone trephination in youth as an aid to longevity. In The Lancet of 1888 there is an account of

the practice of trephining in the Caucasian province of Daghestan, on the borders of the Caspian Sea. Here it was carried out for head injuries and it is interesting that it was the aggressor who was obliged to pay the surgeon for the operation. In 1922 Hilton-Simpson published a book about his four visits to the Aures Mountains in Algeria, where he was able to study the work of local surgical practitioners. Here knowledge was passed from father to son and the surgeons carried out splinting of fractures, reduction of dislocations, circumcisions and lithotomy for stones in the bladder. Trephination was commonly performed, always as a treatment of some form of head injury. The operation comprised the removal of a circular portion of scalp with a cylindrical iron punch heated red-hot and then cutting an opening in the skull by the use of a small drill and a metal saw. Great care was taken not to damage the underlying coverings of the brain, the dura mater.

The question that remains unanswered is how was it that this sophisticated neurosurgical operation came into being so long ago, in such widely separated centres, in communities that surely could have had no possible contact, indeed even knowledge of each other? This is a question that will continue to be debated but will probably never be answered.

Cutting for the stone

This, the third and perhaps most interesting, of these 'primitive' procedures, deserves a chapter of its own, (see Chapter 12).

2

The early years of written history – Mesopotamia, Ancient Egypt, China and India

Mesopotamia

Civilisation as we recognise it today, with cities, organised agriculture, government and a legal system, dates back some 6000 years to the Valley of the Nile and the adjacent land of Mesopotamia between the Tigris and Euphrates. Above all, man learned to write, and translations (an extremely difficult task) of carvings on stone, statues and tombs and writings on baked clay from Mesopotamia and papyri from ancient Egypt give us a much clearer idea of what medicine and surgery must have been like in those times.

The Tigris flows for 1200 miles from the mountains of Armenia to the Persian Gulf. The Euphrates, even longer, runs roughly parallel to its twin. These unpredictable rivers may overflow their banks as the Armenian snow melts in Spring and floods vast areas of land – probably the basis of the story of the Flood in Genesis, a story repeated in much ancient folk lore. At around 4000 BC there arose in this region the highly developed civilisation of Sumeria, with city states of Kish, Lagash, Nippur, Uruk, Umma and, best remembered of all, Ur. In these cities dams were built, surrounding fields irrigated, taxes levied and a picturograph script invented, which was somewhat similar to that developed in Egypt. This primitive writing developed into a script that could be incised onto clay tablets. On clay it is easier to produce lines rather than curves, and the wedge shape of the script gave its name to cuneiform writing, which comprised some 600 signs.

Great kings arose, such as Sargon of the city of Akkad (around 2350 BC), who subjugated the whole of Sumeria and Hannurabi (around 1900 BC), who established his capital at Babylon. In time, Babylon was conquered by Tiglath-Pileser, king of the northern neighbour Assyria, with its capital at Nineveh around 1100 BC. The power of Babylon remained until, in 539 BC, it gave way to the rise of the Persian Empire.

The medicine of Mesopotamia was primarily medico-religious. Practitioners were priests and were ruled by the strict laws included in the code of King Hannurabi. This code, carved on a black stone about eight feet high which was discovered at Shush in what is now Iran in 1901, can be seen today in the Louvre Museum in Paris. At its top can be seen the Emperor Hannurabi receiving the laws from the sun god Shamash (Figure 2.1). His code details family law, the rights of slaves, the penalties for theft and the rewards for success and the severe punishment for failure on the part of the surgeon. We have evidence from these writings that surgical conditions such as wounds, fractures and abscesses were treated. Thus we read:

> If a doctor heals a free man's broken limb and has healed a sprained tendon, the patient is to pay the doctor five shekels of silver. If it is the son of a nobleman, he will give him three shekels of silver.
>
> If the physician has healed a man's eye of a severe wound by employing a bronze instrument and so healed the man's eye, he is to be paid ten shekels of silver.
>
> If a doctor has treated a man for a severe wound with a bronze instrument and the man dies and if he has opened the spot in the man's eye with the instrument of bronze but destroys the man's eye, his hands are to be cut off.

Figure 2.1 The code of King Hannurabi.
Louvre Museum, Paris.

It was obviously a dangerous profession in those days!

If it were not for Hannurabi's code of laws, all memory of surgery in Babylon, nearly 4000 years ago, would have been lost. Surgery as a craft was hardly worth mentioning; only when it became of interest to the law was it engraved in stone.

Ancient Egypt

The influence of Sumerian civilisation upon that of Egypt is a subject of interesting and continuing

Figure 2.2 Imhotep (c. 2900 BC), the first named physician.
Louvre Museum, Paris.

debate, but certainly as long ago as 4000 BC there was a well organised governmental system in the Nile delta. With it came the development of the pictorial writing of hieroglyphics and the discovery that writing material could be prepared from the papyrus reed, a more convenient medium than clay bricks. Around 2900 BC lived the first famous individual whose name has come down to us in medicine, Imhotep, vizier to King Zoser. An administrator, politician and builder of the great stepped pyramid of Sakkarra, still to be seen today, he must also have been distinguished as a physician, although we know nothing of his medical contributions. He was worshipped for many centuries after his death as god of medicine (Figure 2.2).

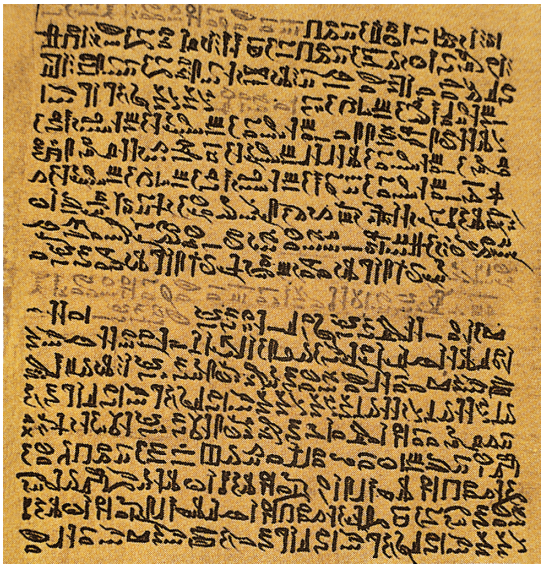

Figure 2.3 The Ebers papyrus.

A number of medical papyri have come down to us which are of great interest. The Ebers papyrus was found in a tomb at Thebes in 1862 by Professor George Ebers and is now preserved in the University of Leipzig (Figure 2.3). It consists of 110 sheets and contained 900 prescriptions. As a calendar has been written on the back of the manuscript, the date of its writing can be fixed with reasonable accuracy at about 1500 BC. However, there is good evidence to show that much of it has been copied from other works many centuries before. The writings are sprinkled with incantations, which suggest that the remedies were given with the intention of driving out the demons of disease. Amulets were also advised; these often consisted of images of the gods and were to be hung around the neck or tied to the foot. A whole variety of drugs are mentioned, including castor oil, which was used as a purgative. All sorts of animal substances were used, including the fat of various animals and bile. Medicine in ancient Egypt would appear to have been of an empirical or magical variety.

Of even more interest to us in our study of the early history of surgery was the discovery by a

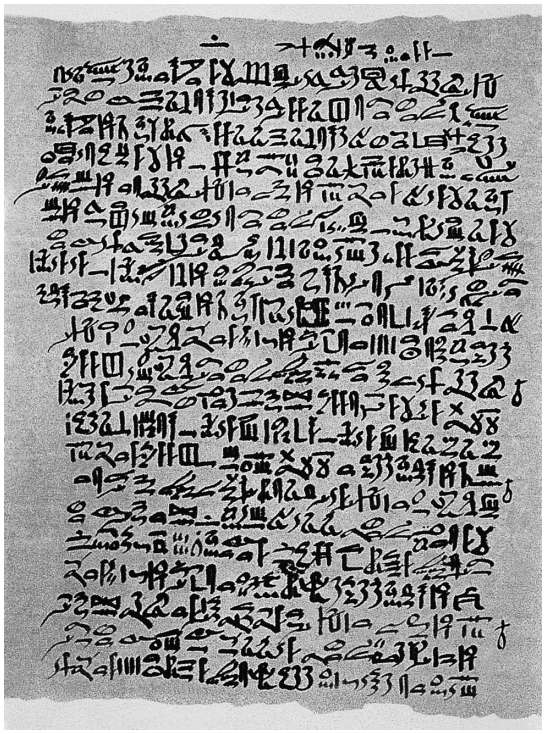

Figure 2.4 The Edwin Smith papyrus.

young American egyptologist named Edwin Smith of another papyrus at the same place as the Ebers papyrus. It remained in Smith's possession until his death in 1906, when his daughter gave the papyrus to the New York Historical Society. The complex task of translation was entrusted to Professor James Breasted. The Smith papyrus (Figure 2.4), like the Ebers papyrus, dates from about 1550 BC, but Breasted demonstrated that it was undoubtedly a copy of much more ancient text, since it used Egyptian words that were no longer current at that time. It comprises 48 case reports which commence with the top of the head and proceed systematically downwards – nose, face, ears, neck and chest – and then mysteriously stop at the spine. Having described the physical signs of the patient, the surgeon goes on to decide on the outlook of the case. If the prognosis is good, or if there is a chance of success, treatment is then advised. If hopeless, then the

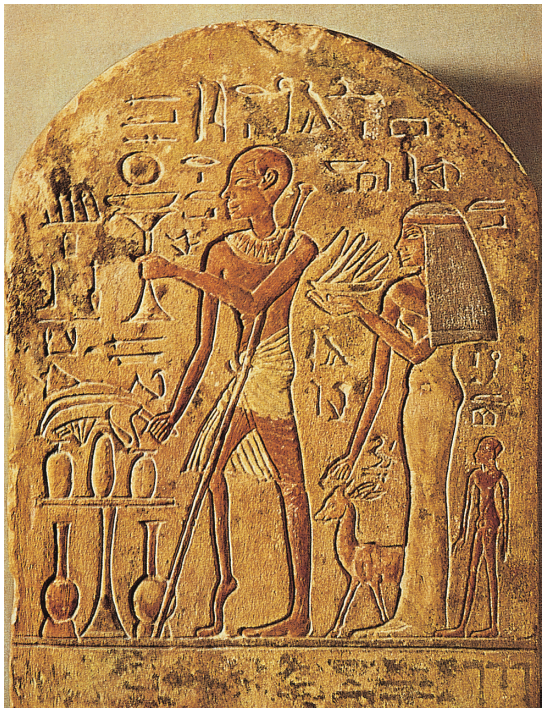

Figure 2.5 An ancient Egyptian stone relief showing a patient with obvious poliomyelitis. Note the shortened right leg with muscle wasting and talipes deformity, together with the crutch.

patient should be left to his inevitable fate. This guarded attitude was widespread in antiquity, when there was rich reward for recovery of your wealthy patient but grave risk of punishment in the case of failure.

The description of a patient with a dislocated jaw and its treatment is very similar to that which can be found in a modern textbook:

> If you examine a man having a dislocation of his mandible, should you find his mouth open, and his mouth cannot close again, you should put your two thumbs upon the ends of the two rami of the mandible inside his mouth and your fingers under his chin and you should cause them to fall back so that they rest in their places.

Equally clear are the instructions concerning a fracture of the upper arm:

> If you examine a man having a break in his upper arm and you find his upper arm hanging down separated from its fellow, you should say concerning him – one having a break in his upper arm. An ailment which I will treat. You will place him prostrate upon his back with something folded between his two shoulder blades; you should spread his two shoulders in order to stretch apart his upper arm until the break falls into place. You shall make for him two splints of linen and you apply one of them to the inside of the arm and the other to the underside of the arm. You shall bind it with ymrw (an unidentified mineral substance) and treat it with honey every day until he recovers.

From these writings it appears that the only surgical conditions treated, just as our evidence from Babylon suggests, were wounds, fractures, dislocations and abscesses. The exception is that circumcision was performed, presumably by priests, as part of a religious ceremony among the nobility (see Figure 1.5).

From the earliest days of Egyptian civilisation, belief in reincarnation meant that members of the royal family and nobility had their bodies preserved. Initially, this was merely done by drying the corpse in sand, but over the centuries increasingly sophisticated techniques of embalming were developed. As a result of our examination of these preserved bodies, a great deal has been learned of the diseases of ancient Egypt. These include congenital deformities such as club foot, dental decay, arthritis, bone tumours and fractures. Some of these injuries, indeed, show treatment by quite sophisticated splinting (see Figure 1.4). Models in tombs and wall carvings demonstrate a variety of diseases, including poliomyelitis, spinal kyphosis and achondroplasia (Figures 2.5, 2.6 and 2.7).

China

The Chinese traced their history back to six emperors. Shen Nung was the inventor of agriculture, Huangt Ti of ships, the bow and arrow, music and writing, Fu Hsi founded the arts of hunting and fishing, the emperors Yao and Shu established the calendar and administration, while the emperor Yu controlled the floods of the Yellow River. According