

# X-ray Examination of the Eskimo Mummies from Qilakitsoq

M. EIKEN

Eiken, M. 1989. X-ray Examination of the Eskimo Mummies from Qilakitsoq. – *Meddr Grønland, Man & Soc.* 12: 58–68. Copenhagen 1990–01–26.

Eight mummified Greenlandic Eskimos, two of which were children, underwent a thorough X-ray examination, which preceded the other comprehensive scientific examinations. The two children were identified as males while all the adult mummies proved to be females. In one of the older adult mummies extensive destruction was demonstrated in the base of the skull, presumably the result of a nasopharyngeal cancer. In the same mummy a pseudoarthrosis of the left clavicle was found. Another, a younger woman, was supposed to have a calculus in the right kidney. One of the children, a four-year-old boy, seems to have suffered from Down's syndrome and a disorder of the left hip, probably Legg-Calvé-Perthes disease.

In two of the older mummies a few compression fractures of thoracic or lumbar vertebral bodies were observed, as well as degenerative osteoarthritis and other signs of advanced age.

As for the remainder, only slight degenerative osteoarthritis was demonstrated, as well as a few congenital anomalies which were probably of no clinical importance. Neither fractures nor bone diseases, whether of older or more recent date, could be demonstrated.

The frontal sinuses were missing in all the mummies and in four of the adult mummies. Harris lines were observed, particularly in the distal femoral metaphyses.

*M. Eiken, MD, Gentofte Hospital, Department of Radiology, Faculty of Medicine, University of Copenhagen, DK-2900 Hellerup, Denmark.*

In the autumn of 1972 Greenlandic Eskimo hunters found two graves with a total of eight mummified corpses, not far from an earlier settlement, Qilakitsoq. Six years later, when a preliminary dating had proved them to be about 500 years old, they were brought to Copenhagen for further examination. The first step in the extensive scientific investigations was to carry out an X-ray examination of each mummy, including its clothing and skin wrappings. X-ray examinations of both natural and embalmed mummies have become increasingly frequent over the past twenty years because they may be carried out without damaging the specimens; in fact, if necessary the mummy is not touched at all.

X-ray examination has been widely used in the study of Egyptian mummies in museums throughout the world. Among the more comprehensive publications should be mentioned Cuenca 1978, Isherwood *et al.* 1979, Harris & Wente 1980, and Christensen 1969.

Although Denmark's "import" of embalmed Egyptian mummies is not particularly great, Danish peat bogs, as well as those of other, mostly Northern European countries, have yielded a number of corpses of people who lived nearly 2000 years ago. Some of these "bog people" are astonishingly well-preserved and a few of the Danish finds have been X-rayed (Krebs & Ratjen 1956). X-ray examinations of Eskimo mummies

from Greenland have not previously been carried out, but the Laboratory of Physical Anthropology at Copenhagen University has a very large number of Eskimo skeletons, mostly from Greenland, which have contributed to our knowledge of these people (Jørgensen 1953).

## Material and Methods

Upon arrival in Denmark, the eight Greenlandic mummies were in varying states of preservation, but their general condition was surprisingly good. All of them were clad in skin clothes; several were also wrapped in large skins, which, like the clothes, were as stiff as cardboard. Almost all the mummies had extremely flexed hip and knee joints, and the heads of some were bent sharply forward or to the side. This to some extent hampered X-ray examination, or resulted in an inconveniently long distance between the object photographed and the X-ray film. However, the mummies were quite robust and could be placed in various positions without being damaged.

The X-ray examination contributed to the determination of age and sex. Radiological age determination is

most accurate in the case of children and young people up to eighteen or twenty years of age. Because of the characteristic development of the bones, evaluation of the ossification of epiphyses and the degree of fusion of epiphyses with metaphyses can pinpoint the age of the individual with a precision ranging from two to three months of age for infants to about one year for 18–20 year-olds, assuming that the development and maturation of bones has remained relatively constant over the intervening 500 years.

Except for the two children, all the mummies proved to be fully-grown individuals. In adults, radiological age determination is far less reliable, because we know little about the aging process in Greenlandic Eskimos today and even less about those of 500 years ago. Therefore the following estimated age is based both on the radiological evaluation and on the joint efforts of experts in different fields.

The X-ray equipment used for the examinations was the Diagnost 85 by Massiot/Philips, which allowed for continuous fluoroscopic control during the radiographic survey. A focus-film distance of 150 cm and a 0.6 mm focal spot was normally used. Supplementary tomographic examinations were carried out on a Stratomatic U by CGR.

In the following the mummies will be identified by the official numbering, where the Roman figure refers to the grave and the Arabic figure to the mummy.

## Results

### Grave I, Mummy No. 1

*General:* A child (Fig. 1) whose age, judging from the development of the teeth and bones, was about six months at the time of death. It was clad in skin clothes with a hood and was extremely well preserved. Although the X-rays did not reveal the sex, the clothing was typical for a boy. No amulets were seen.

*Skull:* At the back of the head there was a small crack, involving both the bones corresponding to the hindmost part of the sagittal suture and the overlying skin, and thus evidently of postmortal origin. In the posterior skull groove a small triangular bone was revealed and identified as a dislocated basilar part of the occipital bone (Figs. 2–3). This small bone has its own developmental centre of ossification and in a six-month-old child is normally in cartilaginous connection with the adjacent bones. In its present position it was turned almost 180° backwards. In continuation of this there was a slightly radiopaque intracranial density stretching upwards towards the upper occipital region, probably representing the shrunken brain.

*Trunchus and extremities:* No skeletal changes were seen.

*Comment:* Normal child.



Fig. 1. Mummy No. 1, a six-month-old child.

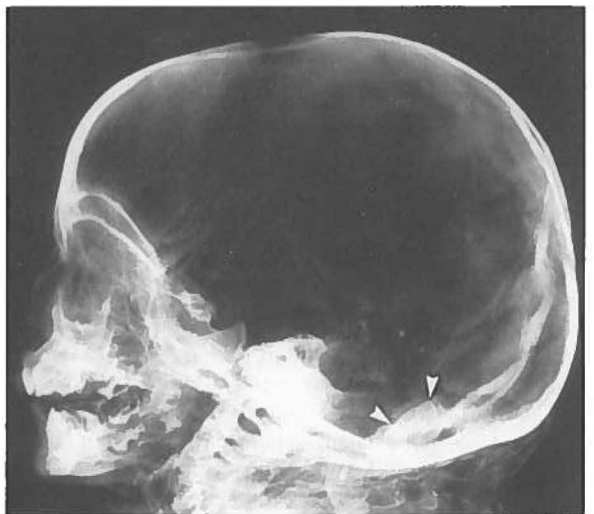


Fig. 2. Lateral view of the skull of mummy No. 1. The dislocated pars basilaris of the occipital bone is marked by two arrows.



Fig. 3. Mummy No. 1. In the AP view the shape of the dislocated pars basilaris is clearly outlined in the occipital region.

## Grave I, Mummy No. 2

*General:* A child with a development of teeth and bones corresponding to an age between 4 and 4½ years at death. Its sex could not be determined from the X-ray examination, but when the clothes were later removed, it proved to be a boy. As in the previous case this child was dressed in skin clothes with a hood but was rather poorly preserved. X-ray examination was carried out before and after removal of various parts of the spine and extremities for special examination. The first radiological survey (at the University Hospital Rigshospitalet) revealed an accumulation of 7–8 teeth, projected level with the lower end of the sternum. They later proved to originate from the child itself, and were found underneath the clothes on the back of the child. Four other detached teeth were observed: one at the left side of the chest, two near the upper thoracic aperture and one just behind the left angle of the jaw. There were no amulets.

*Skull:* Apparently normal in shape and size, corresponding to those of the adult mummies (Fig. 4). The mouth was fixed in a wide open position. The bones of the calvaria appeared undercalcified, with a pronounced fine honeycomb structure of the diploic bone. There were no visible remnants of brain tissue. Some of the cervical vertebrae were detached and dislocated, but no abnormalities could be seen.

*Trunk:* The vertebral bodies of the spine looked undercalcified. Furthermore, it was noteworthy that all

cartilage corresponding to the articulations between the bones in the spine, as well as in the extremities, appeared more shrunken in the case of this child than in the adults. Otherwise there were no changes in the chest or the abdomen.

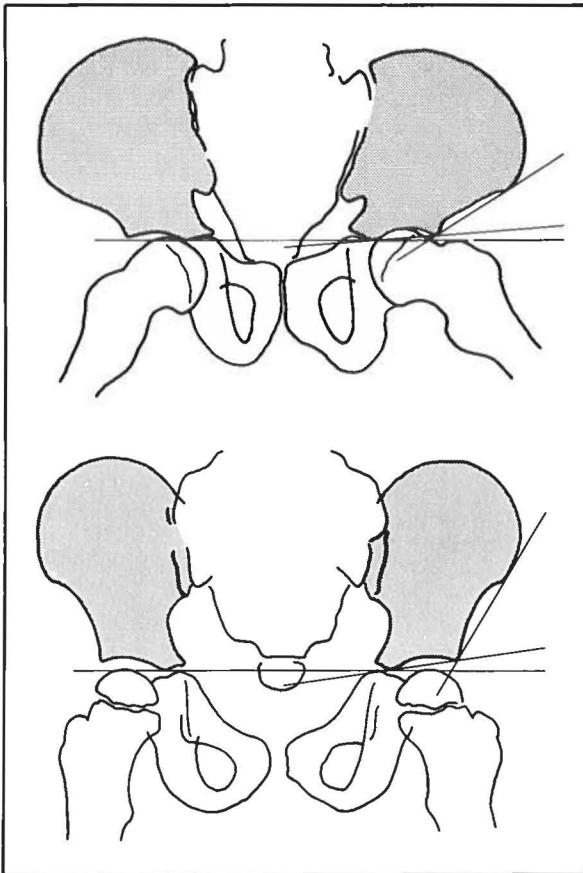
*Upper extremities:* No skeletal changes were observed in the upper limbs. However, it should be mentioned that a generalized rarefaction of bones is difficult to identify radiologically in the extremities.

*Pelvis and lower extremities:* The shape of the pelvis was abnormal, with both ilia flaring laterally and the acetabular slopes flattened (Fig. 5), as is characteristic in children suffering from mongolism (Down's syndrome). The acetabular angle measured by the method of Caffey & Ross (1958), was 4–5° and the iliac angle 32–34° (Fig. 6) (normal values being about 15° and 55° respectively). The lower extremities were widely spread at the hips and with flexed knees – the “frog position”. The epiphyseal ossification centre of the left femoral head was slightly flattened and sclerosed (Fig. 7). There were no structural changes of the femoral neck or of the adjacent acetabular roof, and the right femoral head was normal. An early stage of left-sided Legg-Calvé-Perthes disease is the most probable explanation, with a healed pyogenic arthritis as a less likely diagnostic possibility. Legg-Calvé-Perthes disease is thought to be due to avascular necrosis of the femoral head in childhood. It mainly occurs in boys between the ages of three and twelve, and is not uncommon among Eskimos, although the incidence is not known (Goff 1954).



Fig. 4. Lateral view of the skull of mummy No. 2.

Fig. 5. Pelvis of mummy No. 2 with horizontal position of the acetabuli and flaring of the iliac wings.



On the whole there was a generalized rarefaction of the pelvic bones with increased translucency and a coarsening of trabeculae in the spongiosa.

*Comment:* The rarefaction of bones indicates that this child had been sick and probably immobilized for some time, perhaps because of pain in the left hip, but probably also because of the presence of Down's syndrome. The "frog position" of the lower limbs is remarkable, as the usual position is adducted legs with flexion of the hips and knees.

### Grave I, Mummy No. 3

*General:* Well-preserved mummy of young adult, judged to be a woman between 20 and 25 years of age. The X-ray examination was carried out with the mummy clad in skin clothes.

Furthermore, it was wrapped in a large, stiff skin, containing a number of small fragments of rock. To the right of the head were two loose teeth, an incisor and a bicuspid. No radiopaque amulets were seen.

*Skull:* The head was bent strongly forward. In the right upper jaw the lateral incisor and the first bicuspid were missing and the corresponding alveoli were open.

Fig. 6. Pelvis of mummy No. 2 (upper tracing), compared with that of a normal, 4½-year-old-child (lower tracing). The acetabular and iliac angles are marked on the left side.



Fig. 7. Tomography of the right (a) and left (b) femoral head. The left epiphysis is slightly flattened and sclerosed.



It is probable that the missing teeth were those found in the skin wrapping. Otherwise the dentition was complete. There was a post-mortem subluxation of the right temporo-maxillary articulation. There were no visible remnants of brain tissue.

*Trunk:* Along the margins of the lumbar vertebral bodies a slight bony proliferation was observed, of the type called "lipping". Otherwise there were no skeletal changes. The pelvis was gynaecoid in shape. In both halves of the chest homogenous radiopaque shadows were revealed, probably remnants of lung tissue, without calcifications. To the right of the two uppermost lumbar vertebrae there were two distinct calcium shadows, one of them oval, the other irregularly curved and with a structure similar to bone tissue, both measuring a few centimetres in size (Fig. 8). Judging by their position, they might well be kidney stones. The two calcifications were removed by a minor operation, through the skin clothes and the back of the mummy. Subsequent analysis indicated that the oval one consisted mainly of magnesium ammonium phosphate (struvite), which is a frequent composition of urinary calculi. It had probably been situated in the renal pelvis,

Fig. 8. To the right of the second lumbar vertebra two abnormal calcifications are seen (arrows). The lateral one proved to be a piece of bone, probably from a seal, the other one had a chemical composition consistent with urinary stone (mummy No. 3).

but examination of the surrounding mummified soft tissue did not help to determine the position more precisely. The other piece proved to be bone tissue, apparently a fragment of the temporal bone of a seal or polar bear. It was probably swallowed with food and was on its way through the gastrointestinal canal.

*Extremities:* Both arms were flexed at the elbow joint and the hands placed above the upper chest. The legs were close together, slightly flexed at the hips and knees. No bone changes were demonstrated.

*Comment:* A youngish woman with only very slight degenerative changes of the lumbar spine and a probable stone in the right renal pelvis.

## Grave I, Mummy No. 4

*General:* Well-preserved mummy of youngish woman, probably above thirty years of age. The mummy was dressed in skin clothes and wrapped in a large skin, containing numerous small fragments of rock together with two detached third molars. Most remarkable was a distended abdomen, on account of which she was at first thought to be pregnant. There were no radiopaque amulets.

*Skull:* The head was bent strongly forward with the mouth opened 10 mm. Both third molars in the lower jaw were missing and the alveoli were open, indicating that the teeth found in the skin wrapping probably originated from the mummy itself. There was no evidence of disease, and no visible remnants of brain.

*Trunk:* The number of cervical and thoracic vertebrae was normal while the lumbar spine included a sixth supernumerary vertebra with only slight bilateral sacralization of the transverse processes. Only negligible lipping of the bodies of the lumbar vertebrae was present. Otherwise there were no degenerative changes and no evidence of skeletal disease. In the thoracic cage radiopaque material was seen, probably representing the remains of lung tissue and the diaphragm. The pelvic shape was gynaecoid. As mentioned above, the abdomen was distended (Fig. 9). If this were to be ascribed to a pregnancy, it ought to have been at least in the fifth month, given the size. A fetus of this age would contain enough calcium in its bones to allow for radiological detection. However, even a thorough X-ray examination, including tomography and xerography, failed to reveal any fetal parts, and the pregnancy theory had to be dropped.

*Extremities:* Both arms were flexed at the elbow joint with the hands placed above the chest. The legs were flexed at the hips and knees and kept close together. No disease or malformations were demonstrated.

*Comment:* Youngish woman with a supernumerary lumbar vertebra but otherwise only very slight degenerative changes of the spine. A distention of the abdomen, which could not be ascribed to pregnancy,



Fig. 9. Lateral view of the distended abdomen of mummy No. 4.

was most probably of post-mortem origin although an ovarian cyst is a possibility.

## Grave I, Mummy No. 5

*General:* Fairly well-preserved mummy of a person, about fifty years old, dressed in skin clothes and wrapped in a large additional stiff skin. As with the previous mummies, the skin wrapping contained a number of small stones and gravel. There were no visible amulets.

*Skull:* Flexed a little forward and to the left with the mouth tightly closed. There was a post-mortem subluxation of both the temporomandibular joints. The two upper central incisors and both lower left incisors were lacking. Two of the corresponding alveoli were entirely closed, while the remaining two were partially so, indicating that two teeth had been lost some time before death. At the back of the oral cavity a single stray tooth and a root fragment were demonstrated. Foremost and in the middle of the hard palate a tooth rudiment was enclosed, a rare phenomenon but one which has been reported earlier in two ancient Greenlandic skulls (Jørgensen 1953).

Tomography of the temporal bones was carried out. The ossicles could not be seen but otherwise the anatomy was normal.

*Trunk:* All vertebrae of the spine appeared undercalcified with an increased reticular weblike structure of the spongiosa. In the thoracic spine there was a pronounced biconcave collapse of the fourth and fifth vertebral bodies and a slighter collapse of the ninth and tenth vertebral bodies (Fig. 10), all changes which are characteristic of postmenopausal or senile osteoporosis. Another type of deformation was seen in the two lowest

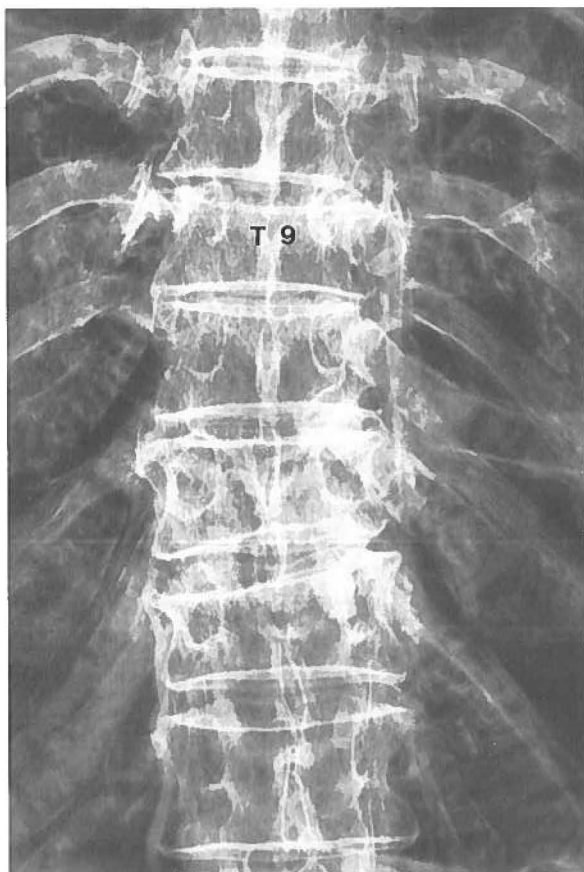


Fig. 10. In mummy No. 5 slight biconcave compressions of the ninth and tenth thoracic vertebral bodies can be seen, with a probable congenital developmental anomaly of the eleventh and twelfth vertebral bodies.

thoracic vertebrae, in that the eleventh vertebral body was lower on the left side than on the right whereas the body of the twelfth vertebra was, in contrast, lower on the right side than on the left, the two thus counterbalancing each another (Fig. 10). This can hardly be due to collapse, but is rather a congenital developmental anomaly. In the lumbar spine a decrease in height of the fourth intervertebral disc was found, with marked bony spur formation on the adjacent vertebral bodies. At the upper anterior margin of the fifth lumbar body a separation of a triangular fragment was seen, caused by a prolapse of the intervertebral disc in youth. Slight degenerative osteophyte formation was seen on the vertebral bodies along the whole lumbar spine. The pelvis was android in shape but the garments, when removed, and the bodily remains, proved to be female. Distinct calcifications of several medium-sized arterial branches were demonstrated in the pelvis. This mummy also had considerable calcification of the rib cartilages, another finding seen mainly among older people, although the age at which they occur may vary greatly.

*Extremities:* The upper limbs were flexed at the elbow joints and the hands were placed above the abdomen. Slight degenerative osteoarthritis was present in both acromioclavicular joints and apparently in the distal joints of the second to fourth fingers of both hands, although these were difficult to represent radiographically. The lower limbs were extremely flexed at the hips and knees and turned to the left. Moderate osteoarthritis was present in the talonavicular joint and the first tarsometatarsal joint of both feet. A post-mortem luxation of some of the toes was present. At the distal end of both femora 3–4 very thin, hardly visible transverse lines were seen. Otherwise the bones of the extremities appeared normal.

*Comment:* Mummy of an older person, which after the clothes were removed, proved to be a woman, even though the pelvis was android. The osteoporosis of the spine with collapse of multiple vertebral bodies, calcification of the costal cartilages, calcification of pelvic arteries and degenerative osteoarthritis in the spine and other joints all pointed to a rather advanced age. Minor developmental anomalies were seen, partly as a deformity of the two lower thoracic vertebrae, partly as a supernumerary tooth in the hard palate.

## Grave II, Mummy No. 6

*General:* The mummy which lay uppermost in grave II was a woman, probably about fifty years of age. She was clad in the usual skin clothes and tightly wrapped in a large skin, which entirely surrounded her head and reached down to the middle of the lower limbs. It contained rock fragments, especially in the pelvic region. There were no visible amulets.

*Skull:* Flexed forward and to the right. The bones of the calvarium were thicker than usual, measuring up to 14 mm.

The sagittal and coronal sutures were closed while the lambdoid suture was still open. There was no special thickening of the skull base. On tomography of the temporal bones the ossicles could not be seen but otherwise the conditions were normal. The mouth was tightly closed, so the teeth had to be examined by tomography. In the upper jaw the crown of the right lateral incisor was lacking, there was hypercementosis of the roots of both third molars and chronic apical parodontitis corresponding to the right lateral and the left central incisor. In the lower jaw the right third and the left second and third molars were missing. Furthermore, both central incisors and the left lateral incisor were missing. There were varying degrees of closure of all the corresponding alveoli and remnants of an apical parodontitis at the alveolus of the right central incisor.

*Trunk:* Slight spondylosis was seen in the cervical spine. The thoracic spine was normal except for a reduced eleventh disc space with slight osteophytosis on

the adjacent vertebral bodies. In the lumbar spine there was disc space narrowing and osteophytosis of L<sub>1</sub> - L<sub>2</sub> and especially of L<sub>4</sub> - L<sub>5</sub>. The second vertebral body was wedge-shaped, probably the result of an old compression fracture. The remaining discs and vertebrae were normal with no demonstrable decalcification. The costal cartilages were rather heavily calcified and calcifications of medium-sized arteries in the pelvis were seen.

*Extremities:* The arms were flexed 130° at the elbows and the hands crossed over the lower end of the sternum. The four ulnar fingers of both hands were extremely flexed and could not be evaluated radiographically. All other bones and joints were normal; in particular there was no demonstrable degenerative osteoarthritis. The legs were flexed at hips and knees and turned to the left. Apart from a single, very thin transverse line at the distal end of both tibiae, and 2-3 similar lines at the distal end of both femora, no abnormality was demonstrated.

*Comment:* Middle-aged woman with a poor dental state, an old compression fracture of the second lumbar vertebra, heavy disc narrowing and osteophytosis, especially of L<sub>4</sub> - L<sub>5</sub>, and slight spondylosis of the cervical spine. Further, there was calcification of the costal cartilages and of arteries in the pelvis.

## Grave II, Mummy No. 7

*General:* Poorly-preserved mummy of younger woman, probably in her early twenties. She was clad in skin clothes but without additional skin wrapping. There were no amulets.

*Skull:* The head, along with the four uppermost cervical vertebrae, were almost separated from the rest of the mummy, and were only held in place by dried-out shreds of skin and the hood of the skin garment. These changes undoubtedly occurred after death. The mouth was half-open. Seventeen teeth of the upper and lower jaw were missing, but the corresponding alveoli were all open, indicating that they had been lost post mortem. Several of the remaining teeth were loose, and in the clothes three separate teeth were found, probably originating from the mummy itself. At the lateral angle of the right eye was a 20 mm long fissure in the skin, but X-ray examination of the orbita revealed no bony damage. Tomography showed the temporal bones to be normal, except for the ossicles. In both ears the malleus was demonstrated to be out of place and the right stapes in an almost normal position. The remaining ossicles could not be seen.

*Trunk:* Normal, apart from a slight wedge shape of the eleventh thoracic vertebral body.

*Extremities:* The arms were placed along the body with 90° of flexion at the elbow joints and the hands above the upper abdomen.

Post-mortem luxation was present in both shoulder

joints. The four ulnar fingers were extremely flexed, and the radiological evaluation of these was difficult. However, neither bony nor articular changes could be demonstrated. The lower limbs were flexed at hips and knees and bent to the right. The toes were flexed. About four very thin transverse lines were observed at the distal end of both femora. No other pathological changes were observed.

*Comment:* Young woman, poorly preserved. Seventeen teeth were probably lost post-mortem. Further there was post-mortem luxation of the cervical spine and of both shoulder joints. Otherwise there were no skeletal changes apart from a single slightly wedge-shaped thoracic vertebral body.

## Grave II, Mummy No. 8

*General:* A woman, who on general evaluation was determined to be about fifty years of age, although the absence of degenerative changes of the skeleton, especially of the spine, might indicate a younger age. She was in a very poor state of preservation. Clad in skin clothes with a hood but without additional skin wrapping. The back of the clothing had disintegrated and skin and soft tissue of the body had disappeared as far down as the level of the pelvic brim, thus exposing the spine and the posterior parts of the ribs. The left scapula and humerus were entirely detached and without remnant of soft tissue while the remainder of the left arm and accompanying sleeve were preserved.

*Skull:* The head was held in place only by the skin hood, out of which it could be lifted. The sagittal and coronal sutures were closed while the lambdoid suture was still open. The six uppermost cervical vertebrae were attached to the head, while the seventh lay by itself. All soft parts had disappeared from the lower jaw, which was also loose. In the upper jaw three incisors (1 + 1,2) and the right second premolar were missing, apparently having fallen out post-mortem, as the corresponding alveoli were all open. In contrast, some time before death the woman had lost her lower incisors and the third right molar, as these alveoli had different degrees of closure. A single loose tooth was found in the clothing.

The radiographs taken of the head frontally and in profile showed some changes in the bones at the base of the skull. The poor state of preservation of this mummy proved advantageous to X-ray examination. Since the head was detached from the body, it could be examined more thoroughly than would otherwise have been possible. The examination revealed an extensive destruction of bone, including the part of the base of the skull which forms the roof of the nasopharynx, along with the internal parts of both temporal bones, which contain the inner ear (Fig. 11). There was also destruction of the posterior part of the left eye socket (Fig. 12).



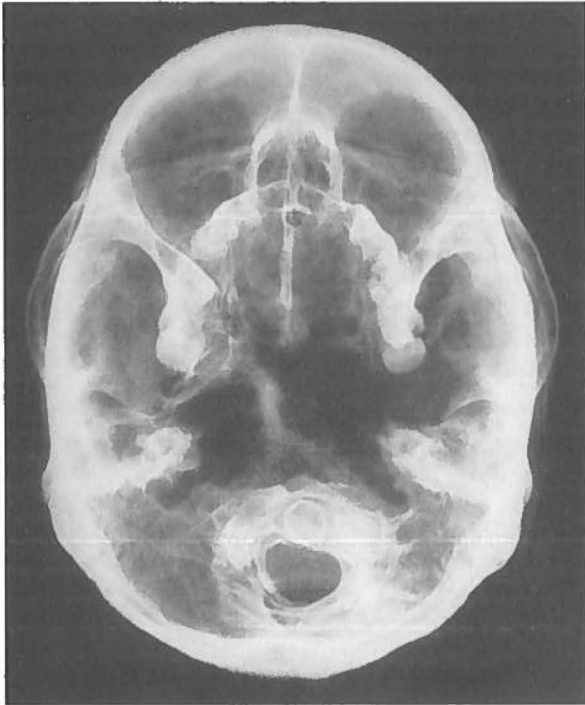


Fig. 11. Base of the skull of mummy No. 8. The extensive destruction of bone is clearly visible as an irregular dark area.



Fig. 12. Mummy No. 8. In the AP view the destruction is seen to comprise the left orbita, particularly the sphenoid bone.

Considering the mummy's poor state of preservation, it was natural to inquire whether the observed destruction of the skull bones might have occurred post-mortem. This possibility can be definitely rejected, for all other bones, including the exposed and rather thin ribs, were completely intact. The changes resemble the effect caused by a malignant tumour spreading in a bone.

Now, it is well known that nasopharyngeal cancer has an exceptionally high incidence among Greenlandic Eskimos (Nielsen *et al.* 1977) and those of Northern Canada (Schaefer *et al.* 1975; Mallen & Shandro 1974) as it does in certain other peoples of mongoloid stock in Southern China and parts of South East Asia. Thus, it is natural to ascribe the destruction in the base of the skull to such a cancer.

*Trunk:* Only the innermost two-thirds of the left clavicle was in proper position; the outer third was missing. However, some time after the recovery of the mummies a small bone fragment was found at the bottom of grave II. This proved to be the lateral part of a clavicle. The two bone fragments proved to be compatible, constituting a fractured clavicle. Along the edges of both fracture surfaces, a thickening of the bone was noted. The surfaces themselves were partly sclerosed, and covered with cortical bone. These changes reveal that the fracture of the clavicle had probably occurred at least six months before death, resulting in a fibrous union or pseudoarthrosis (Fig. 13). There were no cancerous changes here as in the skull. Otherwise, the thoracic cage was normal, with only slight calcifications of the costal cartilages. In the spine there was some disorganization of the lower lumbar vertebrae with irregular height of the intervertebral spaces and subluxation of the fourth and fifth vertebra. This was caused by a disintegration of the discs, but on direct examination of the vertebrae no evidence of disease could be seen; in particular, there was no spondylolysis.

*Extremities:* The right arm was placed along the chest with a flexion at the elbow joint of barely 90° and the hand was placed over the lower abdomen. No abnormalities were demonstrated either in the right arm, or in the loose left arm. The lower extremities were flexed at the hips and knees and turned to the right. At the distal end of both femora, several distinct transverse lines were present, indicating early periods of growth arrest. Such lines were not visible in other long bones. The right fibula was loose. The calcium content otherwise appeared to be normal, and there were no signs of disease.

*Comment:* Probably a middle-aged woman with extensive destruction of bones of the skull base, most likely caused by a nasopharyngeal carcinoma. Five teeth in the lower jaw were probably lost some time before death, while four teeth in the upper jaw seem to have

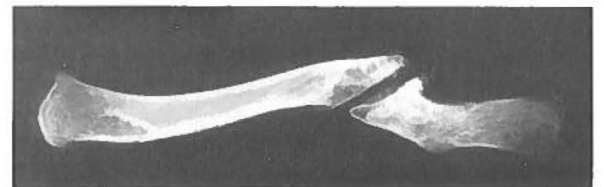


Fig. 13. The two parts of the left clavicle of mummy No. 8, placed in the supposed position while alive.

been lost post-mortem. An old fracture of the left clavicle with pseudoarthrosis formation was demonstrated. Apart from lines of growth arrest in the lower end of the femora there were no other degenerative or disease changes of the skeleton.

## Discussion

An important question raised by the discovery of eight mummified Greenlandic Eskimos was that of the cause of death - and did they die singly or together? However, a possible cause of death, a presumed nasopharyngeal cancer, was found only in mummy No. 8, and even in this case another event may have brought the life to an end. The development of a pseudoarthrosis of the left clavicle indicates that daily work had to continue in spite of the pain and weakness which the fracture may have caused. Another of the mummies, No. 3, had an abnormal calcification to the right of the upper lumbar vertebrae, of a chemical composition corresponding to urinary stone. Only one of the remaining mummies appear to have been sick, i.e. the 4½-year-old boy, presumed to have suffered from Down's syndrome and probably also from a left-sided Legg-Calvé-Perthes disease. None of these conditions necessarily immobilized the child, but the undoubtedly decreased calcium content of the skeleton indicates a rather prolonged period of reduced physical activity.

From a radiological point of view the remainder of the mummies appear to have been normal healthy individuals, with such different degrees of physiological changes and degenerative osteoarthrosis as are to be expected, considering their ages. Even the presence of a few compression fractures of vertebral bodies among two of the older Eskimos may not be regarded as a surprising finding among a population living under such rough environmental conditions. A few small and probably unimportant congenital anomalies were demonstrated.

Some general findings, which have been mentioned only casually in the survey, should be emphasized.

**Skull:** X-rays of the skull were always done in strictly lateral and AP standard projections, with a focus-film distance of 150 cm. However, only in two instances, i.e. mummy No. 7 (Fig. 14) and No. 8, could the head be placed directly on the table-top. In the remaining cases the posture of the head and, if present, the stiff skin wrapping caused various degrees of increased distance between the head and the table-top. Thus, exact cephalometric measurements could not be carried out; but on comparison of the AP and lateral radiographs, the shapes of the calvaria of mummies No. 3 to 7 were very much alike, and all were of dolichocephalic type, while the skull of mummy No. 8 was slightly flattened corresponding to the intersection between the lambdoid and sagittal sutures of the cranial vault.

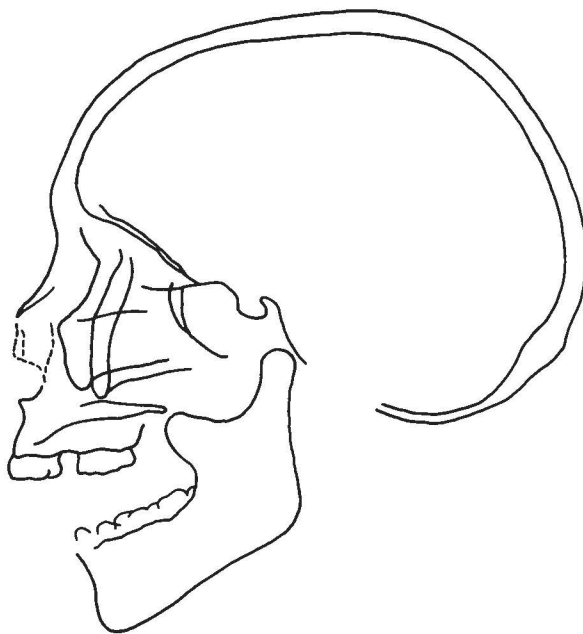


Fig. 14. Tracing of the skull of mummy No. 7. The dolichocephalic shape was characteristic of all the adult mummies.

**Sutures:** The sagittal and coronal sutures were closed or almost closed in all the adult mummies. The lambdoid suture was also in an advanced state of closure, except for mummy No. 4, where it was still open. In fact we don't know much about the normal time for this closure among Greenlanders, although early closure was assumed as early as Pansch (1874).

**Nasal sinuses:** The frontal sinuses were totally absent in all the mummies, while the maxillary and ethmoidal sinuses were well developed. Small or absent frontal sinuses among Eskimos, perhaps due to the climatic conditions, have been described in earlier publications, and recently by Hanson & Owsley (1980).

Transverse lines of increased density (Harris lines) through the metaphyses of the long bones were observed in four of the mummies, Nos. 5, 6, 7 and 8, predominantly at the distal femoral metaphyses. Such lines develop in bones because of a failure of normal removal of calcified cartilage in the zone of provisional calcification during debilitating disease, starvation and probably other types of malnutrition. In mummy No. 8 they were fairly distinct, while in the other three mummies they were negligible. The phenomenon is well known among children and adults of our time, and has been described among earlier human populations of various racial origins, including Eskimos (Lobdell 1984).

Spondylolisthesis and spondylolysis have proved to be surprisingly common diseases among adult present-day Greenlanders (Kalbak *et al.* 1972; Simper 1983). However, no signs of this disease were observed in the present material.

## References

- Caffey, J. & Ross, S. 1958. Pelvic bones in infantile mongoloidism. Roentgenographic features. – *Am. J. Roentgenol.* 80: 458–467.
- Christensen, O. E. 1969. Un examen radiologique des momies égyptiennes des musées Danois. – *La Semaine des Hôpitaux* 45: 1990–1998.
- Cuenca, E. L. 1978. Estudio Radiológico de las Momias Egipcias del Museo Arqueológico Nacional de Madrid (Spanish/English text). – Museo Arqueológico Nacional, Monografías Arqueológicas 5.
- Goff, C. W. 1954. Legg-Calvé-Perthes syndrome. – Charles C. Thomas, Springfield: 71–79 & 162–166.
- Hanson, C. L. & Owsley, D. W. 1980. Frontal Sinus Size in Eskimo Populations. – *Am. J. Phys. Anthropol.* 53: 251–255.
- Harris, J. E. & Wente, E. F. 1980. An X-ray Atlas of the Royal Mummies. – The University of Chicago Press, Chicago & London: 403 pp.
- Isherwood, I., Jarvis, H. & Fawcitt, R. A. 1979. Radiology of the Manchester Mummies. – in: David, A. R. (ed.) *The Manchester Museum Mummy Project*: 25–64. Manchester University Press.
- Jørgensen, J. Balslev. 1953. The Eskimo Skeleton, – *Meddr Grønland* 146(2).
- Kalbak, K., Andersen, S. & Winckler, F. 1972. Forekomsten af spondylolisthesis blandt grønlandere over 40 år. – *Ugeskr. Læger* 134: 2532–2537.
- Krebs, C. & Ratjen, E. 1956. Det radiologiske fund hos mosealiget fra Grauballe. – *Kuml, Årbog for jysk Arkæologisk Selskab* : 138–150.
- Lobdell, J. E. 1984. Harris Lines: Markers of Nutrition and Disease at Prehistoric Utqiagvik Village. – *Arctic Anthropology* 21: 109–116.
- Mallen, R. W. & Shandro, W. G. 1974. Nasopharyngeal carcinoma in Eskimos. – *Canad. J. Otolaryng.* 3: 175–179.
- Nielsen, N. H., Mikkelsen, F. & Hansen, J. P. H. 1977. Nasopharyngeal cancer in Greenland, – *Acta path. microbiol. Scand. Sect. A.* 85: 850–858.
- Pansch, A. 1874. *Anthropologie. Die 2. deutsche Nordpolarfahrt, Bd. 2.* – Leipzig: 144–156.
- Schaefer, J., Hildes, J. A., Medd, L. M. & Cameron, D. G. 1975. The changing pattern of neoplastic disease in Canadian Eskimos. – *Canad. med. Ass. J.* 112: 1399–1404.
- Simper, L. 1983. Spondylolistese og lændesmerter hos grønlandske patienter. – *Ugeskr. Læger* 145: 983–985.