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X-RAY ANALYSIS OF THE ZAGREB MUMMY

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Original scientific paper

The paper describes the results of röntgenogram (x-ray) analysis of an Egyptian mummy — of the so-called Zagreb Mummy. The examination took place at the Clinical Hospital Center Rebro in Zagreb in January 1986. The mummified person was found to be a fully grown female. On the occipital squama, a big bone defect was discovered. Multiple post-mortal fractures of long bones of the extremities and prepared muscles were discovered and so were degenerative changes of the left hip and right knee.

Introduction

Since the times of the earliest dynasties, mummification of dead bodies has been taking place in Egypt. In its modified form, the art has been preserved and is still practised. Although many stages of the mummification process have been clarified, the entire procedure hasn't yet been fully explained.

The physicians therefore focused their attention upon the diseases and causes of death of mummified persons.

The discovery of X-rays made the analysis of anatomical and patho-anatomical features of the bodies possible without interfering into the body's integrity (1). In 1898, three years after X-rays were first discovered, mummies were X-rayed and analysed for the first time. X-raying of mummies revealed some of the procedures in the mummification process. Comparative studies of historical documents and X-rays of the mummies made possible a better understanding of mummification techniques characteristic for given historical periods (Table; 2). Comparing data on mummification procedure with X-ray findings can help roughly determine the period to which a mummy belongs (3).

Predynastic period (4800—3100 B. C.)	Bodies wrapped in loose skins with limbs flexed in sand graves. Natural desiccation occasionally resulted in excellent soft tissue preservation.
Old Kingdom (2750—2260 B. C.)	Bodies wrapped in tight bandages and placed in wood coffins. Poor soft tissue preservation necessitated reproduction of bodily features with resin soaked linen, which is characteristic of this period. Viscera removed through left lower abdominal incision and placed in jars.
Middle Kingdom (2061—1784 B. C.)	Abdominal incision and evisceration not universal as alternative technique of injection of cedar oil per rectum was introduced. Use of dry natron resulted in better soft tissue preservation.
New Kingdom (1570—1070 B. C.)	Transnasal removal of brain became common practice in the 18th dynasty. First known use of artificial eyes.
3rd Intermediate Period (1070—656 B. C.)	Technique of mummification reached its peak during the 21st dynasty. Visceral parcels returned to abdominal cavity and subcutaneous packing introduced. After the 21st dynasty technique began to decline.
Late Period (525—343 B. C.)	Further deterioration in technique. Abandonment of the use of subcutaneous packing and artificial eyes. Viscera occasionally placed in canopic jars or in parcels between the legs.
Ptolemaic Period (332—31 B. C.)	Increasingly, more attention was focused on external appearance and less effort put into adequate preservation of body. Markedly disjointed and composite mummies seem to be continued to this period. Large masses of resin often seen.
Roman Period 31 B. C.—A. D. 395	Further deterioration in technique.

Table: Mummification related to historical period. (From: Th. Vahey — D. Brown. CT Study of an Egyptian Mummy. *J. Comput Assist Tomogr*, Vol. 8, No. 5, 1984: 993)

Methods

The standard native röntgenograms (X-rays) of the Zagreb Mummy were taken in the Institute of Radiology of the Clinical Hospital Center Rebro.

Results and conclusions

The röntgenogram analysis (Plates 1—2) made the following conclusions possible:

1. The features of the skeleton suggest that the mummified person was a female in which growth had been arrested.
2. A bone defect of irregular shape, measuring 11 cm in diameter has been found in the *squama* of the occipital bone. In the cranial cavity a globular shadow of increased density (7 cm in diameter) indicates at the utilization of resins in the mummification procedure. On the convexity of the skull (the *calvaria*) two identical round-shaped metal foreign bodies 3 mm in diameter can be seen.
3. *Thorax* and *abdomen* are covered with shadows of mineral compounds which encrusted soft tissue during mummification. X-rays cannot penetrate such areas; consequently, they are not accessible for detailed analysis.
4. Bone structure can be ideally analysed. It completely matches the bones of living persons. Shadows of soft tissue suggest that the X-rayed subject is a mummy.
5. Degenerative process in the right knee and the left hip can also be seen. Multiple fractures of long bones and muscles encrusted with salts used in mummification took place *post mortem*. On the point where left *os ilium*, *os ischii* and *os pubis* fuse, *os coxae* is hyperostotic, suggesting a fracture healed in the mummified woman's lifetime.

References

1. Gray PHK. Radiography of ancient Egyptian mummies. *Med Radiog Photog* 1967; 43 : 34—44.
2. Vahey T., Brown D., Comely Wenuhotep: Computed tomography of an Egyptian mummy. *J. Comput Assist Tomography*, Vol. 8, No. 5, 1984 : 993.
3. Modie RL. Roentgenologic studies of Egyptian and Peruvian mummies. Chicago: Chicago Field Museum of Natural History, 1931. (Anthropological series 3).

DESCRIPTION OF PLATES

OPIS TABLI

Tabla 1

Plate 1

Röntgenogramme of the Zagreb mummy

Rendgenogram Zagrebačke mumije

Plate 2

Tabla 2

1. Craniogramme of the Zagreb mummy. Defect of the occipital bone. Resine in the cranial cavity. Spherical foreign metal bodies in the bones of calvaria.

1. Kraniogram Zagrebačke mumije. Defekt okcipitalne kosti. Smola u šupljini neurokraniuma. Okrugla metalna strana tijela u kostima svoda lubanje.

2. Röntgenogramme of the knees. Degenerative changes of the right knee.

2. Rendgenogram obaju koljena. Degenerativne promjene desnog koljena.

ANALIZA KLASIČNIH RENDGENOGRAMA ZAGREBAČKE MUMIJE

Uvod

Mumifikacija lešina poznata je iz najranijeg dinastijskog perioda staroegipatske povijesti. Kao vještina očuvana je u modificiranom obliku do danas. I pored otkrivanja postupaka u nizu faza procesa mumifikacije, postupak nije u cijelosti objašnjen. Pažnju liječnika zaokupljaju bolesti od kojih je болоvala mumificirana osoba. Zanima ih i uzrok smrti.

Otkriće rendgenskih zraka omogućilo je uvid u anatomske i pato-anatomske promjene mumije bez narušavanja njezina integriteta. Već 1898. g. tj. tri godine nakon otkrića rendgenskih zraka, učinjene su prve rendgenske snimke i analize mumija. Osim uvida u anatomske i patološke procese, radiološki pregled mumije omogućuje otkrivanje nekih postupaka tokom mumifikacije.

Analizom povijesnih dokumenata uspjelo je proniknuti u osobine tehnika mumifikacije koje su bile svojstvene pojedinim razdobljima (Tablica). Na taj način — usporedbom spoznaja o mumifikaciji s rendgenskom analizom mumije — može se grubo procijeniti iz kojega perioda potječe mumija (3).

Metode

Mumija je rendgenski snimljena u Zavodu za radiologiju KBC — Medicinskog fakulteta u Zagrebu (Tabla 1—2).

Rezultati i zaključci

Klasičnim nativnim rendgenskim snimanjem mumije Arheološkog muzeja u Zagrebu ustanovilo se slijedeće:

1. Karakteristike kostura upućuju da se radi o osobi ženskog spola, rast koje je završen.
2. Na stražnjem dijelu lubanje postoji defekt ljske okcipitalne kosti nepravilna oblika promjera 11 cm. U lubanjskoj šupljini nalazi se kuglasta masa smole promjera 7 cm (Tabla 2, 1). Takva se smola upotrebljavala tokom procesa mumifikacije. Na konveksitetu lubanje vidljiva su dva jednaka metalna strana tijela okruglasta oblika promjera 3 mm.
3. Područja prsnog koša i trbušne šupljine prekrivena su sjenama tvari kojima su inkrustirane meke česti tokom mumifikacije. Kako ta područja nedovoljno propuštaju rendgenske zrake, to nisu pristupačna detaljnoj analizi (Tabla 1).
4. Struktura kostiju udova vrlo se dobro može analizirati, a u potpunosti nalikuju kostima žive osobe. Sjene u mekim čestim udova ukazuju da se radi o mumiji.
5. Postoje degenerativne promjene lijevog kuka i desnog koljena (Tabla 2, 2). Mnogobrojni prijelomi dugih kostiju i preparacijom otvrdnula mišićja nastali su nakon smrti mumificirane osobe. Na mjestu gdje se stapaju crjevnječa, sjedna i stidna kost zadebljana je kost zdjelice s lijeve strane. Nalaz može odgovarati stanju nakon prijeloma kosti za života (Tabla 1).

Literatura:

1. Gray PHK. Radiography of ancient Egyptian mummies. *Med Radiog Photog* 1967; 43 : 34—44.
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