

“The Opening of the Mouth”—A New Perspective for an Ancient Egyptian Mummification Procedure

ROGER SEILER AND FRANK RÜHLI*

¹Centre for Evolutionary Medicine, Institute of Anatomy, University of Zurich, 8057, Zürich, Switzerland

ABSTRACT

“The opening of the mouth ritual” (OMR) is a central and well-documented component of the Ancient Egyptian mortuary ceremony. In the scientific literature, we find various references that indicate that parts of this ritual correspond to physical opening of the deceased’s mouth during its mummification. We denote this physical treatment of the dead the “opening of the mouth procedure,” to underline the distinction against the “opening of the mouth ritual,” which is performed ceremonially later on the mummy or even the statue. The mummifying procedure itself however is known only from rare pictorial representations and the later summary descriptions of Greek authors. Nevertheless, recently some authors tried, on the basis of paleopathological findings, to demonstrate that the mouth of the deceased had to be opened physically before mummifying. Careful examination of the mummies of the Swiss Mummy Project and other cases reported in the literature showed frequent dental pathologies including fractured and totally luxated teeth, which were up to now not sufficiently taken into consideration. The detailed report of the preliminary procedures of mummifying the Apis bull—as appropriate detailed descriptions for humans are missing—gives us insight into the treatment of the oral cavity. Our results, when combined with the available historical literature, indicate that the OMR can be regarded as a ritualized counterpart of a real “opening of mouth procedure” during mummification. *Anat Rec*, 298:1208–1216, 2015. © 2015 Wiley Periodicals, Inc..

Key words: mummification; ritual; dental; trauma; mouth

Mummies are among the most characteristic objects of the Ancient Egyptian culture and their monuments—shrines, coffins, and funeral masks—among the most beautiful objects created by the Egyptians. The “making of a mummy” included a long, complex, and ritually protected operation (Fig. 1) to transform the dead body into an effigy of the eternal Osiris (Assmann, 2005). It ended before the interment with the “opening of the mouth ritual” (OMR). The goal was the animation of the mummy, its transformation to a medium for cultic communication (Bjerke, 1965), to make it able to communicate by opening their mouth and eyes (Quack, 2005). But the whole process of mummification meant also a massive intervention in the physical integrity of the dead person, and often the corpse was dealt with little care (Salter-Pedersen, 2004; Germer et al., 2009). Incidents of *post-mortem* accidents were high, particularly in the oro-facial region

(Aufderheide et al., 1999). Traumatic alterations in the oro-facial region of Egyptian mummies have been reported several times. Here we focus on the frequent

**Present address:* Institute of Evolutionary Medicine, University of Zurich Winterthurerstrasse 190, 8057, Zürich, Switzerland

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*Correspondence to: Frank Rühli, Institute of Evolutionary Medicine, University of Zurich Winterthurerstrasse 190, 8057 Zürich, Switzerland. Fax: +41446350112. E-mail: frank.ruhli@iem.uzh.ch

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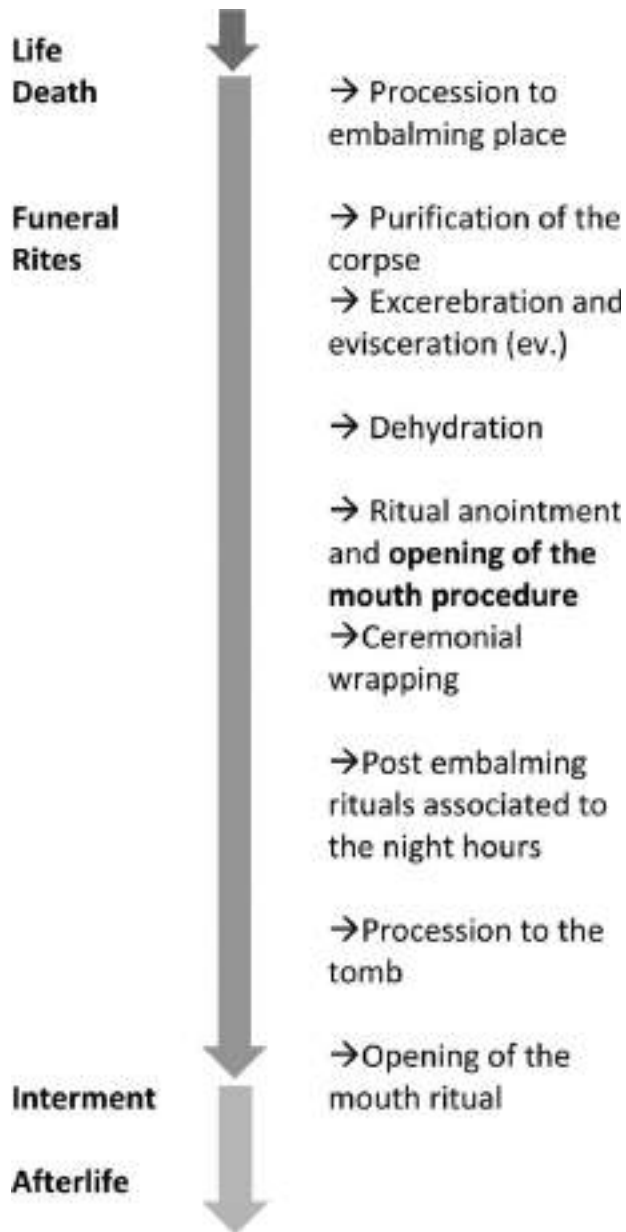


Fig. 1. Diagram of the funeral rites between death and interment, after Hays (2010).

fractures and avulsions of front teeth. Cases of these dental traumas are found in the inventory of Swiss mummies. The present work describes these paleopathological findings and interprets them as consequences of procedures in the course of mummification.

MATERIAL AND METHOD

The Swiss Mummy Project (SMP) is inventorying as completely as possible all existing mummies of various provenances in Swiss collections, with frequent updates to its collection. The SMP is also involved in international mummy projects (see: www.swissmummyproject.uzh.ch).

Here our focus is on the mummies from Ancient Egypt. A preliminary study was published in 2007 (Küffer and Siegmann, 2007). Currently, 51 dentitions of mummies have been examined. Additionally for the study of diseases in the oral region, over one hundred Ancient Egyptian skulls of the collection of the Anthropological Institute & Museum (AIM) have been included. These mummy heads were collected c. 1900 AD (Oetteking, 1908). They were not only unwrapped, as was common in those times, but also the soft tissues were carefully removed to perform craniological studies.

The investigation began with careful macroscopic inspection of the mummy (Ikram, 2011). Here the condition of the possibly present bandages or of the soft tissues in the oral area as lips and cheeks was assessed. Gap formations, fractures, or broken away parts were noted. Sometimes teeth were directly visible due to displacement or shrinking of the lips. Teeth and bones of the Egyptian skulls from the AIM were also subjected to direct inspection. However, if the soft tissue or even the bandages were still present, a radiological examination was necessary. For this, computed tomography (CT) is the gold standard (O'Brien et al., 2009; Wade et al., 2011). The different possibilities for processing the primary data allowed by an "electronic dissection" (Melcher et al., 1997) the close examination of the fine oral structures. Intraosseous processes such as apical granuloma were only visible in the CT, but not discolorations of teeth, for instance those due to coverage by embalming substances.

To determine whether a trauma was caused by the mummification process, it is crucial to determine the date of its occurrence to within a small time frame in order to eliminate *ante-* and *peri-mortem* traumas. A fracture of a vital tooth with opening and devitalization of the pulp would result in an apical osteolysis within weeks. An intravital avulsion, that is the *ante-mortem* tooth loss, leads to the healing and the closure of the socket. Such obvious cases are excluded in this study.

To be included in the study, the trauma must be clearly *post-mortem*. Signs of a *peri-* or *post-mortem* tooth loss are open alveoli with preserved lamina cribiformis or the opening of the pulp by a fracture but without the characteristic apical osseous reaction on its devitalization.

The endpoint of the time frame within which the trauma must occur is the moment when the dead's head is bandaged. Thus, the mouth is no longer accessible to any embalming treatment. Far beyond the defined time period, damage to a mummy, especially its oral region, is possible by tomb robbers or careless unwrapping and storage (Salter-Pedersen, 2004). Such obvious cases are also excluded in this study.

Inclusion criteria for this study are therefore *post-mortem* dental traumas under undamaged soft tissue coverage or intact bandages.

In our inventory of the SMP, the following cases show fractured teeth meeting our inclusion criteria: an anonymous mummy head (Inv. no. 7614), Museum für Völkerkunde, Burgdorf, Switzerland, and two mummy heads (Inv. no. III 15190 and III 1017) in the Naturhistorisches Museum, Basel, Switzerland. Because the removing of the wrappings and the soft tissues in recent times by "cleaning" (Oetteking, 1908), the skulls of the AIM collection, Zurich, Switzerland had to be carefully

evaluated. The condition of these skulls prior to this cleaning was not documented. Additional observations, such as a layer of embalming substance over the fractured teeth, can help to determine the moment of this damage of their teeth. Several heads had probable *post-mortem* fractured teeth: Inv. no. 374, 817, 1094, 1095, 1106, 1109.

Totally luxated teeth in different places in the oral cavity and far down in the larynx can be found in the mummy head (Inv. no. 161E2704) from the Naturhistorisches Museum, Basel, the male mummy (Inv. no. 0492) from the Musée cantonal d'archéologie et d'histoire, Lausanne, Switzerland, and the mummy of Ta-Di-Isis (Inv. no. K 1205), Chur, Switzerland. Fractures and avulsions of teeth appear in the mummy head (Inv. no. III 15188) in the Naturhistorisches Museum, Basel, the mummy of Tches-Mout-peret (D42) from the Musée d'art et d'histoire, Geneva, Switzerland, and a mummy head in the collection of the Centre for Evolutionary Medicine, Zürich.

RESULTS

In the following some selected cases from our inventory are presented:

In the Museum für Völkerkunde in Burgdorf, an anonymous mummy head (Inv. no. 7614) is preserved (Fig. 2). Soft tissues and partially the wrappings over the face are well preserved. While the teeth of the lower jaw are intact, several in the upper jaw are damaged. The crown of the first right incisor (11 in the teeth notation after the FDI World Dental Federation) has completely broken away just over the gingiva with opening of the pulp channel. Other teeth, including 12 and 14, fractured below the alveolar margin and thus kept the fractured fragment in place. Otherwise dental and periodontal status is good, beside a deep carious lesion on 17.

In the upper jaw of the skull AIM no. 1109, AIM collection, Zurich, dating from c. the 17th dynasty (Fig. 3), the crowns of all teeth from 14 to 24 are broken a few millimetres above the alveolar margin. Similarly in the lower jaw, the crowns from 35 to 45 are damaged. The areas of the fractures are covered with a thin layer of embalming substance. The crown of 15 is lost, but occurred long before death as shown by the osseous defect at its apex. A transnasal excerebration was performed. As a radiological investigation was not done, its exact route can't be evaluated. But in the right orbit, the damaged lamina papyracea and damaged parts of the sphenoid are visible.

The Musée cantonal d'archéologie et d'histoire in Lausanne (Fig. 4) holds a perfectly preserved male mummy from about 1,000–800 BC (Inv. no. 0491). Its dentition of the upper jaw is complete, although with severe bone loss. In the lower jaw, 41, 42, 46, and 47 on the right side and 31, 35, and 36 on the left side are missing. The alveoli of 47, of the three front teeth and of 35 are open. General bone loss is also seen in the lower jaw. The CT scans reveals four teeth—two front teeth, a premolar, and a molar—crowded together in the larynx.

An equally well-preserved, also unwrapped female mummy from c. 8th to 7th century BC (Fig. 5) resides in the Musée d'art et d'histoire, Geneva (Inv. no. D242). The dentition is in a very bad condition. Several teeth were lost long before death, some have deep carious

lesions or are elongated in default of their antagonists. The important pathologies in this context are the fractured teeth in the upper front (11, 21, 22) and the *post-mortem* lost teeth 14 and 15 in the lower front and 31, 32, 42, 44, and 45 in the right premolar regions. Several teeth were dislocated into the rear of the oral cavity, another one deeply into the larynx. Rims of calculus are clearly visible on the tooth in the larynx. Two others have been deposited in the cavity of the skull, probably through a hole in the center of the right parietal thinning.

In conclusion, we found *post-mortem* fractures of the crowns of teeth at different levels. In deep fractures, the fragments can still adhere and remain *in situ*, others are displaced in the oral cavity. Periodontally compromised teeth did not fracture, but were more easily broken off their alveoli and moved back to the pharynx and even down to the larynx.

DISCUSSION

Traumatic changes in the oro-facial area have been reported several times in the literature. Korkhaus and Otto (1975) found in a female mummy from the 1st to 3rd century AD four *post-mortem* lost front teeth. They are scattered in numerous fragments throughout the oral cavity and down into the throat. Lichtenberg (1972) reports in his investigations of the Egyptian necropolis of Dusch Qasr, Kharga oasis the detection of several mummies with teeth dislocated into the pharynx. According to the author, the periodontally compromised teeth of these elderly persons were translocated into the throat by manipulation during the mummification.

In the mummy heads of the zoological collection, Marburg, Germany, Harbort (2003) describes a skull of a 10- to 12-years-old child from Thebes (no. 22), whose fractured front teeth are covered with resin. Thus the teeth were damaged before or at the least during mummification. In another skull from the same collection (no. 24), the upper left first molar was lost *post-mortem* probably during the embalming process. This tooth was found together with two intravital lost teeth in the cavity of the skull. Lichtenberg and Harbort relate these dental traumas—fractures and avulsions—to the mummification, but without giving details when or why the injuries happened. Korkhaus and Otto (1975), however, interpret this finding as a man-made breaking out of the teeth by the embalmer in order to gain a better access to the oral cavity.

Nevertheless, the question whether the moment within the mummification process and the mechanism of these dental traumas can be more accurately defined arises. The few representations depicting the mummification process give a first hint. On the coffin of the Djed-bastetiufankh (e-Hibe, c. 600–300 BC, Roemer-Pelizaues Museum, Hildesheim, Germany) the obviously already mummified corpse was subjected to two cleanings or anointments (Dunand and Lichtenberg, 1998; Taylor, 2010). Herodotus (c. 484–425 BC) mentioned in his *Histories* (2,86) this washing after the dehydration (Blackman, 1918): "...and when the seventy days are past, they wash the corpse...". This dehydrated and still rigid corpse is cleaned and rubbed with oily and balmy products. This ceremonial anointment gives him back a



Fig. 2. Mummy head, Museum für Völkerkunde, Burgdorf, Switzerland (undated, Inv. no. 7614, CT: Institut für Rechtsmedizin, University, Bern, Switzerland). The photo (Photo: pmimage Switzerland) shows the intact surface of the soft tissues over the oral region. The 3D curved multiplanar reconstruction of the upper jaw displays the fractured teeth in the front region and the fracture of 14. Note also the deep carious lesion in 17.

certain flexibility and good fragrance (Dunand and Lichtenberg, 1998).

The Ritual of Embalming (Sauneron, 1952) describes these funeral anointments (Maspero, 1875) and finally the wrapping of the dead. This religious text is handed

down to us in two papyri: Cairo Museum (Papyrus Boulaq, no. 3) and in the Louvre (no. 5158) (Smith and Dawson, 1924), giving us little information about the technical procedure of the embalming (Smith and Dawson, 1924). Nevertheless, an attentive reading reveals



Fig. 3. Skull, c. 17th dynasty, AIM collection University of Zurich, Switzerland (Inv. no. 1109). Extensive damage to the upper and lower front teeth. The fractured surfaces are discolored by embalming substances. The tooth 15 has lost his crown *intra vitam*, as shown by the apical osteolysis, which has perforated the cortical bone of the maxilla.

interesting details (Maspero, 1875). The head is anointed several times and two bandages are introduced in the oral cavity and an ointment, the “effusion of Shû” (Maspero, 1875; Töpfer, 2011) is instilled down to the throat. Finally, the openings of the head are closed with thick oil, probably the resinous paste, often found on the mouth of mummies (Smith and Dawson, 1924).

The papyrus Vienna 3873 (Vos, 1993) from the middle of the second century BC includes technical details about the embalming of an Apis bull, but the procedure for the holy animal resembles closely those for persons of high rank (Vos, 1993; Dodson, 2009). Below in extracts some chapters are cited, giving further helpful information for the interpretation of the dental pathologies.

In the §6 of the text on the recto side, apparently an official document from the 2nd century BC (Vos, 1993), says:

*“Mouth and Tongue are embalmed
He opens the mouth of the god. He puts his hand in his mouth as far as his hand can reach. [...] He lays two hbs-cloths¹ on his two throat openings. [...] He lays another two hbs-cloths on his upper jaw. He lays another two hbs-cloths on his lower jaw. He covers inside his mouth with hbs-cloth...”*

The text on the verso side, a less careful compilation from 125 to 75 BC (Vos, 1993) adds:

“The oral cavity is embalmed

¹“mummy cloth” (Vos, 1993).

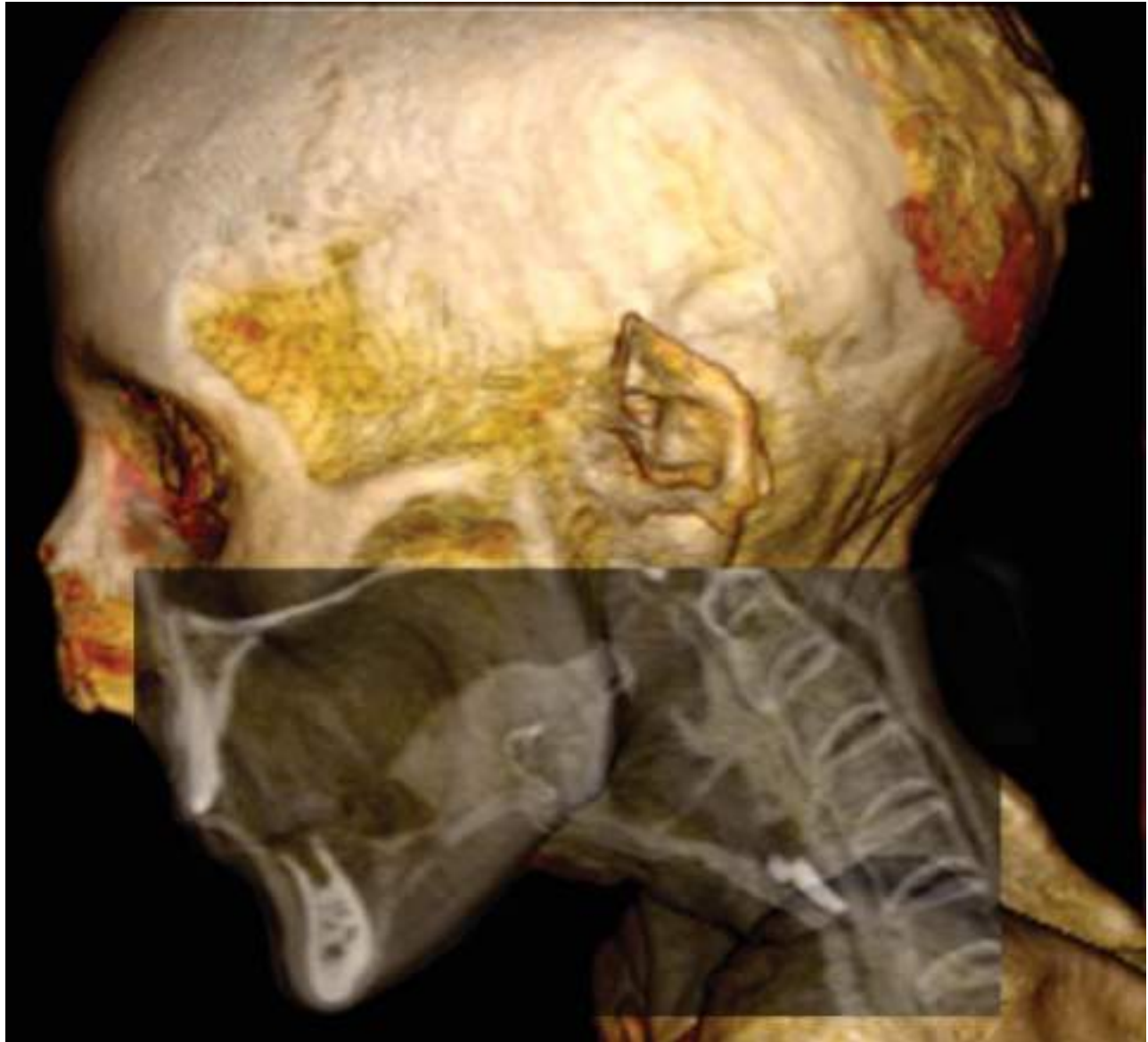


Fig. 4. Male mummy, c. 1,000–800 BC, Musée cantonal d'archéologie et d'histoire, Lausanne, Switzerland (Inv. no.: 0492). A sagittal multiplanar reformatted CT image is superposed to the 3D volume rendering, showing the empty alveolus of a totally luxated front tooth and several teeth crowded together in the larynx.

... two smr-priests² [...] open the mouth of the god before the Overseer of the Mystery³. The Overseer of the Mystery [...] anoints inside the mouth of the god, above and below, as well as the passage of the throat up to the place which his hand shall be able to reach.”

and:

“He makes them go up into the two channels of the throat.”

This procedure is repeated several times.

The quoted texts show that the discussed manipulations and rites in the mouth of the dead were performed after evisceration and excerebration (when performed) and the following dehydration but before the wrapping (Fig. 1). This condition of the dead is represented in only a few paintings, such as on the vignette from a funerary papyrus (Louvre 3074). Here we see a “half-made mummy” (Dawson, 1924)—with its black and shrunken body. The mouth—as on the quoted texts—was several times meticulously cleaned, wiped out with cloths and treated with oils and resins. Because of the rigidity of

²A priest who assists the Overseer of the Mystery in his operations on the mouth of the mummy (Vos, 1993).

³The general director of the embalming, especially charged with the embalming of the head, the most important part of the mummy (Vos 1993).

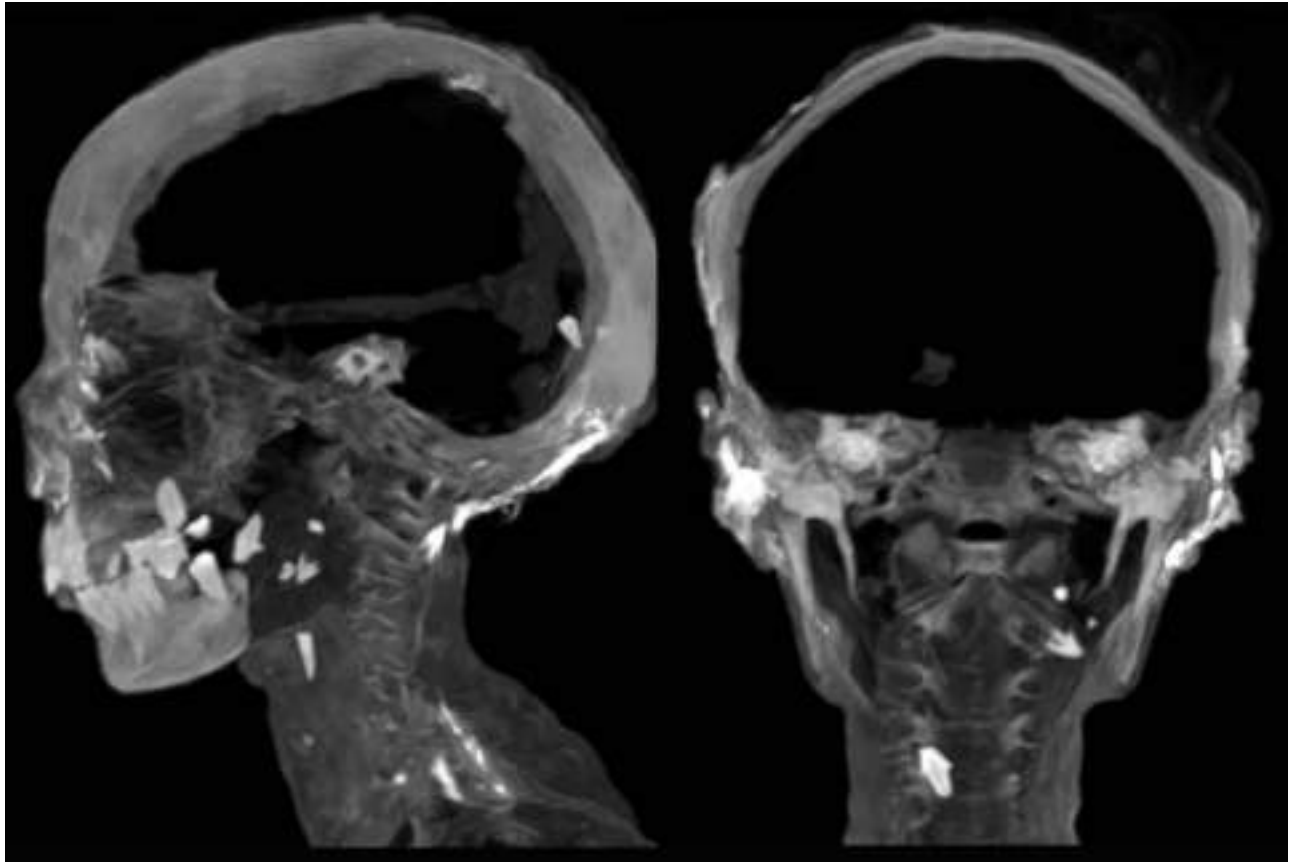


Fig. 5. Female mummy, c. 8th to 7th century BC, Musée d'art et d'histoire, Geneva, Switzerland (Inv. no. D242). A sagittal multiplanar reformatted CT image (left) shows several teeth in the rear of the oral cavity and one tooth in the cavity of the skull. In the transversal section (right), a tooth displaced in the larynx region (possibly recessus piriformis). Also the flattening of the parietal on both sides ("parietal thinning") is visible.

the dehydrated soft tissues, a sufficient opening of the jaws for these manipulations was only attained with the aid of a tool. The Apis Embalming Ritual mentions "2 dowels for operating the mouth" (Vos, 1993). The insertion of such a dowel or chisel (Janot, 2000) between the rows of the teeth in order to open the mouth was also used in the medical context (Vos, 1993; Janot, 2000). Its forced exertion could easily damage the teeth explaining the above-mentioned tooth fractures seen in mummies. If, however, all the front teeth of the upper and lower jaw are broken away, as we see in the above mentioned skulls of the AIM collection (Fig. 3), then it can hardly be the results of only an instrumental manipulation to the jaws. Rather the question arises whether—as Korkhaus and Otto (1975) assumed—the embalmer had deliberately broken away the crowns of these teeth to achieve an easier access to the oral cavity. The coverage of the fractures with resin of the AIM skull no. 1109 indicates that the teeth were damaged during the mummification process, but before the wrapping. Unfortunately, the soft tissues of this skull are no longer preserved. Unlike in the case reported by Korkhaus and Otto (1975), the tooth fragments are lost. Skull AIM 1109 had probably also extensive destruction in the base of the skull, as seen through the damaged internal wall

of the orbit, also a sign of a rather violent execution of the mummification.

A spontaneous *post-mortem* avulsion of a tooth and its dislocation into the oral cavity is possible as shows the periodontally compromised tooth in a naturally mummified corpse of the 16th century AD in the cemetery of the monastery of the Grey Friars in Basel (Hotz et al., 2011). However, such a natural dislocation can be excluded in the case of the anonymous mummy from Lausanne (Fig. 4). The closely crowded teeth deep down in its throat could not have ended there without being forced. Again, the mentioned Apis Embalming Ritual gives an explanation:

"... he [the Overseer of the Mystery] places 2 other hbs-cloths [...] which are soaked in the warm medication. He makes them go up into the two channels of the throat." (Vos, 1993). So, the cloths for the anointment are pushed until the orifices of oesophagus and trachea, where the teeth lie in the mummy from Lausanne. This also explains, how "the mummification treatment made [the teeth] drop down to the pharynx", as Lichtenberg stated. This was probably unintentional. However, in other cases teeth were deliberately displaced, such as two teeth of an adult person found in the pharynx of a young girl (Lichtenberg, 1972), the teeth found in the

cavity of the skull of a Marburg mummy head (Harbort et al., 2008) or in the above described mummy from Geneva. The purpose of this act is not clear.

The OMR was mentioned above. In its sequence of magic ritual actions a symbolic use of different instruments was carried out on the statue or the coffin of the dead. One of these ritual instruments mentioned in the texts to the OMR is a chisel: “*O N, open is your mouth, because it is opened by Ptah with the chisel in iron, by which is opened the mouth of the Gods.*” (Goyon, 1972). Another is the “*psš-kf*”, also called according to its form the “fishtail knife”: “*I have opened your mouth with the psš-kf, by which the mouth of each God and Goddess is opened*” (Otto, 1960). During the OMR the *psš-kf* is used in a purely ritual context, and accordingly it has undergone diverse interpretations (Bardinet, 1990; Roth, 1992). However, Otto (1960) claims the original use of this tool was to open the jaws of a corpse during embalming. Then the tool and the scene in which it was used would derive from the embalming ritual. Therefore, symbolic acts and symbolically used instruments of the OMR can be attributed to and derive from real actions and the use of real instruments during the mummification. For Janot et al. (1999), the instrument *psš-kf* was used to maintain open the mouth of the deceased, as he tried to show with the replication of this tool found in the tomb of Ankh-Hor (656–586 BC). Peacock et al. (2011) think that this knife with the concave cutting blade was applied for the large osteotomies and osteotomies in the facial skeleton they found in the head of the mummy of Djehutynakht (c. 2000 BC). The aim of this operation was to overcome rigor mortis by detaching the masticatory muscles for the later OMR, if this ceremony were to be performed shortly after death. Interestingly, a similar myotomy for forced oral opening in case of persistent rigor mortis is suggested in forensic dentistry (Nakayama et al., 2001). Nevertheless, Sanchez (Sanchez and Tismenetsky, 2009) noticed rightly that for the symbolic procedure of the OMR, performed on the wrapped mummy just before encoffinment, rigor mortis was irrelevant. It was possibly also irrelevant in the beginning of the funeral rites. We know almost nothing about what happened in the time immediately after the death of an Egyptian (Smith and Dawson, 1924). A rare representation of a death scene is depicted in the Old Kingdom tomb of Ankh-ma-Hor, Saqqara (Capart, 1907). Herodotus also gives a short description of the funeral procession conducting the dead to the place where the further rites were performed. He specifically also mentions that in case for some females three to four days were waited *post-mortem* before delivery to the embalmers. The time needed for bringing the dead to the embalmers could exceed the duration of rigor mortis—especially, when we consider the usual elevated environmental temperature in Egypt (Krompecher, 1981).

Thus, it is important to make the distinction between the OMR and a real opening of the dead’s mouth (Fig. 1). Pahl (1986) concluded this after examining unusual *post-mortem* modifications of the mouth region visible on ancient Egyptian mummies. For him, the “ritual of opening-the-mouth” could be performed as a “statue-ritual,” a “bandaged-mummy-ritual” or finally as a “actual-body-ritual.”

One learns from the texts of the Ritual of Embalming and the Apis Embalming Ritual that after the surgical

treatment and the dehydration the dead body was again cleaned and anointed before being wrapped. The jaws had to be forced apart with instruments to wipe out and anoint the oral cavity with oil and resins. For these manipulations, the term “opening of the mouth procedure” may be used, to distinguish it from the purely symbolic actions of the OMR. This opening of the mouth procedure caused in many cases—and with this we come back to the initial point—fractures and avulsions of front teeth seen frequently in ancient Egyptian mummies.

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