HISTORY

The mummy of Pharaoh Amenhotep III (reigned ca. 1388–1351 BC) and its facial approximation: An anatomical approach

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Abstract

This article offers for the first time a facial approximation of the Ancient Egyptian Pharaoh Amenhotep III (reigned ca. 1388–1351 BC) based on photographic material of his mortal remains and anthropometric data collected at the time, and by adopting a novel technique previously used in similar research by our team. A comprehensive discussion of the mummy attributed to Pharaoh Amenhotep III is also annexed to the study, focusing on the bioarcheological and embalming aspects.

KEYWORDS
Amenhotep III, anatomy, Ancient Egypt, bioarcheology, embalming, facial approximation, forensic techniques, morphology, mummy

1 | HISTORICAL BACKGROUND

Mummies from Ancient Egypt have always held a special fascination for people, and the facial reconstruction presented here belongs to one of the most famous kings of the New Kingdom: Amenhotep III. Also known as 'The Magnificent', he ruled over Egypt for nearly four decades (ca. 1388–1351 BC) during the mid-18th Dynasty (New Kingdom) (Breasted, 2016). He ascended the throne as a child; his age at that time is uncertain, but it is estimated to have been between 4 and 12 years. He ruled for 38.5 years; Manetho assigned him 38 years and 7 months, which is probably correct, hence he must have died aged 42–50 (Habicht, 2021). His life has been studied in detail and is described in various monographs on Egyptian history (Fletcher, 2000).

His grandiose building projects and the pinnacle of New Kingdom art made him famous. He was married to Tiye, a queen whose parents were of noble but probably not royal birth. The bodies of Tiye's parents, Yuya and his wife Thuya, were found in the Valley of the Kings in tomb KV 46; their identification is therefore beyond doubt (Bierbrier, 2008). Amenhotep III and Tiye had two sons, Thutmosis and Amenhotep, and at least six daughters.

There are confusing facts about the secondary coffin used for his re-burial in tomb KV 35: the lower part of this wooden coffin was re-labeled for King Ramses III (20th Dynasty) and the lid was re-inscribed for King Seti II (19th Dynasty). In a second stage, a scribe added the final new owner at the side: Neb-Maat-Ra (Amenhotep III).

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Inside the coffin, the wrappings also carried a label by the restorers, naming Neb-Maat-Re again. The inscription is much faded now, so we had to rely on the original observations by the first autopsy team in 1905.

In principle, two Pharaohs can be linked to the throne name Neb-Maat-Ra: Amenhotep III in the mid-18th Dynasty, and Ramses VI, who used the name again in the 20th Dynasty: Neb-Maat-Ra-mery-Jmen (with the epithet 'beloved of Amun'). However, the mummy of Ramses VI is known (Cairo CG 61086); this mummy is clearly made in the style and technique of the 20th Dynasty. There has never been serious doubt that CG 61086 is indeed Ramses VI, and so the mummy Cairo CG 61074 is most likely that of Amenhotep III.

In the present study, following the lines of previous research by our group featuring other Ancient Egyptian characters (Moraes et al., 2023; Moraes, Beaini, et al., 2024; Moraes, Varotto, et al., 2024), we offer a novel facial approximation of this distinguished ruler of Ancient Egypt, together with a review and discussion of the bioarcheological aspects of his embalmed body.

2 | MATERIALS AND METHODS

Forensic facial approximation attempts to reconstruct an individual's face from a skull. Blender 3D software was used for the modeling process, running the OrtogOnBlender add-on (http://www.ciceromoraes.com.br/doc/pt_br/OrtogOnBlender/index.html) and its ForensicOnBlender submodule. The program and add-on are free, open source and multiplatform, and can run on Windows, MacOS, and Linux.

For this work, two images of the mummified head of Amenhotep III were used, available on the Wikimedia Commons portal under Creative Commons license (https://commons.wikimedia.org/wiki/File:Amenhotep_III_mummy_head_profile.png and https://commons.wikimedia.org/wiki/File:Amenhotep_III_mummy_head_profile.png). The images were aligned so that the anatomical structures corresponded (Figure 1A). They were then aligned to the X plane (front) and the Y plane (side). They were also resized to fit the true scale (Habicht et al., 2021).

The skull was modeled using the anatomical deformation technique (Quatrehomme et al., 1997). A computed tomography scan of a living individual was obtained and deformed until it was compatible with the skull attributed to Amenhotep III. Care was needed to correct the occlusion of the mandible, since the mandible in the mummified skull is slightly rotated. During the anatomical deformation process, the soft tissue of the virtual donor was also modified to present a face compatible with the approximated individual (Figure 1B). A series of 31 soft tissue thickness markers, derived from measurements in living individuals using ultrasound (De Greef et al., 2006), were distributed throughout the skull to identify the limit of the soft tissue in some regions of the face. To complement the work and provide data from regions not covered by these soft tissue markers, a series of anatomical points were placed on the skull. From those, a series of projections based on measurements of computed tomography scans of living people (Moraes et al., 2021; Moraes & Suharschi, 2022) provided data for the projection of the nose, positioning of the eyeballs, limits of the ears, limits of the eyelids, dimension of the lips, limits of the nasal wings, and other characteristics (Figure 1C). All the projection data were used to generate a basic face by interpolating between them and the anatomical deformation (Figure 1D). The present work followed the approach by Abdullah et al. (Abdullah et al., 2022), in which the bust of a ready-made facial approximation was used as a base and deformed in accordance with the available facial structure data, generating a basic face (Figure 1E), with pre-defined coloring data that could be adjusted to match the intended face with the ready-made basic face. The final stage of the process consisted of modeling the clothes and the blue crown (Figure 1F) and sculpting the facial details to generate the final bust (Figure 1G).

For a more complete understanding of the techniques used in the facial approximation process, the reader can access a series of video lessons presented in the Data Statement.

3 | RESULTS AND DISCUSSION

Two types of image were generated. One was more objective, without hair, with eyes closed and in grayscale (Figure 2). The hair is absent because it is difficult to establish its correct distribution and configuration for the individual in question. The eyes are closed because it is difficult to know the shape of the open eyes. Grayscale is a way of demonstrating the structure without needing to color the skin, another aspect about which information is limited. The second image had more subjective and artistic elements such as hair, open eyes with eyeliner paint, skin color, and clothing appropriate for the period of Amenhotep III (Figure 3).

Amenhotep III's mummy was found in 1898 by French archaeologist Victor Loret (1859–1946) among other royal mummies in cache KV 35. This was the original royal tomb of King Amenhotep II, but was later used as a storage cache by the priests of the Third Intermediate Period to rescue the rulers of the New Kingdom. On September 23rd 1905, the Australian anatomist Grafton E. Smith (1871–1937) performed the first investigation of the mummy Cairo CG 61074 (Bickerstaffe, 2009; Habicht, 2024; Smith, 1912). Smith obtained various standard measurements used in anthropology and later supplemented by additional ones by Robins and Shute (1983):

1. Cranial length: wrongly published as 194 mm, corrected to 174 mm by checking scaled pictures (Habicht et al., 2021)
2. Cranial breadth: 148 mm
3. Circumference: 550 mm
4. Auricular height: 118 mm
5. Total facial height: 122 mm
6. Upper facial height: 73 mm
7. Minimal frontal breadth: 95 mm
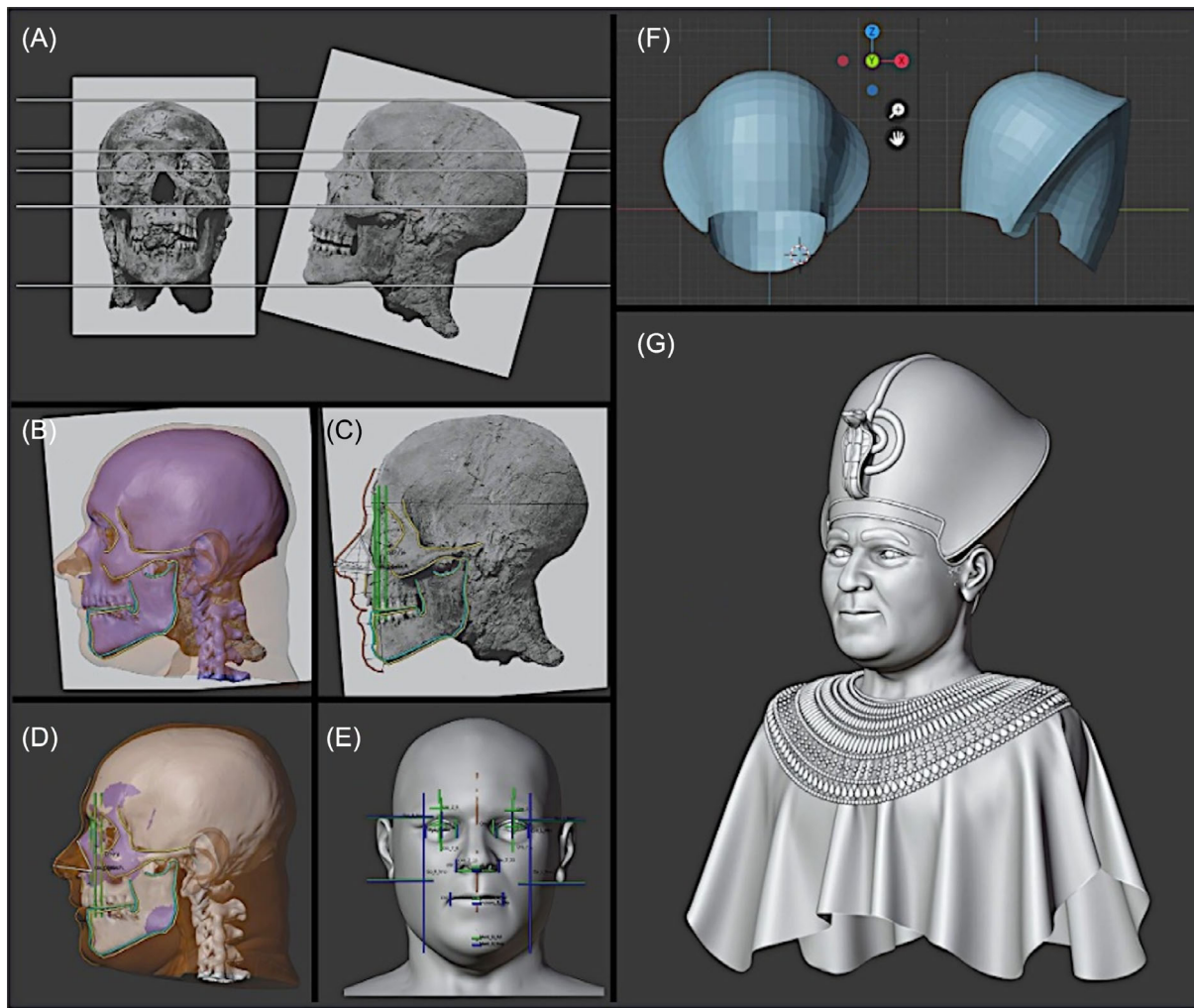8. Bizygomatic breadth: 133 mm

FIGURE 1 Steps of the facial approximation. (A) Reference images aligned (Wikimedia Commons, Smith G.E. 1912). (B) Virtual donor matching. (C) Profile face using soft tissue and anatomical projection. (D) Profile face and facial deformation. (E) Basic face and frontal anatomical projections. (F) Modeling of blue crown. (G) Complete and final approximation bust.

9. Bigonial breadth: 94 mm
10. Nasal height: 53 mm
11. Nasal breadth: 26 mm
12. Interorbital breadth: 27 mm
13. Left orbit: 39 × 34 mm
14. Right orbit: 39.5 × 34.5 mm
15. Chin-vertex projection: 210 mm
16. Body height (direct measurement): 156.1 cm
17. Right femur: 42.45 cm (max) and 42.1 cm (oblique)
18. Left femur: 453 mm
19. Right humerus: 28.5 cm (max) and 28.15 cm (oblique)
20. Left tibia: 355 cm
21. Right tibia 354 mm

During studies of the craniometrics of the Pharaohs, as exemplified above, some authors of this study (MEH and FMG) found that the cranial length measurement in this case was wrong (Habicht et al., 2021). A scaled 1:1 photograph taken by Smith shows that all measurements are accurate except the cranial length, to which 20 mm had been added. We assume that the handwritten note taken during the autopsy read 174 mm but was later misread as 194 mm. Comparing Amenhotep's head in lateral view with the skull of KV 55 (189 mm) or Tutankhamun (187 mm) shows that it is clearly less elongated. A cranial length of 194 mm is thus impossible and should be corrected to 174 mm, as measured on the photograph.

The estimated living stature of Amenhotep III reported in the literature is approximately 160 cm. This is obtained by the combined Pearson's Femur-Tibia formula $71.272 + 1.159 \times (\text{Femur} + \text{Tibia})$ (± 3.0) (Pearson, 1899), which yields:

$$[\text{Mean value for femur}: 43.70\,\text{cm}].$$

$$[\text{Mean value for tibia}: 35.45\,\text{cm}].$$

$$71.272 + 1.159 \times (43.7 + 35.45)\,(\pm 3.0) = 163.00\,\text{cm}.$$
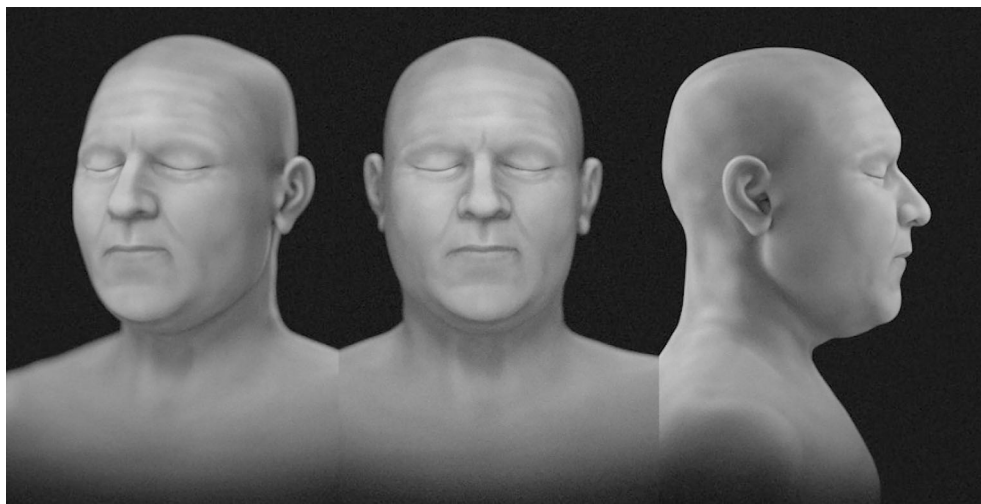
FIGURE 2 Objective forensic facial approximation.

If the measurements provided by Robins et al. (Robins & Shute, 1983) are applied:

$$71.272 \quad 1.159 \times (42 + 34.1) \, (\pm 3.0) = 159.50 \, \text{cm}.$$

Being one of the most famous pharaohs in Egyptian history, Amenhotep III has unsurprisingly been studied in greater detail than other royal mummies. However, the poor state of preservation of this mummy, which has decayed severely owing to grave robbery and humidity-related damage, makes it difficult to explore. The largely skeletonized head does not allow direct conclusions to be drawn about the individual's facial appearance *intra vitam* by mere observation, as is the case for well-preserved mummies.

Moreover, regarding the embalming aspects of this famous mummy, an early chemical investigation by Alfred Lucas, the leading expert on the method of ancient embalming at the time who later worked in the tomb of Tutankhamun, showed that the stuffing material consisted of resin mixed with 14.3% inorganic matter (7.5% of that was a mixture of carbonate, sulfate and sodium chloride) (Smith, 1912). Lucas defined it a crude 'Egyptian Natron', remarking that such packing material was not used during later periods (21st and 22nd Dynasties). According to Egyptologist Joann Fletcher, Amenhotep III was mummified in a peculiar way. He appears to have been dried out in a saturated liquid natron bath, stuffed out, sealed with several layers of resin and eventually transformed into a 'statue-like mummy', more like a statue than a conventional mummy (Fletcher, 2015). This proposed new style could have been the result of the rising preference for the sun god, especially in his visible form as Aton, the sundisc.

4 | CONCLUSIONS

Future investigations on Amenhotep III's mummy, potentially involving genetic tests and more refined state-of-the-art chemistry of the embalming materials, could provide interesting new details about this Ancient Egyptian Pharaoh's ancestry and physiological and

FIGURE 3 Colored forensic facial approximation.

pathological genotype, as well as about the method used to preserve his corpse throughout the centuries. In this specific study, we have focused on his cranio-facial anatomy and have offered a novel approximation of his face, thus opening a window on to an enigmatic yet fascinating past.

DATA AVAILABILITY STATEMENT

Two classes on projection of facial structures such as lips, mouth, ears and others can be accessed at the following links: Class 1: (https://www.youtube.com/watch?v=U6oYkEmfyWo). Class 2: (https://www.

youtube.com/watch?v=Vcz2e5uSFX8). Subtitles need to be activated for non-Portuguese speakers, but the class itself is didactic, given the simplicity of the approach. A class on nasal projection, using statistical data, can be followed at this link: https://www.youtube.com/watch?v=F205kLQ–Oo. Non-Portuguese speakers need to activate the subtitles. A demonstration of anatomical deformation can be seen online at the following link: https://youtu.be/xig5_EcIFWA. A demonstration of facial approximation stages with example of texture/UV map setup: https://www.youtube.com/watch?v=5lM8PybpKqY. A demonstration of facial approximation that includes the configuration of the beard and hair can be seen at: https://commons.wikimedia.org/wiki/File:D._Pedro_I_-_Processo_da_reconstru%C3%A7%C3%A3o_facial_forense.webm.

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