



Mummies are alive within International Orthopaedics: Ramses II speaks with SICOT surgeons about orthopaedics in ancient Egypt and today

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“Mummies viventes (vivos) docent”: the mummies teach the living with 3000 years distance

This sentence differs from “mortui vivos docent or mortui viventes docent”: the dead teach the living that you will find that inscription in most cadaver labs [1] in the world. Since humans have been dissecting other humans in the name of medicine since 300 BC, when the ancient Greeks started the practice, cadaver dissection on a recently deceased person continues to be a learning exercise at medical schools worldwide. However, dissection was not practiced or authorized by the Ancient Egyptians. Only mummification, a process preparing for “resurrection and life in the future,” was approved by Osiris, God of the dead and resurrection. We see him represented in Fig. 1 holding the flail and the hook, symbols of his authority. Mummification was not practiced by doctors in ancient Egypt and was not intended to teach doctors anatomy. Special priests worked as embalmers. However, as we will see, this mummification allows us to teach our current period about specific diseases and enables a form of resurrection for certain mummies, such as Ramses II.

The reason for the scientific study of mummies is to understand the evolution of health and disease from previous or extinct populations of humans until today [2]. In recent years, the importance of historical human remains for understanding the development of human morphology and illness patterns has come to light. Ancient mummies come from all across the world, as well as many civilizations and historical periods, making them a precious source of

knowledge about former human biological conditions. For instance, mummies are more likely to produce ancient DNA than skeletal remains. There are more and more instances when mummy studies have added to our understanding of medicine [3].

This is especially relevant for research on infectious diseases like tuberculosis. Genomic studies of the adaptive evolution of *Mycobacterium* strains have been conducted on human remains that have been artificially mummified (Egyptian mummies). For example, until very recently, no one knew whether the tuberculosis bacilli that reached humans was of bovine origin or whether the reservoir has been purely human for a long time. As a reminder, BCG vaccination is done with an attenuated *Mycobacterium bovis* vaccine which protects children but does not protect adults; one of the explanations was given recently by the study of the DNA of Egyptian mummies, which shows that even in antiquity and in prehistoric times, the reservoir was purely human and not animal and that the bacteria responsible is mycobacterium tuberculosis, which suggests that other types of vaccination against tuberculosis must be considered to eradicate a germ in the reservoir which has been purely human since prehistory.

From mummification to ChatGPT: conversation with a recent dead, Steve Jobs

“The love you gave in life keeps people alive beyond their time. Anyone who was given love will always live on in another’s heart”; Marcus Tullius Cicero [4]

“The living cannot teach the dead anything; the dead, on the contrary, instruct the living”; Chateaubriand in the *Mémoires d’outre-tombe* [5]

Could artificial intelligence(AI) change how we learn history [6]? Could we make reading of history texts into engaging and tailored learning experiences using AI? The answer is probably yes, and people will act as the gatekeepers to

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Fig. 1 Osiris' green skin symbolizes the rebirth of the deceased God, in the image of vegetation. Dressed in his white mortuary tunic, he is wearing the "atef" crown (a white miter with two coloured feathers) and the barber of Pharaoh



ensure that the experiences are morally acceptable, pertinent, and worthwhile.

Steve Jobs died in 2011. Hearing the Apple co-founder explain that “the biggest event of 2020 was the COVID-19 pandemic,” with his calm tone and characteristic timbre [7], will give some people a chill. Obviously, it is not Steve Jobs who is speaking, but a digital reproduction of his voice, with whom it is possible to discuss anything and everything thanks to the Forever Voices service, offered on the Telegram messaging app for 60 US cents the minute. To create it, American developer John H. Meyer trained the chatbot ChatGPT with speeches from Steve Jobs so that it reproduced his personality and turns of phrase. Different software allowed him to imitate his voice from recordings (5 min is enough) and to design an interface for conversing via voice messages.

Can International Orthopaedics do better? Yes, we can! Chat with Ramses II

Let us imagine a fascinating conversation chat [8] between three orthopaedic surgeons, Dr. Gamal Hosny, Doctor Philippe Hernigou, Doctor Marius Scarlat, and a mummy from ancient Egypt named Ramses II.

Doctors (All): We are Egyptian and French orthopaedic surgeons specializing in bone and joint disorders. We can



Fig. 2 Pharaoh is landing to Paris airport

talk with Ramses II, the ancient Egyptian Pharaoh. Though he's been gone for thousands of years, we can learn so much from the remains of his mummified body. Let's begin!

Ramses II: (Seems animatedly in his sarcophagus, yet mysteriously): Welcome, orthopaedic surgeons. It's an honour to converse with surgeons from the distant future. I have many questions about your actual world in Egypt and France.

Doctors (GH): Thank you, Ramses. It's a privilege as an Egyptian to speak with someone from ancient times. Let's start by discussing the reasons for your interest in France.

Ramses: On March 23, 2023, Paris Charles de Gaulle Airport welcomed a distinguished guest, the sarcophagus of Ramses II. It was at 6:10 a.m. that flight AF 567 carrying the coffin landed on the airport tarmac, a real event because the exits of the sarcophagus from outside Egypt are exceptional. I indeed traveled a lot during my period of activities on Egyptian soil, but I also have the privilege of having been to France twice, the first time in 1976.

Doctors (PH): What are your memories of 1976? I was a young resident in orthopaedics and I remember your visit

Ramses: The first time in 1976, President Sadat sent me as ambassador to President Giscard d'Estaing. I was welcomed in France like a head of state (Fig. 2). A special team from France wedged me with moss in my coffin for transport. I was probably the first Pharaoh to fly and travel that far. My flight was on September 26, 1976 (Fig. 3). I was escorted by bikers to the Musée de l'Homme, place du Trocadéro. I made a short detour to Place de la Concorde on the way. I was surprised to admire the Obelisk that I had myself erected in Louxor!

Doctor (PH): I will explain this to you later, but you can be proud because ultimately, not only are you the most famous Pharaoh of Egypt, but you also unknowingly built the oldest monument in Paris (3000 years!).



Fig. 3 Pharaoh is transported to the French Museum

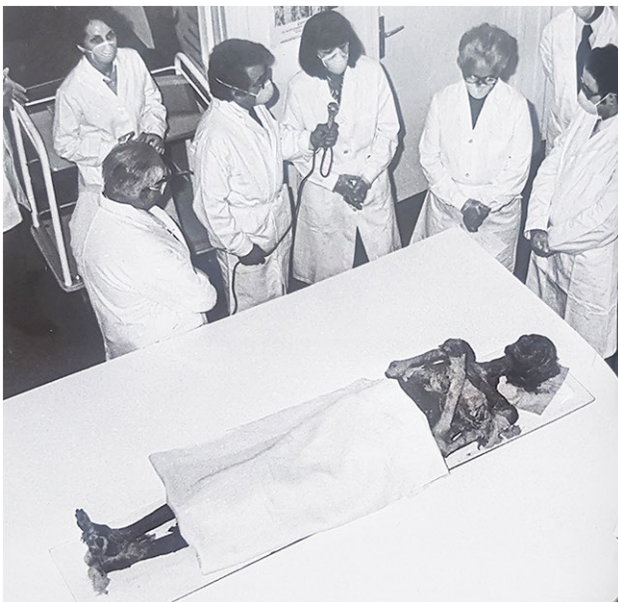


Fig. 4 Ramses is surrounded by Medical international specialists

Ramses: Seen like that, I finally participated in the construction of Paris. On this occasion, I had the opportunity to discover the progress of medical technology in this world of the future: 45 multidisciplinary teams (Fig. 4) bringing together around a hundred researchers and technicians using modern methods: endoscopy, chromosomal and bacteriological studies, and even radiographic studies. But tell me, was I the first Pharaoh to have X-rays?

Doctors (All): No, sorry for that, you were not the first! You had radiographs only in 1976. The radiologist Walter

Konig in 1896 was the first to apply the novel X-ray technology to a young mummy only a few weeks after the famous discovery by Rontgen in 1895. Thus, X-rays have been used for a long time to investigate ancient mummified bodies and other pharaohs.

Why X-raying ancient mummies?

Ramses: Why are you using radiographs to see inside our body? Is it for searching for jewelry in Egyptian mummy wrappings? Do you know that this is disrespectful to our people? Gold is the flesh of the Gods. In Ancient Egypt, gold is a reality, and the most famous illustration is in the sarcophagus of Tutankhamun discovered in the Valley of the Kings by the Briton Carter in 1922: 100 kg of pure gold! But did you ask me for informed consent to do my radiographs in 1976?

Doctor (MS): I am the Editor in Chief, a sort of Pharaoh for the Journal; the others (GH, PH) are scribes. I do not believe that in 1976, doctors asked you for informed consent since it was not in the law at this period. As Editor [9], I can ask you for “informed consent” to publish data on your health through this medical Chat; you probably do not need an answer 3000 years after your death. I am afraid that even if you answer me, it will be with hieroglyphics, and Springer will not be able to print them correctly in the Journal.

Ramses: Agree; no informed consent; furthermore, I cannot find a scribe, writing with hieroglyphs, either in Paris or Cairo. How did you decipher the hieroglyphs?

Doctors (All): It was Champollion who made this discovery. Jean-François Champollion is considered the father of Egyptology since his discovery of the complex system of hieroglyphs. The cartouches in which the names of the Pharaohs of the Ptolemaic era were written on the Rosetta Stone allowed Champollion to decipher the very first hieroglyphics. The Rosetta Stone was found during Napoleon’s expedition to Egypt in 1799, the stone bears the same decree engraved in three languages: Greek, Demotic (a modernized script of hieroglyphics), and hieroglyphics. Your Obelisk of Luxor was a gift given by the Egyptian Sultan, Mohammed Ali, to the French King, Louis-Philippe, in gratitude for the work of Champollion on deciphering hieroglyphics.

Ramses: I am curious to know how you transported it and put it upright. I remember that my vizier Paser had big problems erecting this Obelisk in Luxor.

Doctors (All): The transfer to France of your 23 m high monolith obelisk erected in front of the Luxor temple asked the naval officers in charge of the operation a considerable technical challenge. First to lay down the Obelisk without incident, then to load it on a bar which was towed between Alexandria and Rouen by the first ocean-going steamship of the French navy, an opportunity to highlight all the actors

in this epic of six years which ended with the triumphant raising (Fig. 5) of the Obelisk on Place de la Concorde on October 25, 1836.

Ramses: Let's return to the practice of X-rays; if radiographs were not performed to find gold, what was the reason?

Doctors (All): Main research issues for diagnostic imaging on ancient mummies have been for medical or archaeological purposes. For example, Grafton Elliot Smith (1912) judged the individual age at death Tuthmosis IV by the status of epiphyseal plate fusion. The application of conventional X-rays led to the detection of multiple pathologies, such as degenerative (arthritis) or infectious (tuberculosis), and conditions involving bone or other calcified tissues. Thanks to the papyrus, we learned you had sophisticated techniques to treat and consolidate fractures.

Ramses: What do you know about the treatment of fractures in Egypt? How can you travel in the past for fractures?

Doctor (GH): We have today an extensive experience in fractures [10]. In the past, the Edwin Smith papyrus represents the clinical records of detailed anatomical, clinical and therapeutic information of 48 cases including vertebral injuries and fractures of the clavicle, humerus and sternum. This papyrus shows the physician how to examine patients. For example in Case 31 diagnosis was cervical dislocation with recording unconscious of his two legs and his two arms [paralysis or quadriplegia], and his urine dribbles, an ailment described as not to be treated. And, we can perform X-rays and CT scan on mummies.

Are radiations dangerous for mummies?

Ramses: Aren't these radiations dangerous for mummies? I remember when I went to Paris it was to be treated because of the fungus and other micro-organisms in my body; there was a considerable discussion about the risks of radiation for my treatment.

Doctors (PH): It is true, I remember the discussion. Laboratory studies have revealed the presence in your body of about sixty different species of fungi and insects, which slowly participated in the degradation of your body. There was only one way to overcome it: radio sterilization. But never before has a mummy been treated with gamma rays. Were you going to become a radioactive Pharaoh? Can you risk being sent back to Cairo bald if your red hair fell out after radiation? The Commissariat for Atomic Energy and Alternative Energies (CEA) had an irradiator dedicated to safeguarding heritage as part of a program called Nucleart. This reassured the Egyptologists of your country; nevertheless, it took several months to test the effectiveness of the treatment and its harmlessness on your hair, your teeth etc. The radiation dose was calculated with your skeleton especially surrounded by bands that mimicked the volume and shape of your mummy. On "D" day at the CEA center in Saclay, journalists and a police escort attend the event. For 12 h 40 minutes you were placed in a radiation-proof showcase that will follow you to the Cairo Museum to avoid further contamination. You received the dose considered reasonable at the time of 1.8 Megarads and you left the next day, May 10, 1997, healed! You are undoubtedly the only Pharaoh to have had a double resurrection: the first in 1881 when two Egyptian peasants discovered your hiding place in the mountain of Thebes, and the second when you came to Paris and left cured. You can thank Osiris!

However, considering my knowledge of bone irradiation [11], I can make two remarks to you: it is almost sure that this dose killed all the bacteria and fungi, but it is not certain [12] that all the viruses were eliminated from your body. Finally, at this irradiation dose, a fragility of your skeleton has been induced, as is currently observed on irradiated bone allografts [13]. I don't think you were informed of this risk. "Pharaoh that you are," you would not be a "suitable" donor

Fig. 5 Painting of the erection of the Ramses obelisk in Paris by Dubois François



for a bone allograft [14] for another patient due to your age and irradiation.

Ramses: But you mean that you also currently do a form of mummification, that is to say, that you preserve the organs of the dead to use them in the living? Are you able also to keep heart? How do you manage that with Osiris?

Doctors (all): It's called transplantation and allows certain people to be revived or resuscitated. "Our Osiris" is called the "Transplant Regulation System," and the process remains as complicated and sophisticated as with Osiris in your time to prepare for resurrection.

Chat with Ramses about mummification in ancient Egypt

Doctors (All): Ramses, let's get back to your health in your lifetime. Your mummy and the mummies of the other people of your civilization has provided valuable information about your life and any potential injuries or medical conditions you may have had.

Ramses: Ah, indeed, I lived for about 90 years, and in the end of my lifetime, I faced several health challenges. My knee often troubled me, and my bones sometimes ached. It would be fascinating for me to know what your knowledge is about my mummification and my diseases.

Doctors (all): The mummification process took about seventy days, as you know. In addition to being familiar with the appropriate rites and prayers to say at different times, priests who worked as embalmers also required to have a thorough understanding of human anatomy. Initially, they removed any internal components that might deteriorate rapidly. The process involved delicately extracting pieces of brain tissue through the nostrils using specialized hooked instruments. The abdominal and chest organs were then taken out through a precise incision made on the left side of the abdomen. They removed the heart to embalm it. Your heart has indeed been removed for embalming but has not been put back exactly in its place. It was placed in the right para hilar region with the tip of the heart at the top and the auricles at the bottom; you are a mummy with a double situs inversus. The embalmers then completely dried out the body, removing all moisture. This was achieved by covering the body with natron, a highly effective drying agent, and placing additional natron packets inside the corpse. Once the body had thoroughly dried, the inner packets were removed and any remaining natron was gently rinsed off. Finally, the mummification process concluded with carefully wrapping the body using several hundred yards of linen. At this point, everything was prepared for the funeral and your afterlife. You will learn more about your diseases and cervical spine in international orthopedics [2].

Ramses: Dear doctors, who can go back in time and describe my mummification, can you have an idea of my appearance at the time of my splendor when I was only 40 years old?

Doctors (all): Yes, we have new technology for that. The scanner allows the study of pathologies and reconstructs the face in three dimensions from the morphology of the skeleton. Thus, in our time, we are able, from a meticulous scan of your mummy and with the help of a forensic anthropologist accustomed to identifying skeletons for the FBI or Scotland Yard, to reconstruct in three dimensions your physiognomy not only at the time of your death at 90 years old but also at 45 years old, because it is possible to rejuvenate your face. The great difficulties in the reconstruction in three dimensions do not come from the bone but from the soft parts, which retracted during the mummification due to the dehydration with natron. The process is about three months, allowing us to see you in 3D.

Ramses: Three months is very short; in my time, it took several years to make my statues. Thank you for publishing my portrait in International Orthopedics at 90 (Fig. 6) and 45 years old (Fig. 7). It's ultimately quite frustrating to always see yourself represented as a mummy, mainly when speaking with persons in the future. As I return from Paris to Cairo in "my" Museum, I hope to chat again with you in November during the next World Congress.

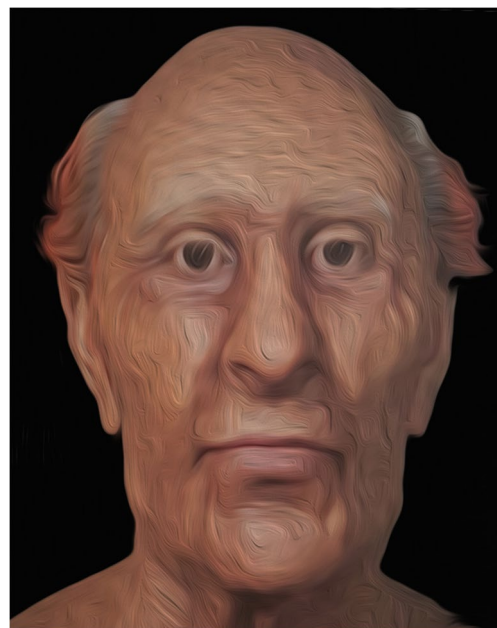


Fig. 6 Face of Ramses at 90 years old: oil painting by PH according to the 3D representation done by Sahar Saleem, an Egyptian paleoradiologist at Cairo University, and Caroline Wilkinson, a British forensic anthropologist at Liverpool University

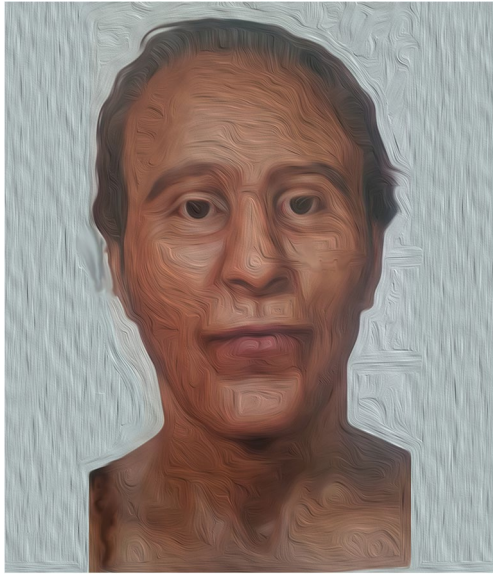


Fig. 7 Face of Ramses at 45 years old (oil painting by PH)

Conclusion

This civilization has been said to be dead, yet some of these names have stood the test of time, witnessing the millennial survival of a forgotten Ancient Egypt. Whether or not we know how to decipher its hieroglyphs, Ancient Egypt speaks to us: it transmitted to us its ideal of beauty and the munificence of its greatest Pharaoh Ramses II. Beyond the impressive monuments that his reign bequeathed to us, more sumptuous than his sumptuous jewels of extreme refinement, his name, Ramses, fiercely retains the force of the God-king. This is perhaps the greatest and, paradoxically, the simplest secret one can inherit: the eternal survival of names. To pronounce the word of Ramses not only offers immortality to the Pharaoh but invites us to 3000 years of distance, abolishing the borders of time to share with him the force and the unalterable power of surgery and diseases through the centuries.

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