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Abstract

Ethical issues are of foremost importance in modern bio-medical science. Ethical guidelines and socio-cultural public awareness exist for modern samples, whereas for ancient mummy studies both are de facto lacking. This is particularly striking considering the fact that examinations are done without informed consent or that the investigations are invasive due to technological aspects and that it affects personality traits. The aim of this study is to show the pro and con arguments of ancient mummy research from an ethical point of view with a particular focus on the various stakeholders involved in this research. Relevant stakeholders in addition to the examined individual are, for example, a particular researcher, and the science community in general, likely descendents of the mummy or any future generation. Our broad discussion of the moral dilemma of mummy research should help to extract relevant decision-making criteria for any such study in future. We specifically do not make any recommendations about how to rate these decision-factors, since this is highly dependent on temporal and cultural affiliations of the involved researcher. The sustainability of modern mummy research is dependent on ethical orientation, which can only be given and eventually settled in an interdisciplinary approach such as the one we attempt to present here.

Introduction

Ethical issues are of foremost importance in modern bio-medical science. For clinical studies, as well as the complex issues of how to deal with modern corpses – such as body donation programs or public anatomy exhibitions – ethical guidelines or at least lively socio-cultural public debates exist. There is also an increasing number of paleopathological studies, research dealing with the bio-medical assessment of historic human remains [1] and its impact on modern bio-medical science, is well respected. [2-4] Such ancient human (and animal) remains do not only consist of skeletal findings, but also of mummies with preserved soft-tissue. These can be found on every single continent. [5] The most famous are ancient Egyptian mummies, but also the European Neolithic Iceman ("Ötzi") has become a prominent object of scientific investigation. Despite the great interest in these mummies, very few discussions about how to generally treat these ancient bodies can be found in public debates. One such public debate arose in 1980 when the Egyptian president Anwar el-Sadat ordered the closure of the Royal Mummy exhibition room in the Egyptian Museum in Cairo due to religious-ethical reasons. Besides limited public debates, very few scientific reports hitherto address ethically disputable issues of ancient mummy or bone research. [6-9] Holm [10] uses the issue of ancient DNA sampling to address a few thoughts on a possible lack of privacy and how to address this issue based on current ethical criteria, such as consent of the dead person's descendants or culturally-linked communities. He concludes that common modern ethical assessments fail for such ancient cases. Thus, both the public and the scientific debate fall short in addressing possible concerns or in initiating a sound ethical reflection.

This apparent lack of rigorous ethical discussion and scientific argumentation about ancient mummy research is particularly striking due to various factors:

Firstly, any modern examination on historic corpses is done *a priori* without informed consent of the deceased.

Secondly, the research undertaken on such a body is often invasive either in terms of technological aspects or in terms of personality traits. The recent enormous methodological evolution - both in the social sciences and particularly in the natural sciences - allows researchers to gain more intimate information about historic personalities, often by means of “invasive” (tissue-destroying) methods.

Thirdly, public and scientific reports about such findings do not follow the common criteria of medical privacy, by explicitly and specifically naming major diseases or causes of death of a famous ancient individual, such as a former king or pharaoh.

Thus, we attempt hereby to advance the ethical debate in ancient mummy research. The aim of our study is to conduct a stakeholder analysis showing the pro and con arguments of ancient mummy research for the various involved interest groups (e.g., the mummy itself, descendents and researchers) and with respect to various cultural concepts. The study will be theoretically based on the literature about stakeholder theory and linked to the normative theory of ethics.

The stakeholder approach is a valuable instrument, not only to identify interest groups, but also to balance and judge those interests according to moral relevance, legitimacy, or economic purpose. [11] It has widespread acceptance, especially in

management sciences [11, 12] and in ethical reasoning used in moral dilemma situations. [13, 14]

We started by clustering relevant stakeholders into four categories and specifying their variable interests and arguments pro and contra relative to ancient mummy research. We continued the evaluation of these arguments with respect to moral content and identified what we call *the moral dilemma*. We will further introduce an ethical concept that facilitates us in reflecting about ethical pitfalls produced by the dilemma situation in light of the ethical theory. However, it is specifically not the goal of this paper to present ultimate recommendations about how to ethically make decisions, but we want to start a discussion about how ethics can be integrated into the research agenda of ancient mummy investigations.

To facilitate the outline, only issues about the scientific examination of mummies will be addressed. We do not discuss whether and how to publicly exhibit them, whether and how to restore/conserve them or how to appropriately communicate research results. In fact, we focus on moral issues that can arise in connection with conflicts of interests, technological advancements or new possibilities of action. We further exclude non-moral questions such as purely economical, political or legal issues.

Material, Methods and Definitions

In this study, “mummy” is defined as human remains with various degrees of soft-tissue preservation. We will not consider specific short-term legalistic definitions of when a body has to be dealt with forensically as a mummy and when the legal rights of

individuality expire. By identifying stakes and stakeholders of ancient mummy research, we implicitly refer to the concept of the stakeholder theory without taking the theoretical heterogeneity into account. A good overview of the stakeholder theory is provided by various authors. [11, 12, 15, 16] Stakeholders are defined subsequently in the broadest sense, by means of any interest group affected by ancient mummy research. In this view, all relevant stakeholders are groups or individuals that might be affected by individual rights such as liberty, integrity or dignity, but also include economic or political interests. A stake in the broadest meaning is therefore an interest that is politically, economically or morally driven. To contribute to the discussion of morally relevant stakeholders, we refer to the normative understanding of morality. Normative is understood as a judgmental comment on norms and principles of conduct or intentions of conduct instead of a descriptive narrative of values or norms that are factually lived by a society, interest group or an individual. The normative moral point of view attempts to ask what norms or values should factually guide an individual, group or society. The way we use the term "ethics" or "ethical reflection", therefore, relates to a judgmental comment on norms and values from a normative point of view. [17] By taking into account different normative positions, ethical reflection can contribute to the catalysation of decision processes and give orientation within ancient mummy research. For instance, what is good or what is bad about ancient mummy research? Who shall decide, based upon what type of criteria, how to conduct invasive procedures? Also, ethics takes into account different perspectives and provides practical advice. It does not allow anyone to escape from responsibility nor does it make any claims for ultimate justification.

Results and Discussion (see also Fig.1)

Categories of interest: pro or contra mummy research

Summarizing the claims of several stakeholders [1] affected by mummy research, shows that there is a relatively wide range of possible pro and contra arguments. We identified the following four categories that are filled with arguments in favor of or against mummy research:

(1) Religion and Culture, (2) Law and Guidelines, (3) Information and Progress of Knowledge, (4) Individualism and the Right of Integrity

(1) *Religion and Culture:* Religious arguments are possibly positive and negative. With regard to ancient Egyptian cultural beliefs, it was of foremost importance to be remembered after death, not "to die for a second time". [18] Research could function as one possibility to retain the individual in memory and to inform the public about the socio-cultural roots. On the other hand, the peace of the deceased is a great and protectable good not only in ancient cultures, but also today.

(2) *Law and Guidelines:* The international code of conduct of the International Council of Museums [19] actually strongly encourages research on museum specimens. Thus, from a legal point of view, research on mummies, which is of benefit for the advancement of science, should be performed. Since there are no clear guidelines about how to specifically perform research on ancient mummified samples, there is no legal basis on how to best perform such studies, similar to the

[1] The categories are drawn from a list of stakeholders, see table 1. The identification of all stakeholders as well as their interest is based on our own knowledge. Without discussing the groups and interests in detail, we directly cluster them in four main categories.

"good clinical practice" - guidelines (as issued by the US Food and Drug Administration or the European commission). In the future, mummy research guidelines shall address issues such as personal rights of the dead (medical data), who shall possess such data and how one may present it within and outside of the research community. Also, the diagnostic validity and invasiveness of the major methods used shall be addressed.

(3) *Information and Progress of Knowledge:* Such arguments are mostly positive towards ancient mummy research. Access to ancient mummies for the purpose of research is one of the most important interests of the single mummy researcher, in terms of research progress, professional reputation, financial benefits and funding. For the research community, mummy remains are of great scientific importance as there are no substitutes for such samples. Bio-medical research using mummified tissue and bone have made significant contributions to the progress in science [20, 21] and the value of such studies has been highlighted on multiple occasions. [2-4] The research results also provide information to the broader public to understand ancient life and the culture of the mummy's homeland. This in turn strengthens an interdisciplinary exchange, which is important for the advancement of knowledge in general.

(4) *Individualism and the right of integrity:* Individualism is a basic ethical premise and a fundamental proposition about value. It defines human beings as an end in themselves, and not just as a means to broader social ends. The right of integrity is understood as the elemental right of each human being to be protected from any kind of harm. [22] Research on mummies has to consider the aspects of

individualism and the right of integrity. This is due to the fact that investigation methods are sometimes invasive and destroy tissue or the investigations are conducted without the informed consent of the deceased. On the other hand, individualism may be supported when research results put aside false accusations (e.g. speculations about cause of death or disease).

Research is always confronted with a plurality of interests. The motivation behind those interests is as manifold as the interests itself, ranging from economic benefits, legitimacy claims or moral concerns. Our objective is to contribute to the ethical discussion about ancient mummy research. We will now continue with the analysis of these arguments with moral content.

Personal integrity vs. personal advance: the moral dilemma and its ethical conceptualization

In light of moral reasoning, the debate about ancient mummy research might run into two conflicting positions. This is on the one hand, the right of integrity including the right of peace for the deceased. On the contrary, there is the importance of the progress of knowledge and the personal advancement of the researcher in contributing to such progress.

Generally said the human body alive or dead has a moral value. This is rooted in religious thoughts as well as in philosophical thinking. Violation of such a moral value is a violation of a person's integrity. Bodily integrity is therefore an important issue in maintaining the integrity of a person and as such is important for the practice of research.

The notion of bodily integrity incorporates different aspects. One distinction made, is between body-oriented integrity and person-oriented integrity. Following Kant's philosophy [23] a body-oriented integrity view is focused on the duties towards our own body rather than to those of others. For ancient mummy research the person-oriented view of integrity is more important. Person-oriented integrity includes the right to be safeguarded against violations of others and the right to self-control over the body. This is especially important within medical ethics as treatments without explicit consent can already be considered as a violation. According to the principles of biomedical ethics developed by Beauchamp and Childress [13], bodily integrity as person-oriented integrity can be further interpreted with regards to: (1) biological wholeness, (2) experiential wholeness, (3) intact wholeness, and (4) inviolable wholeness. [24]

Biological wholeness refers to the unity of the body in terms of anatomical aspects and to the proper operation of the body or parts of the body in terms of functional aspects. The question of ethical interest is therefore to what extent modifications of the body are offenses against biological wholeness.

Experiential wholeness relates to the matter of a subjective experience of bodily wholeness. Subjective-experiential wholeness is not necessarily similar to a functionally perfect body. Even when the body functions less than satisfactory, a human may still feel a kind of bodily wholeness. With regard to a corpse this is of less importance. However, it becomes meaningful for ancient mummies, if we take subjective feelings of bodily wholeness into account before the mummies death.

Intact wholeness strongly mirrors a religious aspect of bodily wholeness. This means that the body is intrinsically important for personal identity. Sometimes intact wholeness is characterized in terms of sacredness and sanctity, stressing the meaning of intactness and completeness. [24] Specifically, an intact physical body was a "conditio sine qua non" in Ancient Egyptian beliefs to gain immortality. Thus, this was the religious reason for the enormous tradition of artificial mummification attempts in this particular culture.

Inviolable wholeness involves the possible misdoing of violating the integrity of the human body. As discussed earlier, this view includes body-oriented and person-oriented integrity. At this point, it is meaningful to refer back to Kant's philosophy. [23] According to Kant, [23] we have not only duties concerning ourselves and other persons, but also regarding other beings such as animals and dead bodies. To realize this duty towards others is to realize the moral duty we have to ourselves, in order to respect the humanity of personhood. With regard to ancient mummy research, Kant's comment on deceased persons [23] is of special interest, as it is in favor of a right of integrity for mummies.

In the light of these remarks, disregarding a person's right of integrity incorporates harming this person or violating their right of autonomy. With regard to ancient mummies, the problem of violation is different compared to those of a living person. Is it possible to harm the dead? Is the bodily integrity of the mummy to some extent at stake through modern research efforts?

As there are no explicit discussions about mummies, we analyzed earlier similar discussions. For example, the right of bodily integrity has been discussed for tissue derivation and organ transplantation from corpses. Within these discussions, offending the right of integrity is as much about the possibility of harming the dead, as about the autonomy and interests of the dead. [25] Partridge [26] holds the view that posthumous harm is impossible because no one can retain interests after death. Levenbook [27] is more in favor of the possibility of posthumous harm. Also Levenbook [27] stresses the metaphysical and meta-ethical difficulties in defending a fully developed concept of posthumous harm. She argues that it is worthwhile starting a discussion on this topic.

In assuming an intrinsic moral value for humans dead or alive, our argumentation is in line with a moderate perspective on integrity issues for mummy research. We assume that it is also desirable to discuss the problem of posthumous harm to mummies. This is especially true with regards to artificially prepared corpses, where we know that the person had a specific desire for the time after his death, which was rooted in his cultural and religious traditions.

We therefore continued with the examination of possible challenges that are at stake and might bring into question the integrity issue for mummy research. We identified four such possible pitfalls and discussed them in light of bodily integrity and wholeness.

1) How to publish individual biomedical data

The public access to individual biomedical data is a well established topic in ethical discussions. If such data was made available, one could claim open access at least for all scientists, if not for the general public. The use and production of biomedical data can therefore contradict the concepts of intact and inviolable wholeness. This could be especially true with regards to ancient Egyptian mummies, as the discussion of very personal information could offend their wish of being remembered as strong and healthy. The risk of commercialization and thus alteration of initial scientific purposes of such individual data opens up another, hereby not treated, area of ethical conflicts. However, imaging data or macroscopic pictures may reveal information at a different level than written sources only and thus should be treated differently when considering the personal rights of the deceased. Some issues dealt with in a clinical setting - such as publishing only anonymized results - is hard to achieve if one deals specifically with the examination of well-known historical individuals (e.g. Royal Egyptian mummies). Yet, it is achievable in cases where the data of less known mummies - with known individual names - are published. However, this contradicts the imminent scientific desire (and often specifically requested by journals and grant bodies) to provide as much reproducible individual data as possible.

2) The use of non-invasive and invasive examination methods

Current research on mummies is dependent on the use of modern technologies. Such technologies diverge in their degree of invasiveness. Often completely non-invasive examinations suggestively reveal a lesser degree of scientific proof and thus are less

respected within the scientific community. Often, such invasive procedures are only regarded as confirmation of an earlier non-invasive finding. A recent exemplary example was the confirmation by invasive histological examinations [28] what had already been shown by non-invasive computed tomography as the cause of death of the Iceman. [29] The more invasive a technology is the more it harms the concept of wholeness.

The exemplary newly arising methods such as DNA analysis will likely revolutionize the whole field of mummy research. The impact of such new methods in terms of ethical issues is huge. DNA analysis may not only allow the detection of individual markers of disease, but may also allow tracing of family relationships, such as inbreeding in royal families or reveal unexpected ethnic relationships. The definition of a mummy's descendants as adequate proxy decision makers is full of pitfalls, too. As Holm [10] highlights, a culturally well informed scientist may have more ethical insights into the cultural beliefs of an ancient mummy than descendants who do not share a common cultural belief, but only ethnical proximity. In some cases, such as for the Neolithic Iceman, based on modern DNA analysis [30] it could be proven that genetic proxies no longer exist today. Thus, "fake" claims of descendency could be repudiated by genetic analyses.

Destroying parts of the mummy by for example unwrapping the corpse, offends the biological wholeness because the unity of the body is destroyed. For the same reason, it is against inviolable wholeness. Experiential wholeness might be disturbed with regard to the desire of the mummy to have the subjective feeling of bodily wholeness before death. Keeping in mind that Egyptians made great efforts to be prepared for life after

death, might offend aspects of intact wholeness as well. The main issues are about: (1) to what degree the process of embalming done for the physical preservation of the body, the necessary mutilations required for this process (e.g. removal of internal organs) and thus the desired integrity of the body, may have been regarded as a religious rather than a mechanical concept, (2) not only the integrity of the deceased, but also the invasiveness of a method may be a problem when examining such a unique material, (3) to what extent will current investigation methods impact the use of this unique material when future generations of scientists want to examine or re-examine it. To sacrifice ones own bodily integrity for the progress of society and other individuals is not only present in modern-times in organ or body donations, but may be assumed to be the case for at least some deceased ancient individuals, too, however this can no longer be proven.

Nevertheless, we would like to point out that not all invasive procedures during the examination of mummies are de facto negative for the corpse, conservation attempts are one such positive by-product. Often, it is better to store a body or body parts in well-climatized scientific laboratories than in their original burial grounds; thus again an invasive procedure may be of benefit to the mummy.

3) Type of mummy

In ethical judgment, one should also differentiate between whether a child or adult mummy involved. This is especially true in cases of artificial mummification, where an adult individual intentionally underwent preservation and thus indirectly took into consideration the possibility of his physical availability to later generations. In the case of accidental mummification, such as for ice mummies, this may be regarded differently.

For such mummies - including artificially embalmed minors - one may assume that the deceased was not aware of the possibility of preservation and of the scientific availability of his body remains to future generations.

In both cases, artificial and natural mummification, consent for later examinations of their mummy is missing. With regard to artificial mummification, as in the case of Egyptian mummies, cultural and religious knowledge can be taken into account relative to questions of consent. Nevertheless, the idea of wholeness might be harmed when one considers the reasons we discussed earlier. Finally, for some researchers the degree of intactness of the ancient body decides the extent of invasive procedures, thus if tissue destroying examinations will be performed at all.

Interests of the living versus those of the death

Based on the above analyses, most of the criteria on whether (and if so how) to analyze ancient mummies can be concluded based on the diverse interests of the living (researcher, general public) and the dead (mummified corpse). Balancing these interests is crucially dependent on various factors such as, current ethical concepts, which is highly dependent on *Zeitgeist* (the spirit of the age or time) and on the cultural background of the ethical framework being applied. Thus, we do not intentionally recommend a specific solution or decision, but rather we want to stimulate an open-minded discussion. Without knowing or exactly understanding the ethical concept of the deceased, it is dangerous and short-sighted to assume based on current knowledge only how to best act in such unique scientific situations. However, any ethical decision pro or contra to mummy research should try to respect the interests of the various stakeholders.

For genuine progress in modern medical research, invasive analyses of historic mummified tissue - after careful ethical considerations - may be well supported from our personal perspective. The intellectual process of ethical decision-making itself - independent of its final judgment - is actually already a progress in the study of ancient human remains.

Conclusion

The specific debate on whether at all and if so how to examine (and display) ancient mummies is one of great controversy. One has to be fully aware, that the issue of how to store and to analyze ancient mummies and how to communicate the respective research results in an ethically appropriate way is highly dependent on current local ethical frameworks and culture. Thus, a final recommendation is beyond the scope of this study. Finally, any attempt to assess the best interests for long-term deceased individuals will always be incomplete. At least in some cases, these individuals could not fathom the concept of the modern technological investigation possibilities, but were also not aware about the whole concept of modern science in general and its needs and ethical bases.

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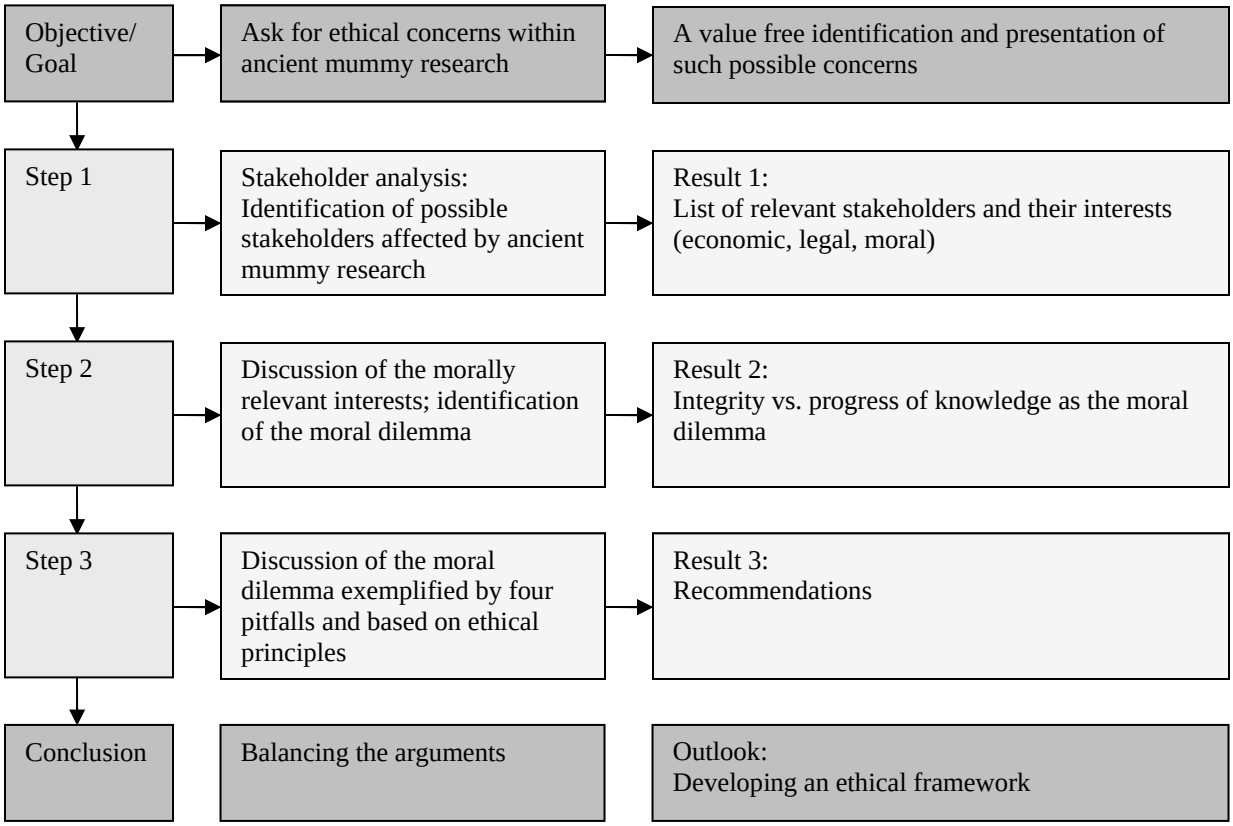

Fig. 1: Story of Argumentation

Stakeholder	possible Pro	possible Contra
artificial mummy / ancient culture	- religious (e.g. to dismiss false acquisitions of a certain medical diagnosis) - religious support for (e.g. "not to be forgotten") - elimination of wrong accusations (e.g. media speculation of possible causes of death) - provide information about a set of religious and moral paradigms - support the benefit for all mankind through scientific mummy research - in some cases informed consent of individual is available (e.g. modern mummies of famous politicians or clerics) - research may physically protect a mummy from grave robbers (mummy no longer stored in a tomb)	- general religious and cultural objections (e.g. the right of peace for the deceased) - lack of patient privacy (complete medical data publicly available, may affect ones own authority) - research done without informed consent - in some cases an invasive procedure is used (X-ray, histology) - in some cases the mummy is removed from the tomb (lack of peace for the dead) - instrumentalisation / lack of autonomy (of ones own body)
single researcher / research community	- personal interests (financial benefits, professional reputation, pure curiosity, progress of ones own research) - no sample substitutes are available (uniqueness of the mummy as a research object) - progress of research in general (e.g. development of new research methods) - mummies as a means to establish a new field of research	- absence of any beneficial research results or personal interests despite research efforts - bad reputation, e.g. by using incorrect methodologies, accusations of unethical behavior towards a researcher
tourism/ museums	- provides information on mummies and ancient cultures to the public - increased media interest thanks to research - increased interest in the mummy's country of origin, e.g. foreign research teams	- destruction of mummies as a result of research methodologies - limited access to touristic areas due to scientific activity
civil society	- gains in scientific and cultural information e.g. for the progress of science - impact of mummy research on other fields of research (side-effects) - to satisfy ones own curiosity	- research may contradict ones own morale paradigm e.g. inappropriate risk-benefit ratio - religious reasons
descendents (present, not ancient ones)	- knowledge about ones own predecessor - identification of economical and/or political interests - morale interests link with ones own cultural roots	- negative research results may act as prejudgments or prejudice against present-day descendents (e.g. racism)

Tbl. 1: Exemplary list of pro and cons of mummy research interests by main stakeholders