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A mere technical exercise? Challenges and technological solutions to the identification of individuals in mass grave scenarios in the modern context

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Introduction

The identification of individuals from mass grave contexts is a difficult process which is made more challenging by a variety of taphonomic and situational variables, such as cause of death, number of bodies present, disturbance of the grave, climatic conditions, and the time since death. Clothing, personal effects, and type of burial have traditionally been used as an identification tool where the victims are recognized by family members and identified in the field; a practice that is frequently used in Latin America. Commingling of human remains is a common occurrence in large mass graves. Here an added challenge is that these burials are often 'open context cases' where the list of actual victims is unknown and the search for families of the dead has to be conducted on a national and sometimes international level. This is especially difficult in situations where populations have been displaced or disappeared by the state and records remain classified or unobtainable. An additional complication is the issue of body parts that cannot be identified and, therefore, cannot be returned to the family, which has societal repercussions on national reconciliation policies. Further, it is imperative to identify the victim group if charges of genocide are being pursued.

Forensic scientists, including anthropologists, have been exploring the potential of new methods and processes in the resolution of such contexts. The introduction of DNA to contexts where these challenges exist has had some success in the Balkans and in Guatemala, two areas that have experienced brutal civil wars for a number of years. More recently, the analysis of elemental and osteometric measures on the body have demonstrated potential in attempts to reassociate remains. Ultimately however, technological developments complement extensive ante-mortem investigation and the two cannot be utilized independently if the required end result is to successfully identify victims.

The search for and identification of corpses and human remains in post-genocide and mass violence contexts presents a particularly pressing aim for the twenty-first century. The interest in this work stems from a number of different sources. From an academic perspective this may include legal scholars, forensic archaeologists and anthropologists, historians, sociologists, and so on. This chapter is an example of such academic interest. From a social perspective this may include those directly affected by the violent and traumatic events that require investigating, or those with the responsibility to scrutinize such events. This chapter will focus on one particular aspect of the search and identification of corpses and human remains, namely the application of technical methods to the examination of bodily remains recovered from mass graves.

Why bother with human identification?

One of the primary issues to be addressed when investigating these contexts is the question of why to bother making the effort to identify the victims held within a mass grave. The very fact that clandestine mass graves exist means that the circumstances of the death of the victims within this context is evidence that an illicit act took place. Massacres of innocent civilians and extrajudicial executions are a violation of the Third and Fourth Geneva Conventions and Additional Protocol I which govern the proper burial, identification, and registration of those killed in conflict.[1] During an armed conflict perpetrators may attempt to hide their crimes by creating mass graves. Surviving family members can be left ignorant about the whereabouts of their loved ones and can only assume that they have been killed or are still being detained. Therefore, identifying victims of mass graves can bring closure to family members, and the very process of the investigation brings an acknowledgement of the terrible crimes that took place. Identifying victims can support prosecutions, especially if charges of genocide are sought. Article 6 of the

Rome Statute defines genocide as five acts with the intent to destroy, in whole or part, a national, ethnical, racial, or religious group. The five acts are: killing members of the group; causing serious bodily or mental harm to members of the group; imposing conditions on the group calculated to destroy it; preventing births within the group; and forcibly transferring children from one group to another.[2]

Investigation of mass graves in this context can be used as a means of creating a 'truth and reconciliation tool',[3] which may at times be linked to a sense of a state owning up to the crimes of its past. Included within this process are reparation payments to the families of victims, where the need for a positive identification and subsequent issue of a death certificate adds pressure to investigators to identify victims. Other reasons for identification may also exist. One of the consequences of the use of mass graves can be to further cause insult by effectively excluding the victims from their communities of death.[4] Thus the primary factor governing the search and identification of victims of the armed conflict in Guatemala is to bury their loved ones in cemeteries reflecting the funerary practices of the indigenous culture, a religious blend of Catholic and Mayan rituals.

The second key issue to be addressed is how these identifications are to be achieved. Technological solutions have in some cases given false hope to family members who perceive DNA technology as an all-encompassing solution. They are then disappointed if an identification is not possible, and may feel misled by the whole process. In his recent work, Francisco Ferrándiz highlights this very issue with the identification of victims of the Spanish Civil War.[5] The science of identification is fallible and care must be taken not to present these advances as a solution with a guaranteed outcome. There are numerous challenges that exist that hinder an identification being made.

Traditional approaches to identification

Before the advent of DNA technology in human rights violation contexts, identifications of human remains in mass graves were carried out using a variety of methods. The cornerstone of these presumptive identifications was extensive ante-mortem investigation and the subsequent comparison of the ante-mortem profile of a suspected victim with a post-mortem profile of a cadaver.[6] The circumstances surrounding the death of an individual was usually provided by a witness interview, and corroboration of this testimony would be sought through archaeological and anthropological evidence. An identification would then be made if the two profiles matched. Official documents can also prove to be significant here.[7] Archaeological evidence can include the type of grave and the position of the bodies within the grave, along with clothing and personal artefacts which are recognized by family members during the remains' archaeological recovery. The post-mortem description provides a biological profile (sex, age at death, height, ancestry, and dental characteristics) of the victim, which, when including any individualizing features (such as an ante-mortem injury or pathological disease that the individual may have experienced in life), can help to narrow down or confirm the identity of the victim. This emic approach to identification is often used in developing countries, where ante-mortem data is not available in the form of medical and dental records,[8] or has been subsequently destroyed.[9] Clothing and personal effects recovered within the grave are compared to descriptions of what the person was wearing when they were 'disappeared' or killed, details of which form an important stage of the ante-mortem interview.[10] Despite the passage of time, family members present when a loved one was kidnapped or killed tend to remember exactly what their loved one was wearing at the time the incident occurred. One woman who was kidnapped as a 14-year-old alongside her mother during the Civil War in Spain remembered exactly what her mother was wearing as she was driven off in a truck by paramilitary groups in 1936.[11] All of these constitute a 'traditional' identification and have their place in certain contexts where DNA analysis is not available, either through a lack of resources or because a long period of time has elapsed since the event occurred and degradation of bone inhibits successful DNA analysis.

Context is paramount, and these types of identifications can only be used in what are termed 'closed' context cases or a 'closed synchronic system' as defined by Baraybar.[12] This constitutes a finite group of victims at a single point in time and space. The situation is much more challenging in 'open' context cases where the number and identity of victims is unknown. This may occur when individuals are brought to a central place for detention purposes, may occur over a longer period of time, and may not be confined to one location. In Guatemala the largest mass graves are found within ex-military bases that served as detention and execution centres throughout the armed conflict. People were transported there from both urban (where they became more commonly known as 'the disappeared') and rural areas (where rebel groups were operating).

Challenges to the identification of individuals in mass graves

Unfortunately the very nature of a mass grave, that it involves multiple bodies, means that identification of specific individuals can be difficult. This can be a result of a number of variables, from the location and size of the mass grave to the number of bodies placed inside and whether it is subsequently disturbed.

Therefore there are a number of issues to address which derive from the actual process of identification. The first issue to consider is the quantity of remains that must be sampled before identification of an individual person can be confirmed – for example, does the identification commission require identification from just one or multiple bodily elements? This is relatively straightforward if the bodies still have considerable soft tissue present, but is more complicated if the remains are skeletonized. The identification process can be further complicated if the particular mass grave in question is an 'open' context. As noted above, this means that the identities of the individuals within the grave are unknown, and indeed the actual number of people placed there may also be uncertain. This differs from a 'closed' context in which the identities of the victims within the grave are already known, and the identification process focuses more on individual verification. Clearly the former requires greater resource investment, such as through a national campaign of DNA collection. Any investigation of mass graves requires coordinated and well-thought-out legal and institutional structures, at both regional and national levels. Examples of the problems that can occur when this is not the case abound.[13] It should also be noted that the opposite can be a hindrance, too – a multitude of influential international bodies and organizations can also bring confusion and impact the identification process.[14]

Time is a complicating factor with all of these issues. The longer the time since initial deposition, the more difficult the remains will be to identify. As Komar notes, it is not uncommon to have a significant time delay between conflict and recovery, and recovery and identification.[15] Such identification problems include the increased decomposition of the remains, the greater degree of soil activity, and the passing away of witnesses. Location of the mass grave will also be instrumental in determining the success of body recovery and identification. In their retrospective study of cases from Croatia, Šlaus *et al.* noted that the identification of bodies found in wells was significantly more difficult than those recovered from other contexts.[16]

Experience has also shown that different bones within a single skeleton will degrade at differing rates, further compounding the identification and recovery of individuals.[17] Ultimately, in the field, preservation of the remains correlates with the probability of positive identification.[18] Very short time periods can also be challenging, since the conflict that caused the mass grave may still be ongoing, thus making it difficult or dangerous to access the graves (as is the case in Afghanistan).

A key problem associated with multiple individuals in a single grave is commingling. This is a process where body parts from one person become associated with another. This can lead to problems when trying to determine the minimum number of individuals in a grave context and when attempting to reassociate body parts. Work in the field has shown that increased commingling of remains will cause increased problems with identification.[19] Commingling within a grave can be the result of a number of factors, such as natural processes like flooding or animal activity, or due to human intervention as a strategy to prevent identification of the remains in the future. In some contexts, intentional dismemberment was performed on the victims prior to burial[20] and this would also increase the degree and complexity of any commingling present.[21] In a similar vein, it was seen in the Balkans, for example, that large machinery was used to remove sections of graves which were then transported to different parts of the country and placed in new graves (which are termed secondary burials). Damage by large machinery, whether used to move bodies to secondary burial sites or as part of the excavation process, has also been noted as causing additional challenges associated with commingling and identification. Ensuring that bodies are composed of parts from only one individual is important for a variety of reasons, including humanitarian considerations and the success of DNA identification of the remains.[22]

It should be noted that the origins of mass graves can vary. Although they are often associated with genocide, they can also be a consequence of other forms of mass violence – such as wars[23] or criminal activity[24] – or originate from non-violent events such as mass disasters[25] or epidemics.[26] The latter examples associate mass graves with the managing of large numbers of the deceased with local resources that cannot manage the scale of event, rather than hiding the evidence of crimes. Nonetheless, subsequent identification of the deceased, perhaps to allow for more culturally appropriate funerary practices, may still be problematic. It is also worth noting here that although our focus is the mass grave context, the issues and potential solutions we discuss are also applicable to many other forensic contexts where multiple or fragmented remains are recovered.[27]

There are potentially a number of solutions to the issues and concerns discussed above. Traditionally the mass grave management process involves sorting out the osseous material (from bones) and the non-osseous material (such as debris or vegetation), removing the non-human bone and teeth, ensuring that the remains in question are indeed modern and not of archaeological origin, and then sorting the remaining skeletal material.[28] It is this sorting of skeletal material into specific and identifiable individuals that gives rise to the greatest challenges. This chapter will explore some of the more technical approaches to managing this identification of individuals from mass graves.

Technical solutions

DNA profiling

The techniques used by anthropologists to identify individuals in mass grave scenarios through traditional or classical methods and the challenges these bring have already been discussed in this chapter. The introduction of DNA technology to the identification process has certainly changed the way practitioners identify the missing. In Serbia, for example, identification rates of bodies from mass graves increased noticeably following the implementation of a thorough DNA profiling process.[29] There are two ways that DNA can be used for mass grave identifications; the first is that a DNA profile taken from a family member is used to confirm a traditional identification in a small, closed context. The second, and perhaps more important, way is to attempt a blind match between a victim's DNA extracted from soft tissue (or more frequently bone and dental samples) from exhumed remains compared against a family reference database which comprises profiles from donated buccal (mouth) or blood samples.[30]

For a number of reasons the application of DNA analysis is not always as successful as is perceived and can present severe limitations.[31] One limitation is that it is not always possible to achieve a DNA profile from bone that has gone through a lengthy process of diagenesis (the term used to describe the structural and chemical changes to bone after death). In Guatemala, some of the bone samples did not produce a workable DNA profile because of the destructive burial environment, and as a result more traditional methods of identification had to be relied upon. Another limitation is that the family must have donated a reference sample in the first instance, and be included on the database, for a match to be made. A further reason why a match cannot sometimes be made between a victim and family member is that a genealogical link does not exist in the first place. If this is the case, it is essential that social anthropologists are at the forefront of the ante-mortem investigation, because they have the skills required in dealing with sensitive situations that a DNA scientist may not possess. In another case in Guatemala, a mother and her three daughters were identified in a mass grave as members of the same family, but the fourth daughter had a different genetic profile despite the father insisting that it was his child. Social anthropologists skilled in dealing with specific cultures in this community were able to establish that the child had been 'adopted' unofficially, and that the father did not want to admit this fact in case he got into trouble with the authorities, as he had previously registered the child as his own. In his worldview she was his daughter, as he had raised her from an early age, and therefore the father's insistence is understandable. This is just one example of how DNA analysis can add a complication to already extremely sensitive issues within the community. Finally, if there are several siblings in one mass grave who cannot be individually identified through a DNA profile, a post-mortem biological profile must be relied upon if individual identification is to be achieved. In some cases, such as in Rwanda, whole families were massacred and it was not possible to trace surviving family members for DNA identification purposes.[32]

Methods employed by anthropologists to remove the soft tissues in preparation for a full anthropological examination can also have an effect on the quality and quantity of DNA recovered from a body or body part.[33] Over a period of time, soft tissue decomposes and the likelihood of obtaining usable DNA decreases as the soft tissue is compromised.[34] Eventually bone or dental tissue becomes the only tissue available from which a DNA sample can be taken. Unfortunately, it may be necessary to remove the overlying soft tissues to access this material. With this in mind, a study by Steadman *et al.* which compared ten different maceration techniques involving heat or chemical treatments on pig ribs, found that the highest yield of DNA were with methods that involved macerating at high temperatures (above 90 degrees centigrade) for short periods of time. Mitochondrial DNA (mtDNA), which is found in large numbers in the cells of the body, is less useful for unique identification (since it derives only from the maternal line and therefore is shared by all siblings), is not affected by maceration techniques.[35] A later study by Lee *et al.*,[36] this time using human lower-leg long bones and nine heat and chemical maceration methods, replicated the results found by Steadman *et al.* and concluded that of the main maceration techniques, heat treatments of high temperatures and short duration produce the highest of levels of nuclear DNA amplification.

The use of DNA for identifications in mass grave contexts has been used since the mid-1990s. Mitochondrial DNA profiles are more easily produced in ancient or degraded bones than nuclear DNA because it has a high copy number per cell.[37] However, nuclear DNA is more useful in forensic identification contexts because it is inherited from both parents.[38] In Guatemala mitochondrial DNA was utilized after an exhumation in 1992 of twelve skeletons in two mass graves.[39] Mitochondrial DNA was chosen over nuclear DNA because the victims were men and only one maternal relative to donate a DNA sample was necessary. Nine of the twelve skeletons were identified using traditional techniques, but three proved more difficult because of a lack of ante-mortem data. Only six families were willing to donate a DNA sample, and of these six, four had a common maternal lineage. In small, traditional, and isolated villages such as are found in Guatemala, with little admixture between settlements, using mtDNA may not be the best option. Since then in Guatemala, a Short Tandem Repeat (STR) population allele frequency database was created from 451 Guatemalans.[40] In the Balkans, where it was estimated that 40,000 people went missing, the first DNA-led strategy for identification was proposed and implemented by the International Commission for Missing Persons (ICMP) Forensic Science Department.[41] However, in all of these contexts, traditional techniques are still necessary to corroborate the identification.

Bone and teeth are the more reliable sources for DNA and provide higher success rates,[42] but the extraction methods are more complicated and time-consuming than for soft tissues.[43] Nevertheless, there are very real problems associated with contamination in commingling contexts. Usually, this is of greatest concern when sampling the soft tissues; however, following the tsunami in Southeast Asia it was noted that samples taken from bone tissue also exhibited contamination.[44] The source of the contamination is uncertain, especially considering that the samples were extracted from within the bone tissue rather than the surface, but putrefaction fluids or contaminated formalin preservative fluids have been suggested.[45] One way to address this issue is to clean the bones using various chemical washing solutions, UV radiation, or removal of the surface. Unfortunately, it has also been noted that this may not entirely remove the risk of contamination.[46] Nonetheless, the challenges of using DNA profiling in the field should not detract from the fact that it can be an extremely successful and potent tool for identification in commingled and mass grave contexts.[47]

Elemental analysis

The chemistry of the human skeleton has been shown to hold great potential in terms of identification and understanding our actions and activities during life. Yet despite this existing knowledge, anthropologists have been slow to apply it to the investigation and resolution of mass graves in the modern context.

One such elemental tool is the use of stable isotope analysis. This has had wide application in forensic science generally, but in terms of the study of human skeletons, is largely limited to the archaeological context. Stable isotopes are atoms of a given chemical element which vary in their number of neutrons, do not decay over geological timescales, and are subject to fractionation.[48] It is this fractionation which is useful in forensic science, since it causes slight variations in the ratios of these elements within a given material. Stable isotopic analysis therefore has the ability to help with the study of mass graves in two key ways. First, it is possible to learn information about diet and migration through changes in isotopic ratios, and this can be used to suggest the status or geographical origin of the deceased. This has been used very successfully in archaeological mass graves, such as those in Britain[49] and the USA.[50] In all of these examples it was possible to comment on the relationship between the victims and those living in the local regions associated with the mass graves. The second potential use is referred to as stable isotope profiling. In this analysis, the ratios of a number of elements are examined, not with a view to interpreting life history, but simply to create a unique chemical signature which differs from those of other individuals. Forensically this approach has already been used to study non-human evidence such as drugs, explosives, paper, and wood.[51] Stable isotope profiling would be particularly useful in cases of commingled remains where the combination of ratios for a collection of elements from one individual should differ from other bodies. Juarez has tried to address this issue in the USA and has carried out a pilot study which analysed strontium isotopes from the dental enamel of individuals originating from four states in Mexico.[52] The results demonstrated that individuals could indeed be associated with originating from distinct regions in Mexico. This research can then hopefully be applied to unidentified border crossers found on the US side of the frontier so that their remains can be identified and repatriated back to Mexico.[53]

X-ray fluorescence is a method of analysis that utilises a material's response to exposure to X-rays in order to determine the elemental or chemical composition of that material. It has been proposed as a potential solution to reassociating disarticulated remains in a mass grave context,[54] having already been used in other forensic contexts to identify bone from other non-osseous material.[55] Initial research using medieval articulated skeletons[56] has indicated that trace elemental composition differs between individuals and can be used through chemometric analysis to literally identify 'which bone' belongs to 'which person'. The idea behind this technique is to establish a method that is non-destructive, portable, easy to use, and less costly than DNA analysis – the more conventional way of reassociating remains in challenging commingling circumstances. In the first instance, individual elements were chosen which are considered to be associated with diet or physiological importance. Individual elements were successful in separating two individual skeletons but when further skeletons were included it became more difficult to differentiate between individuals. Therefore, bone element ratios have been used to differentiate between skeletons in an attempt to increase separation and reduce chemical noise. Five ratios were used: Pb/C, K/Fe, Zn/Fe, Sr/Ca, and Sr/Pb, with the most effective being Pb/Ca, Zn/Fe, and Sr/Pb.[57] One of the issues that emerged from this research was the question of whether bone diagenesis is affected by the results and whether the length of time that the bones are in contact with the soil affects the separation of the bone element ratios. In modern mass grave contexts, however, diagenesis may be less of an issue and all skeletal elements are likely to be subjected to the same elements and processes within the soil, therefore it could be possible that any variation in elemental analysis is related to the individual's diet.

Other analytical methods have also been proposed as a means of resolving commingling of skeletal remains using the elemental composition of the bones themselves. Dillane *et al.* have demonstrated the ability of inductively coupled plasma-atomic emission spectroscopy, a form of spectroscopy which detects trace metals in a material (when combined with subsequent discriminant analysis), to differentiate between bones of different origins.[58] This method is really designed for speciation but would prove to be particularly useful when dealing with highly fragmented remains, which can be challenging to analyse macroscopically.

Caution must be applied when using any of these elemental methods since bone will continue to exchange certain elements with its surrounding environment even after death.[59] This is problematic, as it may mean that the original elemental signature may be altered and thus no longer suitable for individualization.

Osteometric approaches

Osteometric methods of studying the skeleton rely on the application of measurements and statistics to the bones of the body, with the aim of contributing to the biological profile of the deceased, or addressing ancillary questions such as a minimum number of individuals and commingling. Crucially they are used to maximize objectivity in the study of the skeleton.[60] With regard to commingled remains, osteometric methods aim to associate body parts through the analysis of size and shape relationships of said body parts, and these methods can contribute to the resolution of complicated mass grave scenarios in a number of ways. Often the use of such measures is enhanced by the application of statistical methods, such as Principal Components Analysis and logarithmic transformations, which can provide a stronger understanding of these osteometric relationships.[61]

One of the more straightforward means of addressing commingled remains is to group left and right bones into pairs. This process works by assuming that the left and right bones of a person are essentially a mirror image. Traditionally this would be performed visually, with the anthropologist assessing size and general shape alongside other variables such as colour and degree of decomposition. More recently, this approach has become increasingly quantitative with a drive to reduce potential observer error. In 2013 Thomas *et al.* published the results of their research into pair-matching of the skeleton and introduced the new *M* statistic as a measure of asymmetry in the skeleton, therefore allowing one to comment on the likelihood that a pair of elements came from the same individual. They concluded that the differences between the sexes was minor, with only three of the fifty-one measures that they investigated showing signs of statistically significant sexual dimorphism.[62] This is advantageous for a method which seeks to investigate remains where biological profiling may be difficult. In addition to size differences, there are also shape-based asymmetrical differences which can be used for examining the skeleton. Although shape-based methods are currently focusing on other aspects of biological profiling, these very statistical measures should also be able to assist in cases of commingling.[63]

Asymmetry within the skeleton has been noted for a long time, and understanding the nature of this in humans is critical to resolving issues of commingled remains. Although asymmetry is in essence the difference between the left- and right-hand sides of the body, or the deviation from a mirror image, it should be noted that there are different forms of asymmetry with different aetiologies, and that the degree of asymmetry will vary between different geographic and temporal populations.[64]

Skeletal remains can also be reconstructed by assessing the articulation of adjoining elements.[65] Since adjoining bones grow and develop together and in a related manner, their size and shape should correlate to form a functioning moving joint. It should be noted that the effectiveness of this method is influenced by the fact that some articulations are anatomically tighter than others and by the presence of pathologies.[66] Research has shown that articulations with a good degree of confidence with regard to fit include the cranium and mandible, vertebrae, humerus and ulna, and the metacarpals/tarsals.[67] Low confidence can be seen, for example, with the ribs and the humerus and scapula.

One challenging aspect of the use of osteometric approaches is when dealing with fragmented remains. Indeed, Adams and Konigsberg suggest that bone preservation is the most critical limiting factor when selecting the appropriate quantitative method for sorting commingled remains.[68] Clearly the relationships discussed above still exist, but the broken nature of the bone increases the degree of inaccuracy likely to be experienced and complicates or makes impossible the measurement of the bones. Nevertheless, detailed recording of the remains *in situ* combined with delicate and careful recovery can allow the spatial relationships between fragments to be understood, thus potentially facilitating conjoining of the pieces.[69] Currently there is interest in the ability of computer software to match bone fragments together following their scanning through non-contact methods.[70] This may be a way to resolve some of the issues associated with working on fragmented bony remains.

On occasion there are additional challenges faced when attempting to decipher commingled remains and these require specific methods. An example of this is when the remains have also been burned. Here the technical approaches discussed above will likely be even more problematic to implement, since the process of burning can cause DNA to denature, may result in shifts to the elemental composition of the skeleton, and can cause shrinkage and warping of bones.[71] In resolving these issues, traditional osteological analysis is generally still of use, but some workers have also demonstrated the benefit of examining the weight of the burned remains. It has been argued that the weight of the burned remains will correlate with the number of individuals present.[72] The use of such metric measures has been applied to burned commingled remains in both archaeological[73] and forensic contexts.[74]

Conclusions

Although highly technical approaches to the identification of victims in mass graves, such as those discussed above, have real scientific potential, it has also been noted that the realities of the field may inhibit their use and application. In her reflection of the identification process in Bosnia, Komar notes that the scale of bodies to be examined combined with time pressures may negate the use of more labour-intensive methods.[75] Klonowski implies this for the same country in a later work.[76] She also adds that there are issues with the experience and training of the anthropologists in the field, and we could extend her conclusion with regard to the methods discussed here. In this situation, osteometric approaches may be preferable since they are easier and less expensive to apply,[77] yet there are times when these methods will struggle to resolve mass grave issues – which explains the more recent exploration of more technical approaches. We also acknowledge that there are other approaches to resolving these issues in mass graves than the ones discussed above, but our focus here is on more technical and quantitative methods. Nonetheless, the availability of expertise, equipment, and the necessary standards are real limiting factors in the wide-spread application of advanced analytical methods in forensic anthropology. And of course, despite the methodological developments within the discipline, there are times when complete reassociation of remains will still be impossible.[78]

Good local knowledge and witness testimony is key to a high identification rate. Although technological solutions have assisted in these efforts, effective ethnographic investigation is still the crux of any mass grave investigation. Yet this raises many questions. From an ethical perspective, is it always appropriate to investigate mass graves? We could think of this from the perspective of the local community (whose support for exhumation should not be assumed, and is discussed further below) or from that of the forensic practitioners, where the investigating bodies have an ethical duty to ensure the safety of their personnel.[79] Is there a strategy in place to deal with the remains once they are exhumed? Is the DNA-led identification process targeted correctly? The work by Ferrándiz in Spain demonstrates the problems that can occur further down the line of the investigation if this is not thoroughly considered at the start.[80] Is the solution a traditional approach corroborated by DNA or a DNA-led process that uses traditional techniques if necessary? Naturally, the answers to these questions entirely depend on the context and the legal authority of the country involved and the resources available. Further, the application of more technical identification methods in commingling contexts may be welcomed, but should balance the needs of the families as well as those of the scientists and politicians. This is more complicated than it seems, since the evidential needs of each group will vary and shift.[81] In some contexts, family members and next of kin are actively involved in the application and management of the identification methods and processes.[82] These new technical methods can be complicated and rather abstract to explain to non-experts, without the additional difficulties of applying them in the field.

We should also note, as alluded to above, that identification of the victims of mass graves is not always supported or desired. Examples exist of pressures to keep mass graves undisturbed (such as displayed in Crossland's 2002 work in Argentina) or to emphasize the broader political or community-based identities of the victims over their individual ones.[83] There are also examples of families opting to rebury their identified loved ones in a communal mass grave with the other victims with whom they were originally buried (such as in Chile).[84] In extreme cases the perpetrator of the crime may still live in the village or town. When this occurs the grave may be tampered with or 'disappeared', and the family threatened if they insist on pursuing an exhumation. One such case in Guatemala resulted in the double tragedy of the family losing their loved ones twice.

It is imperative to identify the missing for many worthy reasons, including the right to a dignified burial being a basic human condition that transcends cultures, and the will to prosecute the guilty in order to create a better future for those communities that have suffered as a result of armed conflict. However, we conclude with a note of caution which should be borne in mind before embarking on a mass grave exhumation. An identification strategy that is achievable and affordable must be in place before any soil is removed. Misidentifications must not happen, and any combination of traditional and technological techniques must work when applied in the field in order to achieve the best possible outcome and the maximum number of correct identifications.

Notes

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