Radiography Superimposition in Personal Identification - A Case Study Involving Surgical Implants

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Abstract

Till date, the identity of decomposed corpse is a challenging task in all Forensic Laboratories. DNA typing is the primary technique for personal identification. Using ante-mortem and post-mortem DNA profiles in personal identification is impossible in South Indian population due to non-availability of DNA profile for the existing population. Personal identity of the deceased becomes critical in instances like the absence of parents and children for DNA profile comparison. Skull-photograph superimposition is another technique for personal identification in Forensic Science Laboratories. One-third of the cases received for identification through DNA profiles failed with some technical inabilities. Though superimposition technique is easily available and most pioneering, only a probable opinion could be arrived from it. But the court of law accepts only the conclusive identity, the DNA profiles give. When ante-mortem dental records or radiographs are received for superimposition, the conclusive identity will be achieved. In this case of personal identity of a skull, DNA profiles for comparison could not be obtained as the deceased had no parents and children, the skull-photograph superimposition offered only a probable opinion, but the superimposition of the photographs of ante-mortem and post-mortem radiographs of the surgical implant (stainless steel orthopedic fixation device) of the suspected deceased rendered conclusive identity.

Keywords: Personal identification; DNA profile; Skull-photo Superimposition; Post-mortem and ante-mortem dental records; Stainless steel orthopedic fixation device; conclusive identity.

Introduction

The DNA profiling and Skull-photograph superimposition are the techniques adopted in Forensic Science Laboratories for personal identification. The first use of DNA testing in a forensic setting came in 1986 [1] and it is the ‘Primary Identifier’ at present in Forensic Laboratories as it gives conclusive identity.

The skull-photograph Superimposition is the most prevalent method used for identification of unidentified skulls recovered from the scene of crime [2]. The work of Glaister and Brash [3] in Mrs.Ruxton’s case had given a good start for superimposition for establishing individual identity. A variety of techniques were applied in identification of skulls using skull-photograph superimposition [4 -16] and attempts are still going on to reduce the ambiguities due to soft tissue thickness in Cranio-Facial matching of skull – photograph superimposition [17]. The facial soft tissue thickness was studied by magnetic resonance imaging (MRI) for 300 individuals of northwest Indian adults and the data was published with the comparative study with some other races. This helps the forensic experts in reconstructing the face from the skull for identification purpose [18]. Comparison of ante-mortem and post-mortem radiographs is a commonly used technique for identification in Forensic Anthropology [19,20]. Superimposed comparison of radiographs proved useful when the areas of interest were small or hard to visualize with side by side or over lay techniques [21]. Skull-Photo Superimposition can also be a very useful identification technique in border deaths in the event that ante-mortem photographs can be located [22].

Though the superimposition technique is the easily available and is most pioneering identifier for personal identification, a probable opinion could only be arrived. Cautions have been given by many researchers regarding ‘false match’ or ‘mismatch’ in skull – photograph superimposition technique [8,23-26]. Some researchers established the anatomical relationships other than the metrically correlating characters between the organs of the skull and the face [27-32]. Since the persons belonging to closely-inbreeding populations are known to share a striking similarity in their facial features only a probable opinion could be offered by this technique. The cranio-facial morphanalysis (evaluating the shape correlations between a skull and the face) is suggested as a conjoint application for skull-photograph superimposition to enhance the reliability of identification and to increase the confidence of the analyzing expert [2,31].

When ante-mortem dental records or radiographs of a suspected deceased are received along with the skull for identification, the definite identity could be achieved [33-38]. But the availability of such dental records and radiographs are very rare in Indian population. In few instances, the dental pattern superimposition is used for definite inclusion and exclusion.

Problems during Skull-photograph Superimposition:

The following situations will reduce the level of confidence of the analyzing expert.

1) Non-availability of clear photograph.
2) The available hazy photograph does not reveal the facial features of the suspected deceased.

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3) Missing of bone pieces in facial skeleton and missing of mandible.

4) Teeth-less skull with clear ante-mortem dental records or dental pattern revealing photographs.

5) Distorted photograph for comparison.

**A case study**

A skeleton was found inside a well situated in a paddy field. Spot post-mortem was conducted by a medical team which suggested that the skeleton might have belonged to a male aged about 25 years.

A skull without mandible along with a hazy photograph of the suspected deceased individual was forwarded to this laboratory for skull-photograph superimposition. In addition to the skull, a right femur was also received for age estimation. When this case was taken up for analysis, two parts of (stainless steel orthopedic fixation device) broken steel plates along with five screws in each were found fixed on the lateral side of the right femur. As analysis demanded, the missing mandible, a clear original photograph and the treatment details with the batch number of the orthopedic fixation device and the radiographs of the femur were called for. Unfortunately, the mandible could not be recovered as it had gone missing in the sandy well. The treatment details of the femur bone with the batch number of the orthopedic fixation device and clear photograph/dental pattern revealing ante-mortem face photographs could not be received from the family of the suspected deceased. However a radiograph of the medically treated femur alone was received subsequently. Only a probable opinion could be arrived from the superimposition of a skull without mandible with a hazy photograph. But the police investigation demanded ‘definite identity’ as this was a sensational case. Since parents and children were not available for the deceased person for personal identification, the DNA profiling technique became impossible and the ante – mortem DNA profile was also unavailable. The only solution for fixing the identity in this case was Skull–Photograph Superimposition.

**Materials and Methods**

**Skull–photograph superimposition**

The Skull–Photograph Superimposition was carried out with the available materials. The frontal eminences, the leftwardly asymmetric nasal ridge and the simian gutter in the alae of the nose of the skull were correlated with the corresponding organs in the face photograph during Cranio-Facial morphanalysis. Further the fitness of the organs of the facial skeleton and the face photograph were examined using Computer Aided Video Superimposition Device (CAVSID) [2,31]. The above said features and the anthropological landmarks were also fitted during superimposition. Since the analysis was done with a hazy photograph and the skull without mandible, a qualified or definite opinion could not be arrived on the identification of the skull. The opinion could be arrived as ‘The skull could possibly have belonged to the suspected deceased.’ The (Figures 1(a-d)) show the fitness during superimposition.

**An additional Superimposition**

Since the police investigation demanded the conclusive identity, an idea struck in the mind of the author to use the femur by superimposing the photographs of the ante-mortem and post-mortem radiographs of the steel plates in the femur in addition to the age estimation. The video superimposition set-up proved useful for ante-mortem and post-mortem radiograph comparison [21]. The computer aided video superimposition device is used for the superimposition of the photographs of ante-mortem and post-mortem radiographs of the steel plates and screws fixed in the femur.

In our Laboratory, post-mortem radiograph of the steel plates in the femur was taken exactly in the same position as it was in the ante-mortem radiograph after numerous tireless attempts in various angles to obtain the exact angle of the femur as it was in ante – mortem radiograph. The photographs of both ante-mortem and the post-mortem radiographs were taken in our Laboratory.

**Technique**

The photographs of ante-mortem and post-mortem radiographs were taken and they were scanned. Since superimposing the negative and positive images would give a clear idea about fitness, the image of the ante-mortem photograph was taken as a negative image while the post- mortem image was taken as a positive image. The additional superimposition was carried out in the above said Computer Aided Video Superimposition Device (CAVSID) [2,31].

During superimposition both the ante – mortem and post – mortem images were enlarged equally to ‘life-size’ images. The length of the steel plates fixed in the femur received for analysis were measured and the same were used as scale in bringing out the life-size enlargement of the images of the steel plates. The wipe modes of the CAVSID were used to position the scanned images. The outline of the broken steel plates including the broken edges with screws and screw threads of...
Ante-mortem radiograph were fitted exactly with the same in the post-mortem radiograph during superimposition. The (Figures 2(a-c)) show fitness during superimposition for the proximal end whereas the (Figures 3(a-c)) show fitness for the distal end.

Both the broken steel plates were superimposed separately owing to the fracture in the middle of the femur in ante-mortem radiograph while the fracture is reunited in the post-mortem radiograph. The sectional analysis is advised in these circumstances [39].

Discussion

The skull-photograph superimposition was the only technique trusted in personal identification even before the development of DNA profiling technique. Though every human being is endowed with uniquely individualizing facial features, the opinion could not be given in a definite form by this technique because the persons belonging to closely-inbreeding populations are known to share sticking similarities in their facial features [2,31]. When the primary identifying technique such as DNA profiling technique is failed, the investigation demands the identity from superimposition technique. When the court of law expects the conclusive result from superimposition technique, the ante-mortem radiograph of the suspected deceased shall be used. The availability of ante-mortem radiograph of the suspected deceased in a criminal case is rare.

Conclusion

Plates and screws are more commonly used for internal fixation of fractures in the upper and lower thirds of the femur and the misuse of this method produces poor results [40]. The fixed plates will be removed upon healing after a period of time. But in this case, the plate was not removed despite the reunion of the broken femur and instead has broken accidentally paving the way for the author to make use of the broken plates as a tool for identification.

At the end of the additional superimposition, the author offered the opinion in a definite form as ‘The femur bone belonged to the individual of whose ante-mortem radiograph of femur bone was furnished’. The skull – photograph superimposition offered only a probable opinion but the additional superimposition of ante – mortem and post – mortem radiographs of the femur rendered definite opinion to fix the identity. This opinion could be very useful for investigation and the administration of the Justice when it would come to the Court of Law. In this case, the surgical implant fixed the personal identification.

References

28. Francis EC (Ed.) (1968) Gradwohl’s Legal Medicine, 2nd Edn, John Wright & Sons Ltd., Bristol, page 15.