Journal of Forensic Research
ISSN: 2157-7145

Pushparani et al., J Forensic Res 2012, 3:1
DOI: 10.4172/2157-7145.1000140

Research Article Open Access

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

C Pushparani*, C P Ravichandran and K Sivakumari

Scientific Officer, Anthropology Division, Forensic Sciences Department, Chennai-600 004, Deputy Director, Anthropology Division, Forensic Sciences Department, Chennai-600 004, Associate Professor of Zoology , Presidency College, India

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 radiograph 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.

***Corresponding author:** C. Pushparani, Scientific Officer, Anthropology Division, Forensic Sciences Department, India, E-mail: pushparani.c@gmail.com

Received October 03, 2011; **Accepted** October 15, 2011; **Published** October 18, 2011

Citation: Pushparani C, Ravichandran CP, Sivakumari K (2012) Radiography Superimposition in Personal Identification - A Case Study Involving Surgical Implants. J Forensic Res 3:140. doi:10.4172/2157-7145.1000140

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) devised by Jayaprakash [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

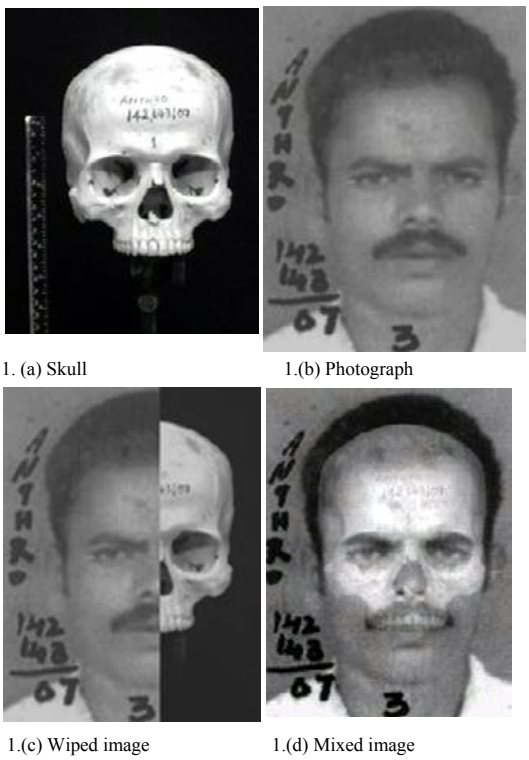


Figure 1: (a&b) The frontal eminences, the leftwardly asymmetric nasal ridge and simian gutter in the alae of the piriform aperture of the skull 1(a) and its manifestations in the corresponding face photograph 1(b)
(c&d) Show the incomplete fitness of the skull without mandible in wiped and mixed mode of CAVSID.

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].

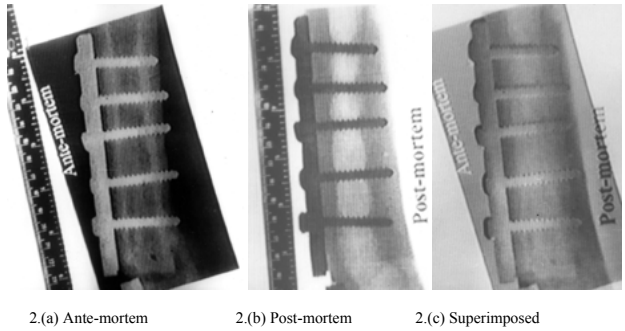
During superimposition both the ante – mortem and post – mortem images were enlarged equally to 'life-size' images. The length of the steel plates fixed in the femur received for analysis were measured and the same were used as scale in bringing out the life-size enlargement of the images of the steel 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].

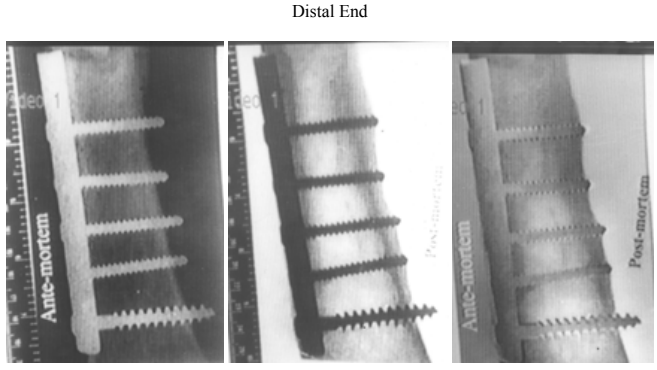
Discussion

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.



2.(a) Ante-mortem 2.(b) Post-mortem 2.(c) Superimposed

Figure 2: (a) The negative image of ante-mortem, 2(b) the positive image of post-mortem, 2.(c) Superimposed image show the fitness in the proximal end.



3. (a) Ante-mortem 3. (b) Post-mortem 3. (c) Superimposed

Figure 3: The negative image of ante-mortem, 3(b) the positive image of post-mortem 3.(c) Superimposed image show the fitness in the distal end.

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

1. Butler JM (2005) Forensic DNA typing (Biology, Technology and Genetics of STR markers) 2nd edn., Elsevier Academic Press page 3.
2. Jayaprakash PT, Srinivasan GJ, Amaravaneswaran MG (2001) Cranio- facial morphanalysis: A new method for enhancing reliability while identifying skulls by photo superimposition, Forensic Sci Int 117:121-143.
3. Glaister J, Brash JC (1937) Medico-legal aspects of the Ruxton Case. Baltimore: William Wood and Co.
4. Prinsloo I (1953) The identification of Skeletal remains in Regina versus K and another: The Howick Falls Murder Case. J.Forensic Med.1:11-7
5. Chandrasekharan P (1971) A revised superimposition technique for identification of the individual from the skull and photograph. J Criminal Law, Criminology, and Police Science. 62:107-13.
6. Chandrasekharan P. (1973) A Scientific method for positioning of the skull for photography in superimposition studies. J Police Sci. Admin.: 1:232-40.
7. Gruner O. (1988) The identification of Skulls: historical review and practical application. Proceedings of the advances in skull identification via video superimposition: An international symposium and workshop. Kiel, West Germany.
8. Dorion RBJ. (1983) Photographic superimposition. J Forensic Sci. 28:724-34.
9. Webster WP, Murray WK, Brinkhous W, Hudson P. (1986) Identification of human remains using photographic resonstruction. In:Reichs KJ, editor. Forensic Osteology; advances in the identification of human remains Springfield: Charles C Thomas; 256-89.
10. Reddy KSN (1973). Identification of dismembered parts: the medicolegal aspects of the Nagaraju case, Forensic Sci.; 2:351-74.
11. Janssens PA, Hansch CF, Voorhamme LL (1978) Identity determination by superimposition with anthropological cranium adjustment. OSSA: J Skeletal Res 5: 109-22.
12. Gerjvall NG (1974) Superimposition. Plus SEM – comparison of hair cuticle for identification purposes OSSA: J Skeletal Res:1:96-9.
13. Gerjvall NG. (1975) Unexpected identification, OSSA: J Skeletal Res : 2:69-70.
14. Gerjvall NG, Johanson G. Solving a mystery death. OSSA: J Skeletal Res 1976-77 3/4: 169-81.
15. Mckenna JJ. (1988) A method of orientation of skull and camera for use in forensic Photographic investigations. J Forensic Sci; 33:751-5.
16. McKenna JJ, Jablonski NG, Fernhead RW (1984) A method of matching skulls with photographic portraits using landmarks and measurements of the dentition. J Forensic Sci.; 29:787-97.

17. Ghosh A.K, Sinha.P (2001) An economised craniofacial identification systems, Forensic Sci Int: 117: 109-119.

18. Sahni D.Sanjeev,Gurpreet Singh, Indar Jit, Paramjeet Singh (2008) Facial soft tissue Thickness in northwest Indian adults. Forensic Sci.Int 176:137-146.

19. Maples WR (1997) Forensic Anthropology, In:Stimson PG, Mertz, CA, editors. Forensic dentistry. Boca Raton: CRC Press:65-81

20. Stahl CJ (1973) Identification of human remains. In:Spitz WU, Fisher RS, editors. Medicolegal investigation of death Springfield: Charles C Thomas;32-65.

21. Austin D (1999). Video Superimposition at the C.A. Pound Laboratory 1987 to 1992, J. Forensic Sci; 44 : 695-699.

22. Todd W.Fenton, Amber N. Heard, Norman J. Saver (2008), Skull-Photo Superimposition and border deaths: Identification Through Exclusion and Failure to Exclude, J. Forensic Sci. 53:34-40.

23. Koelmeyar TD (1982) Video camera superimposition and facial reconstruction as an aid to identification, Am J Forensic Med Pathol 3: 45-48.

24. Schimmer JB, Helmer RP, Rieger J Craniometric Individuality of human Skulls, In: Iscan M.Y, Helmer RP.editors. Forensic analysis of skull- craniofacial analysis, reconstruction, and identification, Wiely Liss Inc, New York, USA;89-96.

25. Seta S, Yoshino MA (1993) A combined apparatus for photographic and video superimposition, In Iscan M.Y, Helmer RP(editors) Forensic Analysis of the Skull- Craniofacial Analysis, Reconstructions and Identification. Wiely Liss Inc., New York, USA: 161-169.

26. Austin Smith D, Maples WR (1994) The reliability of skull/photograph superimposition in individual identification.J Forensic Sci. 39:446-455.

27. Krogman WM, Iscan MY (Eds.) (1986) The human skeleton in forensic medicine. Charles C Thomas , Springfield IL; 413-457,530.

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

29. Gatliff BP(1984) Facial sculpture on the skull for identification. Am. J. Med. Pathol 5:327-332.

30. Rhine JS, Campbell HR (1980) Thickness of facial tissues in American Blacks. J.Forensic Sci .25:847-858.

31. Jayaprakash PT (2001) Cranio- facial morphanalysis: A new method to enhance reliability in Forensic identification of skull by photo- superimposition; An analysis on the preadolescent permanence of suture patterns, Degree of Doctor of Philosophy - University of Madras.

32. Ghosh AK, Sinha P(2005) An unusual case of Cranial Image recognition. Forensic Sci. Int. 148:93-100.

33. Whittakar DK,Mac Donald DG(1989) A Colour Atlas of Forensic Dentistry. Wolf Medical Publications Ltd., London. page 94-97.

34. Webster WP, Murray WK, Brinkhous W, Hudson P(1986) Identification of human remains using photographic reconstruction, in: J.R. Kathleen (Ed.), Forensic Osteology: Advances in the Identification of Human Remains, Charles C Thomas, Springfield, IL 256-289.

35. Ferris JA, Stockdale RE (1972) The Bluebell Woods case: A problem of Identification. J.Forensic Sci. Soc.12:339-345.

36. Chandrasekharan P (1985) Identification of Skull from its suture pattern. Forensic Sci. 27: 205-214.

37. Law FM(1934) Roentgenograms as a means of identification. Am J Surg 26: 195-198.

38. Jayaprakash PT (1997) Skull Sutures:radiographic contour of Wormian bone as an individualising epigenetic marker, Can. Soc. Forensic Sci. J.30:39-47

39. Michael Bowers C (2004) The use of Digital imaging in Human Identification, In Foresic Dental Evidence: An Investigator's Hand Book 1st Edn; Elsevier Academic Press: California,USA.; page 177.

40. Sisk D (1984) Fractures, In Campbell's Operative Orthopaedics. 6th Edn; Allen S, Edmonson, A.H, and Crenshaw; Eds; Mosby.V, Westline, Missouri , pages 607-612.