Analysis of the Anterior Dentition Visiblity in Photographs and Its Application to Forensic Odontology

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Abstract

Introduction: Dental identification is one of the most reliable and frequently applied methods for identification of human remains using smile photographs and dental models when there is total or partial loss of soft tissues. The occlusal profiles and special features of anterior maxillary teeth capable of being seen in smiling photographs are evaluated for individuality. *Aim:* To analyse the utility of smiling photographs in identification of the individuals and the use of anterior dentition and its features in the identification of individuals. *Material and Methods:* Photographs with broad smile and dental models were obtained from 65 students of the institute. A blind trial was done by four observers to identify the dental models on the basis of photographs. *Conclusion:* This method of using smile photographs for identification can be used as screening method in mass disaster cases and is less time consuming.

Keywords: Forensic Odontology; Smile Photographs; Mass Disaster.

Introduction

Forensic Odontology is a science that utilizes the dentist's knowledge to serve the judicial system. The role of forensic odontologist is to collect, preserve and interpret trace evidence, then to relay the results to the judicial authority in a form of a report. Those functions require sound knowledge in dealing with crime scenes and sufficient acquaintance in law. The use of teeth as evidence is not recent. There are historical reports of identification by recognizing specific dental features as early as 49 A.D. However, Forensic Odontology, as a science, did not appear before 1897 when Dr. Oscar Amoedo wrote his doctoral thesis entitled "L'Art Dentaire en Medecine Legale" describing the utility of dentistry in forensic medicine with particular emphasis on identification [1].

In modern age, death due to drowning, conflagration, high speed trauma, terrorism, natural calamities and other agencies are an everyday occurrence. Frequently due to nature of these deaths, the soft tissues of body may be partially or totally destroyed. Teeth, as other calcified human tissues, are often preserved after death thus providing vital information regarding the identity of the individual.

Human dentition is never the same in any two individuals and this forms the basis for dental identification [2]. The potential for every individual to have 32 teeth with each tooth having 5 surfaces which may be sound, decayed, missing or filled gives every individual a unique dental identity. Variations in shape, colour, position, age changes, wear patterns and restorative work make the dentition as individual as finger prints [3,4]. However these variations need to be analysed by the dental examiners and almost all the time require the availability of antemortem records of an individual. Unfortunately, obtaining antemortem information may not be possible in all the cases [5]. In such cases the forensic team need to rely on alternative sources of references such as photographs for identification of personal features at post-mortem examination.

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McKenna JJ, Jablonski NG, Fearnhead RW in 1984 described a method of matching and identifying skulls to family snapshots or passport photographs. They suggested that the technique depends on the recovery of teeth, particularly the maxillary anterior teeth, with the skull and the availability of an antemortem photograph showing those teeth. They used the measurements of the anterior dentition of unidentified skulls to determine the magnification factor necessary for the preparation of life-sized transparencies of photographs. Superimposition of dental landmarks in those transparencies lead to correlation of further cranial features, thus enabling a successful positive identification. Suggestions were made by the authors for a system of identification based on assessment of visible features of the dentition [6].

A smile can reveal dental relationships of symmetry, dental axis, gum contours, inter-dental contacts, incisal edges, teeth proportions and smile lines. The identification of unknown human by smile photographs that show specific characteristics of each individual has found acceptance all over the world [7]. Each subject has at least one special feature of anterior teeth which could be classified as unique [5].

Aims and Objectives

1. To analyse the utility of smiling photographs in identification of the individuals.

2. To analyse the reproducibility of the result of different observers at different periods of time.

3. To analyse the use of anterior dentition and its features in the identification of individuals.

4. To assess the role of oral pathologist in identification of individuals in forensic odontology.

Materials and Methods

The study was carried out in the Department of Oral and Maxillofacial Pathology and Microbiology at I.T.S - C.D.S.R. Muradnagar (Ghaziabad). Photographs with broad smile and dental models were obtained from 65 students of the institute after informed consent. The camera used was a Sony DSC-W120 with a Carl Zeiss 4x optical zoom *lens* for coloured photography. The camera was held at horizontal plane and it was focussed on the central incisor teeth.

The impression of maxillary dentition was taken using alginate. The models were cast in dental stone. A blind trial was done by four observers at different times to identify the individuals on the basis of smile photographs. All the observers were not trained forensic odontologist but were oral pathologists with varying levels of experience ranging from a period of 11 years to 1 year.

Results

A blind trial was done by four observers at different times to identify the model on the basis of smile photographs. The special features of anterior maxillary teeth capable of being seen in smiling photographs were noted and evaluated for individuality. Among all the maxillary anterior teeth seen in photographs, features of central incisor and lateral incisors were commonly used for identification by the observers.
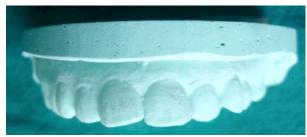

Fig. 1: Dental model of the subject

Fig. 2: Smile photograph obtained from subject

The common features of maxillary central incisor which were used for identification were:

1. Shape

2. Angulation

3. Incisal edge

4. Overlapping

Features of maxillary lateral incisor which, were commonly used:

1. Angulation

2. Incisal edge

3. Peg shape laterals

In some cases, position of canine was also used for identification. And some general features like spacing, attrition and missing teeth were also considered. Among all the features mentioned above, the angulation and incisal edges of both central incisor and lateral incisor were used in identifying more than 50% of individuals.

1st observer	53	81.5%
2nd observer	40	61.5%
3rd observer	54	83%
4th observer	63	96.9%

Table 1 indicates the number and percentage of individuals correctly identified on the basis of the characters of anterior dentition mentioned above.

1st observer identified 81.5% of total subjects, 2nd observer identified 61.5%, 3rd observer identified 83% and 4th observer identified 96.9% of total subjects. So, overall result was 80.7%.

Discussion

The use of antemortem photographs of the deceased in the identification has been established since half a century[8]. Teeth are the hardest tissue in the human body – the enamel being 97% mineral (0.5% wet weight and 99.5% mineral dry weight) therefore they are the tissue that is most resistant to trauma, decomposition, water immersion, chemicals and fire (*Clark, 1982; Knight, 1996*) making them an invaluable evidential source [9,10]. Identification from dental remains is based on multifactorial variations that will permit an accurate and reliable assignation. Dental comparison is one of the four primary identifiers recognised by *INTERPOL* in the identification of the deceased and as such it is placed in a similar legal category of confirmation of identity as DNA and fingerprints (*Black et al., 2009*) [11]. Despite recent advances in DNA science, dental identification still offers a quick, economic and reliable approach to identification of the deceased provided comparable antemortem records are available [12]. Dentistry is therefore of immense value in identification procedures in both single fatalities and mass disasters where body disruption may be extensive (*Cameron and Sims, 1974; Cottone, 1982; Whittaker and Macdonald, 1989; Sainio and Clark, 1992; Bowers and Bell, 1995*) [13-17]. Recent examples where the discipline has proved to be of significant value

include *the Lockerbie air disaster (1988), the World Trade Centre (2001), the Asian tsunami (2004), the London bombings (2005), the Dhow boat disaster (2006) and the Phuket air crash (2008) [18].*

The concept of forensic odontology comes into picture in case of unidentifiable cases where forensic medicine finds its limitations. Antemortem data for forensic identification include dental records, patient records, cast models, intraoral photographs, periapical radiographs, interproximal and panoramic radiographs and postero-anterior skull radiographs. However, in certain cases, the victim being analyzed may not have clinical records showing relevant odontologic characteristics. Therefore, experts in the practice of human identification currently search for information from alternative sources, such as facial photographs, video recording or smile photographs that show specific characteristics of each individual [7].

Regardless of the method used to identify a person, the results of the comparison of antemortem and post-mortem data lead to 1 of these 4 situations:

1. Positive identification: Comparable items are sufficiently distinct in the antemortem and postmortem databases; no major differences are observed.

2. Possible identification: Commonalities exist among the comparable items in the antemortem and post-mortem databases, but enough information is missing from either source to prevent the establishment of a positive identification.

3. Insufficient identification evidence: Insufficient supportive evidence is available for comparison and definitive identification, but the suspected identity of the decedent cannot be ruled out. The identification is then deemed inconclusive.

4. Exclusion: Unexplainable discrepancies exist among comparable items in the antemortem and post-mortem databases [19].

Smile photograph showing front teeth has found wide acceptance throughout the world as a tool for positive identification, characterized as fast and secure method [7]. Photographs may yield valuable information on dental characteristics even if not taken for dental purposes. A smile may enable detection of crown, gold inlay or diastema [5].

Anterior dentition photographs have contributed to the resolution of many cases and mass fatality incidences as well. Routine identification tasks are a simple one to one matching process. But mass disasters represent a big challenge for identification

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of victims.

Each dentition is considered to be unique, although to the non-dental eye they all may look the same. Variations in shape, colour, position, age changes, wear patterns, caries and periodontitis, and all associated dental restorations and prosthetic work, make the dentition as individual as fingerprints [3].

In our study, the special features of anterior maxillary teeth capable of being seen in smiling photographs were evaluated. Among all the maxillary anterior teeth seen in photographs, features of central incisor and lateral incisors were commonly used for identification. Features like angulation and incisal edges of maxillary central incisors and lateral incisor were considered for identification in most of the cases. Other features like shape and overlapping were also used. The identification was based on shape and placement of canine in few cases. Generalized spacing and diastema were considered for identification in some cases.

McKenna, J.J.I in 1986, investigated identification type smile photographs and dental models of 100 subjects and found that 96% of subjects had at least one special feature of anterior teeth which could be classified as unique [5].

Silva et al, studied three cases which were subjected to personal identification by photographs of smile. The photographs of the smile were used by comparison of the ante and postmortem images and provided accurate and useful information not only about dental state but also the anatomical features surrounding the upper and lower anterior dental arches [7].

Johnson et al, discussed a technique for comparing six individual human dentition characteristics using the standard measuring tool in Adobe Photoshop CS2 as compared to measuring individual characteristics with an automated software program [20].

Bastlaan R J, Dalitz G D and Woodward C., discussed the technique of using video equipment, to enlarge antemortem photographs and then superimpose these on the video picture of the skull of the suspected deceased person [8].

Limitations

1. In cases of mass disaster there can be tooth loss which can lead to wrong identification or difficulty in identification.

2. Precautions should be taken in case of identification of children, as some changes can occur due to the transient dentition.

3. The quality of photographs is also an important factor while using this method.

Conclusion

This method of using smile photographs for identification can be used as screening method in mass disaster cases and is less time consuming. It is especially helpful in the identification of individuals having tooth anomalies like macrodontia, peg laterals, mesiodens.

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