

REVIEW ARTICLE

From Selfies to Identification: The forensic potential of dental and facial features in Photographic images.

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Abstract

The application of smile and selfie photography in forensic odontology has emerged as a promising approach for human identification, especially when conventional dental records are unavailable or compromised. This review explores the evolution, methods, advantages, and limitations of using smile and selfie photographs as forensic tools. A literature search was conducted using PubMed, Scopus, and Google Scholar, focusing on studies published from 2008 to 2025 with terms such as "Smile Photography," "Forensic Selfie," and "Dental Identification." The selected articles were analyzed for methodologies, technological tools, and real-world applications. Techniques such as direct dental trait comparison, incisal outline analysis, and photograph superimposition—augmented by tools such as GLID and AutoIDD—demonstrated effective results. Several case reports illustrate the successful application of these methods in scenarios involving decomposed bodies, mass disasters, and missing persons. Despite limitations such as image distortion and time lag between photo capture and death, smile photograph analysis proves to be a low-cost, non-invasive, and accessible method. The integration of digital imaging and AI may further enhance its forensic utility. This review affirms the growing potential of smile photography as a supplementary technique in human identification.

KEYWORDS

Incisal Outline Analysis, Photograph Superimposition, Supplementary technique, Human identification

1 | INTRODUCTION

"Forensic dentistry is an important method for human identification." It is highly valuable when traditional methods of identification, such as fingerprints or visual recognition, are cannot be utilized.¹ In this field, teeth are the primary structures of interest due to their remarkable durability and resistance to natural decomposition, even in cases of soft tissue decomposition or burning, showing valuable features of individualization. Within skeletal remains or in cases of advanced decomposition or charring, teeth often remain among the Best preserved body structures. Forensic examination primarily relies on comparative analysis of pre- and post-mortem data, often derived from dental records, encompassing radiographs, clinical forms, dental casts, and intraoral photographs,

and orthodontic appliances such as retainers and bleaching trays.² Nonetheless, in some instances, the victim under analysis may lack clinical records documenting relevant odontological characteristics. Therefore, experts in the practice of human identification currently search for information from alternative sources, such as facial photographs, video recordings or smile photographs that show specific characteristics of each individual.³ Ante-mortem smiles or self-photographs can be sourced from smartphones and social networking sites. Smile photography provides information about smile morphology and anterior tooth anatomy, encompassing aspects such as the number, structure, shape, form, and position of each tooth, their interrelations, occlusion, dental health status, dental pathologies, dental trauma, restorations, and prostheses.⁴ The dentition in the dental arch creates an individual unique

pattern and provides enough data for comparison. Forensic Odontologists have been analysing features on decedents' photographs, including smile photographs, using superimposition techniques commonly known as smile analysis. Specialized 2-D and 3-D software encompassing skull-photo superimposition methods are utilized for this approach, with recently developed techniques such as the GrinLine identification technique (GLID) and Automated identification for dental data (AutoIDD).⁶ When these various clues are available, they may collectively provide substantial information for facilitating positive identification or exclusion in the realm of human identification.²

2 | METHODOLOGY

A comprehensive review of the literature was carried out by searching PubMed, Scopus, and Google Scholar databases using keywords such as "smile photography", "forensic selfie", "dental identification", and "forensic odontology". Studies published in English from 2008 to 2024 were included. Case reports, original articles, and review papers describing the forensic use of smile or selfie photographs were selected. Articles were screened based on relevance, novelty, and the presence of identifiable forensic techniques. Data were extracted and synthesized thematically to reflect the technological tools, applications, and challenges in forensic identification. Consequently, this review aims to explore existing literature on techniques for analyzing smile and selfie photographs as a comparative means of human identification, offering a simple, convenient, cost-effective, and reliable approach. Here are a few methods by which smile and selfie photograph analyses are conducted for human identification in forensic dentistry: 1. Direct comparison of the dental traits - In this approach, dental characteristics in photographs taken before and after death are directly juxtaposed for comparison. 2. Dental Superimposition - In the three-dimensional superimposition technique, ante mortem and post-mortem photographs are progressively layered to increase the translucency



FIGURE 1 Smile line juxtaposed with corresponding "AM" photo

. However, small differences in size between the two sets of pictures can create problems. This issue can be solved by combining multiple techniques. This method is renowned for its high reliability, cost-effectiveness, and efficiency in terms of time. 3. Analysis of the incisal outline of the anterior teeth: This process involves using Adobe Photoshop CS 6R graphic design software for analyzing the alignment of incisal borders in the anterior upper teeth from both ante-mortem (AM) and post-mortem (PM) photographs. Here are the steps simplified: i) Mark the alignment of incisal borders in Adobe Photoshop CS6 software using photographs "AM" and "PM" obtained for analysis.

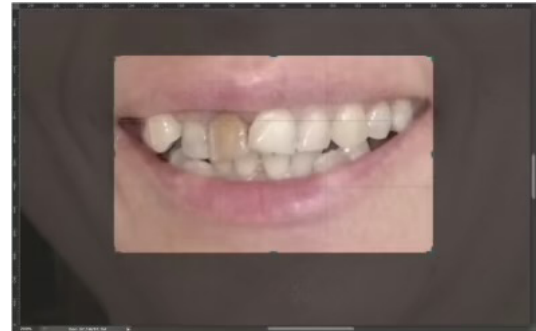


FIGURE 2 Cropped area located between the corners of the mouth

ii) Crop the "AM" picture to a 2x3 aspect ratio using the Crop Tool. Locate the cropped area between the corners of the mouth, with the center determined by the incisal borders of the upper teeth.

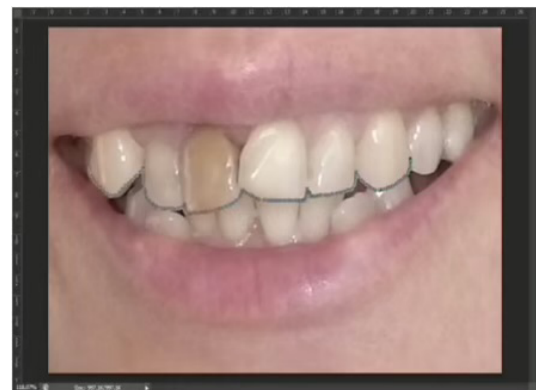


FIGURE 3 Marking points to form an alignment of the anterior teeth

iii) Highlight the incisal outline of each tooth with the Pen tool, starting from the distal margin of a canine. The Pen tool allows marking numerous points, forming a fully editable line.

iv) Ensure accuracy by using many points in the selection. Each point can be edited or removed to correct any shortcomings. v) Copy the selection into a new layer. In the Blending Options tab, select a stroke



FIGURE 4 Use of the "Make selection" tool

pattern with a size of 5 px, creating a filled contour. Use colours corresponding to Interpol forms mark the smile line from photo "AM" in yellow and mark "PM" data in pink. Remove the fill from the contour by reducing the value from 100% to 0% using the fill level option.



FIGURE 5 Creation of the colored contour of the teeth

. vi) Choose the Rasterize Layer Style and remove the unnecessary upper border of the contour.

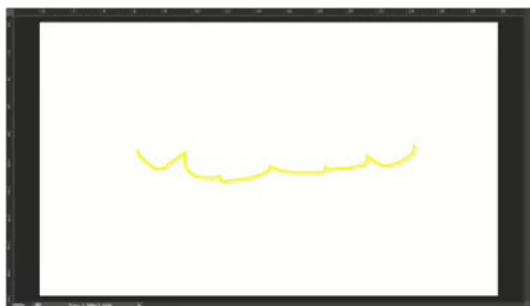


FIGURE 6 Elimination of the filling and upper border from the contour

vii) After completing the steps, you can use the Free Transfer Option to move, rotate the copy, enlarge, or reduce the smile line. Perform comparison and analysis of the incisal outlines.



FIGURE 7 "AM" and "PM" smile lines compared next to each other and then superimposed M.

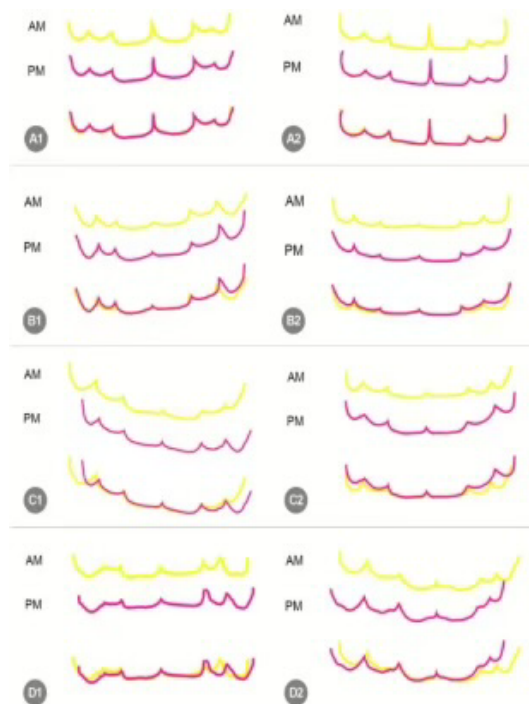


FIGURE 8 Selected comparison of the smile lines from "AM" and "PM" pictures classified as exact match [A1,A2], satisfactory [B1,B2], tolerable [C1,C2], and insufficient [D1,D2].

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3 | SELFIE FORENSIC ID APP

A selfie identification application created by Nuzzolese et al. (2019) known as Selfie Forensic ID allows users to capture and save photos of their dentition from a selfie angle along with their latest location. It uses selfie and face photographs to create an archive of dental

data and features of the front teeth, facilitating the identification of missing persons. The app allows users to share this information on popular social networks such as Instagram, Tumblr, and Twitter. It is available for free download on both Android and Apple stores at <http://onelink.to/selfieforensic>.

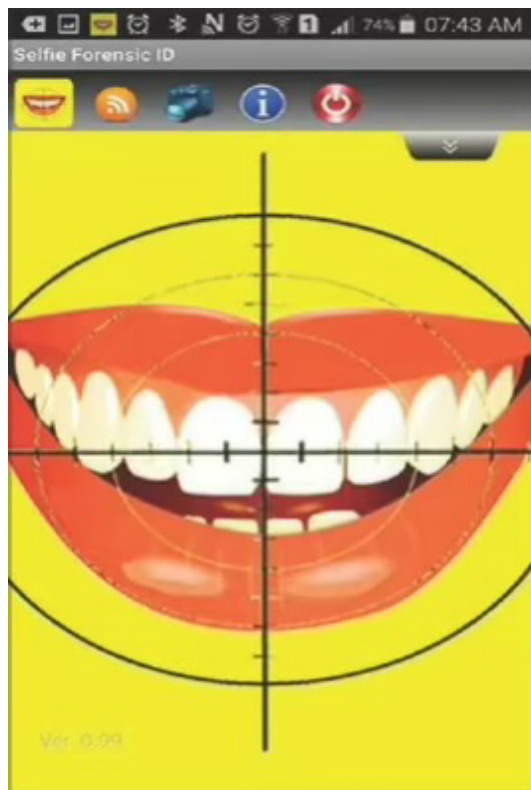


FIGURE 9 "Selfie Forensic ID" App main screen

. Characteristic dental features were used for comparing ante-mortem (AM) and post-mortem (PM) data. Numerous cases related to the identification of missing persons have been successfully resolved using smile and selfie photographs. Here are concise summaries of few of cases.⁶

4 | CASE 1: MISSING PERSON

1. A male with transition between adolescent and adult was found in a decomposed state. 2. A forensic odontology examination showed that his upper left central incisor (21) was missing when he was alive. 3. In this region, the alveolar process underwent remodelling and part of the mesiodistal space was preserved partially. 4. The police investigated that a person with matching anthropological characteristics with that of the recovered body was found. 5. In order to find the missing person, the family members distributed some posters with his photograph. 6. His smiling picture showed that there was a missing central incisor (21). 7. Based on the evidence, the corpse skull image was compared

by computerized superimposition of images along with DNA analysis, confirming that the retrieved body was the person who was missing. A forensic odontology examination showed that the upper left central incisor (21) was missing when he was alive. His smiling picture showed the same

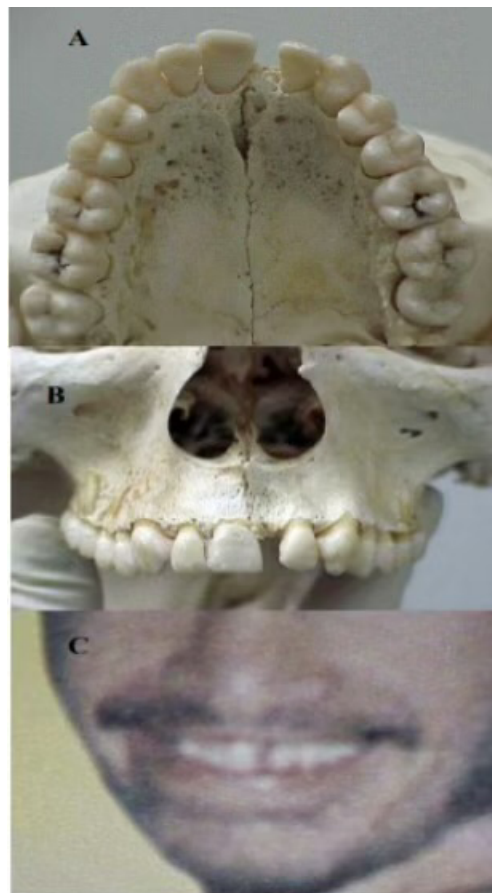


FIGURE 10 Absence of 21 in the superior dental arch (A and B) and in the smile photograph (C)

5 | CASE 2: A RUSSIAN FEMALE DISAPPEARED DURING AN ECOTOURISM TRIP

1. A Russian female disappeared during an ecotourism trip, and posters containing her smiling photographs were distributed in the city. 2. The investigation started effectively one year after her disappearance, when the suspect in the murder indicated where the victim's body was hidden. 3. Forensic odontology investigation showed that the inter-arch relationship was an Angle class II type with upper incisor overjet, horizontal crossbite and midline diastema. 4. Along with this there was wearing on the incisal face of the upper right central incisor, upper left central and

lateral incisors. 5. With skeleton removable orthodontic retainer was found which fit the maxillary arch. 6. Combining anthropological analysis, computerized superimposition of photographs of face and skull images, and analysis of information from smile photographs and clinical dental records, a positive identification was made.⁷ Investigation revealed unique occlusal and dental wear patterns which matched smile photos [[FIG:11,12]].

6 | CASE 3: MASS GRAVEAREA IN DAMASCUS COUNTRYSIDE GOVERNORATE SYRIA

1. In 2017, a skeletonized human remains along with 52 other skeletons were found. 2. The forensic odontologist noticed that 2 teeth lower central incisors were lost PM and AM tiny fracture at middle of incisal edge in upper right central incisor. 3. Two weeks later, a man came to the recognition center in search of his missing brother who was lost in 2014. 4. He provided a photo showing the missing anterior teeth and a defect in the upper right central incisor that matched exactly what had been found in the examination.

7 | CASE 4: IDENTIFYING AN AMAZON RAINFOREST ALLIGATOR ATTACK VICTIM THROUGH SMILE PHOTOGRAPHS

We present a remarkable instance of human identification involving a victim of an alligator attack in the Brazilian Amazon. The victim, along with three others, drowned in the Madeira River. The autopsy revealed the partial skeletal remains of an adult male. Fingerprint and DNA analysis was impractical, and dental and medical records were unavailable. Instead, a photograph of the victim's smile, provided by the family, was employed for identification. Two forensic dental methods were utilized: 1. Direct Comparison: Post-mortem and ante-mortem photographs revealed the following differences in tooth features : -The upper left canine exhibited forward inclination. -Tooth 21 was slightly longer than tooth 22. -There was more wear observed in the mesial third of the incisal edge of tooth 11. -Teeth 12 and 13 displayed a slight divergence in the root apex direction. -Tooth 14 exhibited a cervical lesion of the abfraction type. 2. Computerized Delineation: Smile line morphology was assessed by tracing a line along the incisal contours of the upper anterior teeth of both photographs using software, confirming alignment in both analyses, ultimately identifying the victim.⁷ Smile photo matched a tiny fracture at the incisal edge of the upper right central incisor



FIGURE 11 Tiny fracture of the incisal edge in the upper right incisor a) Antemortem, b) Post-mortem.

8 | CASE 5

In December 2014, a carbonized male body was brought to the Legal Medical Institute of Belo Horizonte, Brazil. A necropsy and dental examination revealed that the teeth were healthy. To identify the victim, the family provided six selfies of the individual, which showed his teeth. The investigation used two methods to compare the photographs and identify the victim. First, a "smile line" was traced on the photos of the victim's smile, highlighting the outline of the maxillary teeth (from canine to canine). This smile line from both sets of photos (morning and post-mortem) matched. Second, superimposition of the photographs was used, layering them at different levels of transparency (0%, 25%, 75%, and 100%) to further check for consistency. A scoring system was also applied to the teeth, assigning scores based on how closely the photographs matched. The final score, 81.25%, indicated a high probability of a match, confirming the identification. The victim's father signed a consent form for the publication of the case.⁸ [[FIG:14,15,16,17,18]]

9 | CASE 6

The carbonized body of a male individual was found in a forest region and sent for anthropological and forensic odontology examination. The autopsy examination revealed skull bone fractures with exposure and loss of encephalic material, absence of the arms, and calcination zones in the osseous extremities and disarticulated lower limbs. Investigation with the presumed family located odontologic documentation (clinical records and periapical radiographs), two radiographs of the right upper arm, and a smile photograph. This photograph showed the anterior upper teeth, indicating the absence of the upper right and left first premolars (14* and 24*) and evidence of amalgam restoration on the mesial face of the upper left second premolar (25*). All these indications had been confirmed during forensic odontology examination, which combined with the data present in the medical and odontological records, showed a positive correlation between the identity of the missing victim and the body examined.⁷



FIGURE 12 Absence of the upper left first pre-molar and presence of amalgam restoration in the mesial face of element 25 in the smile photograph (A) and the upper dental arch in the frontal view (B) and occlusal view (C).



FIGURE 13 Photographs of the victim in the frontal view (A) and lateral right view (B).

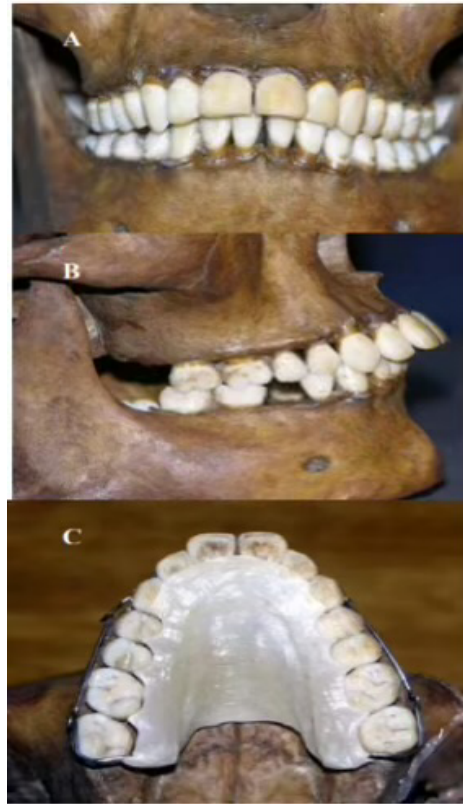


FIGURE 14 Characteristics of the occlusion and superior incisors in the frontal view (A). Lateral right view (B) and orthodontic appliance adapted in the superior dental arch.



FIGURE 15 Carbonized body

there is a necessity to gather quantitative data for forensic identification based on these anatomical structures. The key findings centered on the analysis of missing teeth, dental pathologies, wear patterns, and the use of orthodontic appliances, among others, which provided crucial details aiding in positive identifications. Additionally, the surveys conducted among Dentistry undergraduates and Forensic Odontology postgraduates revealed a high success rate in identifying individuals based on smile photos using dental criteria. Anterior teeth' incisal edge morphology emerged as a pivotal element in this process, emphasizing its importance in the field of forensic dentistry and human identification. Moreover, the methods employed, such as direct comparison of dental traits, dental superimposition, and incisal outline analysis of anterior teeth, highlighted the precision and reliability of this technique. Cutting-edge software tools, like the GrinLine identification technique (GLID) and the Automated identification for dental data (AutoIDD), further validate the significance and advancements in this domain.¹⁴ However, it is crucial to acknowledge the drawbacks and challenges associated with this method. Environmental alterations, time lapses between images and death, and image distortion can pose significant hurdles in the use of smile photographs for forensic identification. The range of head movement affecting image distortion necessitates protocols to mitigate such discrepancies for accurate comparisons.

11 | CONCLUSION

The growing frequency of terrorist attacks and natural disasters coupled with the ethical and administrative implications for families of unidentified victims has heightened public willingness to share personal identification data via the internet and social media. Selfie photographs, such as those generated through the "Selfie Forensic ID" app, along with images shared on social networking platforms; offer a quick, cost-effective, and accessible means of disseminating individualizing information. These tools can significantly support the forensic human identification of otherwise unidentified individuals. In conclusion, the integration of smile and selfie photography as a reliable method in human identification has shown promising results, particularly in cases where traditional medical or dental records are inaccessible. The method's effectiveness in identifying individuals, based on distinct dental characteristics visible in selfies, has been substantiated through various missing case reports and survey studies. Recent technological advancements have further enhanced this identification technique, making it more efficient and accurate. Despite its strengths, there are existing drawbacks associated with this approach. However, ongoing research in this field holds the key to overcoming these limitations, fostering its continuous improvement and reliability. An important aspect of this method lies in its potential to complement and work alongside other forensic dentistry methods, increasing the robustness and accuracy of the identification process. The evolving synergy between this innovative identification method and technological progress offers a promising trajectory in forensic dentistry. As more studies and advancements are made, the integration of smile

and selfie photography is expected to become an increasingly valuable and dependable tool in the pursuit of accurate human identification in various forensic scenarios.

12 | DRAWBACKS

1. It can be used as an adjunct data in preliminary reconstructive identification process. 2. The period which passes from the moment of taking a picture to the time of death should not be too long in order to avoid possible alterations, both environmental (loss, discoloration, attrition) and medical which are likely to significantly change a person's smile. 3. In analysis of portraits potentially serving as comparative material for positive identification in forensic context, image distortion appears as critical disadvantage. 4. It was found that only the lateral bending of the cervical spine (the ear to the shoulder) will not cause deformation in the 2D image. Flexion (forward bending), extension (backward bending), and torsion (left right rotation) of the head affect the result of the comparison; therefore range of motion of the head can vary only by 2 degrees to both sides without distorting comparative process.

13 | ADVANTAGES

1. Low cost it does not require the use of expensive equipment and complicated computer software (the ability to analyse even in PowerPoint). 2. Photographing is now so popular that there is a very high probability of finding an appropriate ante-mortem picture presenting smile, or otherwise the incisal border of the maxillary teeth, of the missing person. 3. Ability to observe cavities, fillings, gold implants, and other individualizing characteristics. 4. The usefulness of the method in the absence of medical or dental data. 5. It can serve as a supplement to previously used and validated methods. 6. Individuality and uniqueness of the tooth pattern.

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