



University of Dundee

Exploring the use of selfies in human identification

Naidu, Dharshini; Franco, Ademir; Mânica, Scheila

Published in:
Journal of Forensic and Legal Medicine

DOI:
[10.1016/j.jflm.2021.102293](https://doi.org/10.1016/j.jflm.2021.102293)

Publication date:
2022

Licence:
CC BY-NC-ND

Document Version
Peer reviewed version

[Link to publication in Discovery Research Portal](#)

Citation for published version (APA):
Naidu, D., Franco, A., & Mânica, S. (2022). Exploring the use of selfies in human identification. *Journal of Forensic and Legal Medicine*, 85, [102293]. <https://doi.org/10.1016/j.jflm.2021.102293>

General rights

Copyright and moral rights for the publications made accessible in Discovery Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from Discovery Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain.
- You may freely distribute the URL identifying the publication in the public portal.

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

EXPLORING THE USE OF SELFIES IN HUMAN IDENTIFICATION

Selfies and Human Identification

Dharshini NAIDU¹, Ademir FRANCO¹, Scheila MÂNICA¹

1. Centre of Forensic and Legal Medicine and Dentistry, University of Dundee, Dundee, United Kingdom.

Corresponding author:

Dharshini Naidu, BDS/MFDS/MFOdont

Centre of Forensic and Legal Medicine and Dentistry, University of Dundee

Nethergate, Dundee DD1 4HN

+44 01382 383000

dharshtnaidu59@gmail.com

ABSTRACT

Background and Aims: The comparison of post-mortem evidence to ante-mortem data is the usual approach Forensic Odontologists take in managing human identification cases. Although dental charts and radiographs are widely used as ante-mortem dental evidence, photographs, including non-clinical ones such as selfies are not regarded as such. Therefore, photographs are not regularly assessed in identifying the deceased. This cross-sectional study was aimed to investigate the possible contributions of selfies in human identification and to suggest a structured methodology to assess selfie images with the data collected.

Material and methods: An e-survey composed of five open and seven close-ended questions was designed using JISC Online Surveys programme (2020) to explore the opinions of practising Forensic Odontologists and related professionals on the use of photographs and selfies in human identification. Responses to the survey were collected and analyzed into descriptive charts and statistics.

Results: Eighty-two out of 200 professionals completed their responses (40.8% response rate). 73.2% of them acknowledged that selfies could be used as a main or adjunct evidence in dental identification. Experienced participants in selfies assessed dental anatomy (n = 6), dental restorations (n = 6), craniofacial landmarks (n = 5), oral soft tissues (n = 3), and implement the use of photo-editing software (n = 3) when provided with photographs to analyze using the direct comparison technique.

Conclusion: It may be concluded that selfies could be supplementary dental ante-mortem evidence. The designing of a step-by-step visual analysis of dental characteristics on a selfie photograph could subsequently be incorporated into official Forensic Odontology association guidelines worldwide. Further research in this area should be carried out along with the advancements in technology.

Keywords: Dental Evidence, Forensic Dentistry, Human Identification, Forensic Photography, Selfies, Guidelines

INTRODUCTION

Comparative dental analysis that is routinely used to dentally identify a victim comprises comparing post-mortem (PM) evidence obtained during the dental autopsy of the deceased to the ante-mortem (AM) data provided by the suspected individual's dental practice and next of kin. AM evidence includes operator notes, radiographs, study models and photographs but they might not be available, adequate or complete which jeopardizes the comparison to the PM information noted during the autopsy.¹ When this problem occurs, Forensic Odontologists might attempt to build a profile of the victim including the sex, ancestry and age. This may be in tandem with located dental records when compared against stored missing persons' records in the future. This constitutes a part of reconstructive dental analysis using the dental profiling method.^{2,3}

Forensic Odontologists have been analyzing features on decedents' photographs, including smile photographs using superimposition techniques, commonly known as "smile analysis".³⁻⁵ Specialised two- (2-D) and three-dimensional (3-D) software encompassing skull-photo superimposition methods are utilised for this approach, with recently developed techniques such as GrinLine Identification technique (GLID) and Automated Identification from Dental Data (AutoIDD).⁶⁻¹⁰

In the mortuary, Forensic Odontologists are recommended to document their cases by photographing and labelling the decedent's dentition from the frontal, left and right lateral profile, maxillary and mandibular occlusal views, together with the palatal/lingual views of the teeth to observe possible dental treatment and other distinctive traits on those surfaces.^{1,11} Considering AM data,

smile photographs and selfies of the individual taken from social media (SM), family keepsakes and video imaging may be used to assist with the identification of an individual.^{12,13}

Selfies refer to “a photograph that one has taken of oneself, typically, with a smartphone or webcam and shared via social media”.¹⁴ With the advent use of SM platforms such as *Facebook*, *Instagram* and *Snapchat*, individuals are more inclined and less reserved in posting photos of themselves online. Outwardly, selfies may reveal vital information such as missing anterior teeth, anterior malocclusion, and obvious dental restorations.^{13,15} Forensic experts may further explore these images to assist in obtaining dental characteristics observed on selfies. A selfie identification application created by Nuzzolese et al (2019) known as *Selfie Forensic ID* which allows users to capture and save photos of their dentition from a selfie angle along with their latest location (providing users switch on the geolocation setting), may also be useful as AM evidence for smile analysis and further dental assessment.¹⁶

There is a lack of studies and/or case reports to do with the practice of photography, notably selfies, except with a single case report published on the use of human identification and selfie images.¹⁷ Prior to that, Silva et al have discussed in their papers the importance and success of using intraoral photographs and other non-clinical images in dental identification.^{12,18} Moreover, Forensic Odontology (FO) associations have not mentioned the amassment of selfies and smile photographs in their guidelines, save for British Association for Forensic Odontology (BAFO) who advocate the obtainment of smile photographs as part of their AM evidence.¹⁹

The aim of this study was to explore selfies as supporting evidence in human identification via distribution of an online survey among qualified Forensic Odontologists and those who assist in FO cases, subsequently recommending a systematic methodology in human identification using selfies.

MATERIALS AND METHODS

Ethical Approval

This research project was approved by institutional committee of ethics in human research under the protocol UOD\SDEN\TPF\2020\012\Naidu.

Online Survey

The study consisted of an observational descriptive e-survey entitled “*The Use of Photographs in Human Identification*” designed using the JISC Online Surveys programme (2020) to assess the outlook of qualified Forensic Odontologists. The survey was distributed on 16th June 2020 and closed on 31st July 2020. The 12-question survey consisted of two parts: five open-ended questions (Part 1) which explored the participants’ general view on managing human identification cases and their opinions on using photographs, including selfies and seven close-ended questions (Part 2) which presented fictional cases created to evaluate the skills and knowledge of the participants in using photographs as AM data. A condensed description of the questionnaire is shown in Table 1.

| Questions and their categories | |
|---|--|
| Personal details/Demographic information | (Q1) Sex (Q3) Years of Experience |
| Experience in Forensic Odontology | (Q2) Commitment with Forensic Odontology (Q4) Average number of Human Identification Cases Carried out per Month |
| Opinions on dental identification | (Q5) Method Used to Identify Victims (Q5a) If you selected Other methods, please specify. |
| Opinions on photograph assessment in dental identification | (Q6) Are there any landmarks or specific analytical processes that you use when assessing ante-mortem intraoral photographs in human identification cases? If so, please explain further. (Q6a) If you selected Yes, please specify. (Q7) Have you ever used selfie photographs of the victim(s) in human identification cases? (Q7a) If yes, were the selfie photographs useful in establishing the identity of the victim(s)? (Q8) Do you believe that selfies are helpful for dental identification? (Q11) Please explain the reasons (e.g., dental features) for your conclusion for questions 9 and 10. (Q12) Would you consider selfies as a supporting evidence, main evidence or not useful in human identification cases? Please explain further. |
| Test question. | (Q9) & (Q10) Please choose your answers from the options below. |
| * The order of the questions in the questionnaire summary is not continuous. Please refer to the numbers in the brackets (e.g., Q number) | |

Table 1 – Summary of survey according to its questions and its background ideas

With respect to the fictional cases, participants were given two case scenarios of photograph assessment and were required to visually compare Image 1 and 5 (see Figures 1 and 2) which simulated a PM intra-oral photograph (Subjects A and B) and choose from three different images simulating AM photographs and four other options of ‘All of the above’, ‘None of the above’, ‘I am not able to compare’ and ‘I do not compare photographs in human identification’. The participants were given the option of choosing more than one answer for each task as it was not stated that only a single AM image would correspond to the PM image, i.e., two or more or none of the AM images could be a match.



Image 1 – post-mortem photograph of Subject A



Option 1 - ante-mortem photograph (Image 2)



Option 2 - ante-mortem photograph (Image 3)



Option 3 - ante-mortem photograph (Image 4)

Figure 1 – Case scenario 1



Image 5 – post-mortem photograph of Subject B



Option 1 - ante-mortem photograph (Image 6)



Option 2 - ante-mortem photograph (Image 7)



Option 3 - ante-mortem photograph (Image 8)

Figure 2 – Case scenario 2

The images included adult dentition of anonymous postgraduate students aged between 20 to 30 years old in frontal and lateral views. These photographs were taken using a Huawei Nova 2i smartphone (Huawei, Shenzhen, China) with a 16 megapixel and f2.2 aperture for the primary camera, and a 13 megapixel and f2 aperture for the front camera.

The link was distributed via email to the professionals who could be contacted via four organisations: International Network for Forensic Odontology (<https://dentify.me/>), Association of Forensic Odontology for Human Rights (www.afohr.org), members of the American Board of Forensic Odontology (ABFO) and International Organization for Forensic Odonto-Stomatology (IOFOS).

Data Collection

Responses to the survey were automatically collected in JiscOnline survey forms and descriptive charts and further statistical analysis was performed using Microsoft Excel (2016). Specific responses to the open-ended questions were analyzed qualitatively using content analysis, i.e., the answers given were categorized into assorted themes or ideas and presented in forms of pie charts and bar graphs.

The method of distributing a 12-question survey to Forensic Odontologists and related personnel in the field was chosen as it was considered a simple way of reaching out to the experts on this subject. It was also regarded as the most reasonable method of communication during the initial outbreak of the coronavirus (COVID-19).

RESULTS

Commitment with Forensic Odontology and Years of Experience

Of the 205 recipients that the survey was emailed to, four of them returned with an error due to deactivated accounts. 82 of the participants completed the survey, which gave a response rate of 40.8%. Out of the 82 respondents, most of them were male (n = 53, 64.6%). Majority of the participants were part-time Forensic Odontologists (n = 33, 40.2%), followed by 36.6% (n = 30) in academia, 25.6% (n = 21) full-time Forensic Odontologists and 3.7% (n = 3) from law enforcement. 23 respondents considered '*Other*'; among which, 12 who were from other scientific backgrounds who assisted in FO cases, eight were involved in other forensic fields, mainly Forensic Medicine and in dental malpractice, while three stated that they were students. As this question allowed participants to choose more than one answer, there was an overlapping of options selected. According to the number of years that the participants have been involved in FO or other respective fields, 52.4% (n = 43) have managed FO cases for more than 10 years, 37.8% (n = 31) have had experience of below five years in the specialised field and 9.8% (n = 8) have expertise of up to 10 years.

Average Number of Human Identification Cases Carried out per Month

Majority of the participants (86.6%, n = 71) stated that the number of human identification cases managed or assisted monthly are 10 cases on average. Two of the participants (2.4%) had experience of 21 to 50 cases and another two (2.4%) regularly managed 51 cases and above per month. Four participants (4.8%) answered, '*Not yet*', '*Not applicable*', '*Depends on the*

availability of cases' and *'Only did one DVI case*'. The remaining three participants' (3.7%) responses could not be inferred as their answers were unclear.

Methods Used to Identify Victims

Table 2 illustrates the various methods that participants use in identifying victims, including the comparison method, superimposition technique with smile photographs, and dental profiling. More than half of the participants stated that they use a combination of the first two methods to establish a conclusion in their cases.

Out of the 30 participants who used other methods in identifying deceased victims, a few participants mentioned the use of DNA. Besides that, several participants stated the use of secondary identifiers such as personal effects found on the victims, medical history, and oral jewelry. Visual identification by the relatives of the deceased was accounted for too.

| Methods Used to Identify Victims | Number of Participants (n =) / Percentage (%) |
|---|--|
| Comparing ante-mortem and post-mortem dental data (dental treatment, dental anatomy, radiographs, dental casts) | 60 / 73.2 |
| Superimposition of ante-mortem and post-mortem photographs (smiling photograph(s) of victim(s)) | 29 / 35.4 |
| Combination of methods | 45 / 54.9 |
| Dental profiling | 33 / 40.2 |
| Other methods (facial recognition, scar, tattoos, fingerprints, etc) | 30 / 36.6 |

Table 2 - Grouping of participants according to methods used in victim identification

Landmarks or Specific Analytical Processes Used When Assessing Ante-mortem Intraoral Photographs in Human Identification Cases

Most of the participants (59%, n = 48) acknowledged to never having used intraoral photographs in human identification cases as opposed to the 41% (n = 34) of respondents who do use non-clinical AM photographs.

Out of the 34 participants that examine photographs, the majority (n = 12) assess dental anatomy and morphology, others evaluate dental treatments (n = 6), craniofacial landmarks (n = 5) and oral soft tissues (n = 3). Three participants use photo-editing software to analyze photographs. The remaining participants (n = 5) had unclear answers, i.e., stating '*not applicable*', '*none*' and '*direct comparison*', hence, their answers were excluded.

Use of Selfies in Identification Cases

Most of the participants had no experience in using selfie photographs of victim(s) in human identification cases but would like to do so if given the opportunity, i.e., 41.5% (n = 34). The rest of the participants responded as indicated in Table 3. Incidentally, response to the follow up question presented 90.2% (n = 37) of participants answering 'Yes' to selfies being useful in establishing the identity of victim(s).

| Use of Selfie Photographs of the Victim(s) in Human Identification Cases | Number of Participants (n =) / Percentage (%) |
|--|---|
| Yes, I used selfies as a secondary AM record for my conclusion | 21 / 25.6 |
| Yes, I used selfies as the main evidence for my conclusion | 7 / 8.5 |
| No, I would never use it | 9 / 11 |
| No, but I plan on doing so if necessary | 34 / 41.5 |
| I don't know | 11 / 13.4 |

Table 3 - Options of participants for the use of selfies in human identification cases

Selfies in Dental Identification

More than half of the total participants, 53% (n = 42), agreed that selfie photographs are helpful in identifying victims odontologically. 30% (n = 24) of them who were noncommittal, responded 'Maybe' while 12% (n = 9) were unsure of their use in identification. 5% (n = 4) of participants were negatively inclined towards using selfies in dental identification.

Fictional Cases

Majority of the participants, 56.1% (n = 46) chose the first option as the closest match to the dentition observed in Image 1, which is the correct reconciliation for the first fictional case (see Figure 1). For the second fictional case, most of the participants (41.5%, n = 34) chose the option of 'None of the Above', which is the right answer (see Figure 2). Table 4 shows the remaining results of the case scenarios.

| Choices of Answers | Case Scenario 1 | Case Scenario 2 |
|---|------------------------------|-----------------|
| | Number of Participants (n =) | |
| Option 1 (Image 2) | 46 | 6 |
| Option 2 (Image 3) | 4 | 5 |
| Option 3 (Image 4) | 2 | 12 |
| Option 4 – None of the above | 13 | 34 |
| Option 5 – All of the above | 0 | 1 |
| Option 6 – I am not able to compare | 20 | 24 |
| Option 7 – I do not compare photographs in human identification | 5 | 5 |

Table 4 – Distribution of responses given to ‘Case Scenario 1 & 2’

Participants collectively mentioned using dental anatomy or characteristics observed in Image 1 (see Figure 1) and Image 5 (see Figure 2) to compare to the options given in the answer section for both case scenarios. 24.4% (n = 20) of the participants mentioned the presence of diastema or spacing as the reason for the choice of answer in Fictional Case 1. This was not relevant for the second scenario; thus, no participants had explained this in their reasoning. The analysis of the rest of the results is represented in Table 5.

| Reasons for Answers | Case Scenario 1 | Case Scenario 2 |
|--|--------------------------------|-----------------|
| | Percentage of Participants (%) | |
| Diastema / spacing | 24.4 | 0 |
| Dental anatomy or characteristics | 32.9 | 45.1 |
| Lack of knowledge | 3.6 | 3.6 |
| No specific explanation | 9.7 | 8.5 |
| Inadequate information and poor quality of photographs | 12.2 | 13.4 |
| Uses specific method which could not be performed | 6.1 | 6.1 |
| No comparison done | 8.5 | 8.5 |

Table 5 - Rationale of answers given for fictional cases

Selfies and Dental Evidence

When asked about the importance of selfies as an important element of AM dental evidence, more than half of the total participants (64.6%, n = 53) stated that selfie photographs are useful as supporting evidence in managing human identification cases. Remaining opinions are reflected in Table 6.

Out of the 22 participants who were unclear of their answers, 10 stated that they considered selfies as vital dental evidence but did not specify whether they regard them as a main or supporting type of evidence. Five participants mentioned that the usefulness of the selfie photographs depended on the quality of the photographs provided, which also rendered their responses as unclear.

| Selfies and Dental Evidence | Number of Participants (n =) |
|------------------------------------|-------------------------------------|
| Main evidence | 7 |
| Supporting evidence | 53 |
| Not useful | 4 |
| Unsure / unclear | 22 |

Table 6 - Participants' opinions on selfies as part of dental evidence

DISCUSSION

There is the notion that photographs, which could be collected as AM dental evidence may present low spatial resolution and distortions. However, the Forensic Odontologist may still extract further qualitative information from these images to compare with the PM images, especially those available for public viewing on SM platforms.²⁰ Irrespective of this, there are no scientifically tested protocols that are presently followed, as to what dental crown characteristics are compared, both on smile photographs and selfies. Novel guidelines in the form of suggestions to practice were established in 2011 for the analysis of smile photographs.²¹ Nevertheless, formal protocols or standards remain essential.

Therefore, the research at hand is aimed at further exploring the idea behind this and to recommend its use as supporting data in human identification among Forensic Odontologists worldwide.

Respondents' answers to the case scenarios indicated that most Forensic Odontologists in this study would assess the overall characteristics observed on the dentition, then specify the features on the tooth itself, i.e., shape, size, position, and anomaly. This rationale was previously demonstrated in scientific studies.^{22,23} Smile analysis and assessment of incisal edges of the anterior teeth on photographs require Forensic Odontologists to examine then compare the contour lines of the anterior teeth to detect AM/PM similarities for an individual.¹⁸ Systems that adopt an equivalent technique are GLID, AutoIDD and 2-D-3-D superimposition method; the incisal edges and entire labial surface of the teeth in question are assessed to obtain a corresponding pair. Difficulties that may interfere in uniqueness, such as orthodontic treatment, are discussed in these studies as well.^{6,10,24}

Several participants mentioned the assessment of anatomical landmarks on the skull such as the nasion, glabella and gnathion in acquiring a possible correspondent, and comparing them on AM photographs. This may serve as a useful tool in establishing the identity of the individual as illustrated in studies of anthropometrical landmarks.^{25,26} Forensic Odontologists would have to determine whether craniofacial landmarks could be used in establishing one's identity depending on the condition of the victim(s) when brought into the mortuary.

The confusing discrepancy as to the participants' experience of using selfies in human identification cases was noted in which there were some who admitted to never having analyzed a selfie for dental identification purposes, yet fewer respondents dismissed selfies to being ineffective in these instances. On the contrary, many participants who have used selfies as a primary or supplementary evidence in dental identification indicated their support in its practice though low number of case reports have been documented successfully.^{13,17} The uncertainty of the features that need to be assessed on photographs, particularly selfies could be a key reason to the reduced use of these images.

For selfies in particular, Miranda et al (2016) reported that the smile analysis method was utilised on a charred victim in which PM and AM images were compared and superimposition of the incisal edges of the anterior teeth were carried out.¹⁷ The innovation of oral jewelry also gives an edge to the Forensic Odontologist in aiding dental identification; e.g., tooth modification and implanting of diamonds and gems directly onto the tooth surface.²⁷ To ease the process of collection of AM data, a checklist with vital dental evidence necessary in aiding the Forensic Odontologist plays a key role as suggested by Sallis et al (2021); notably observed was "selfie images showing teeth" in the checklist proposed.²⁸ This term is useful to describe not only the type of images required but the important features that are needed to be seen on them.

Studies that have been conducted recently have integrated the use of AM and PM photograph comparison, including selfies for successful identifications, pioneered in Brazil by Miranda and Silva.^{13,15,17,18} The development of a selfie

identification application and other smartphone applications for 3-D image superimposition in FO has also centred selfies in recent days.^{16,29} Digital software with features that allow photo editing and quantification with the evaluation of dental traits may aid in human identification.²³ Additionally, performing a general craniofacial assessment on the photographs provided, superimposition discretionary, before continuing with a more detailed dental analysis may prove beneficial and considered more thorough.

A chronological list of recommendations (Table 7) for assessment of selfie photographs as dental AM evidence was created based on the responses and literature review conducted on the topic. The suggestions incorporate a general assessment of visible craniofacial landmarks on a selfie and a visual analysis of the photograph with the use of image superimposition that is already regularly practiced. With this proposal, it must be kept in mind that the use of selfies and other smile photographs is an adjuvant to the main methods used in FO, along with DNA and fingerprint analyses. The analysis of selfies should not be used as the sole scientific evidence in human identification.

| Methods / Steps involved | Elements to examine | Rationale |
|--|--|--|
| Step 1: Craniofacial assessment | <p>Depending on the condition of the human remains:</p> <ul style="list-style-type: none"> i) Undecomposed bodies: Evaluate soft tissue and hard tissue anatomical landmarks. ii) Decomposed to skeletonised remains: Evaluate hard tissue anatomical landmarks. | <p>Recommended to be practised if selfie image shows entire facial front and the photograph is clearly not seen taken from angles that are not frontal, i.e., lateral or side angle.</p> |
| Step 2: Visual analysis | <p>Dental characteristics of six anterior teeth (upper or maxillary central incisors, lateral incisors, and canines) should be assessed according to:</p> <ul style="list-style-type: none"> i) <u>Dental anatomy</u> <ul style="list-style-type: none"> a) shape b) size c) angulation/position d) presence or absence of cervical margin of tooth e) measurement of entire length of labial surface observed if cervical margin is present f) measurement of (midline) diastema or spacing between teeth ii) <u>Dental restorations</u> <ul style="list-style-type: none"> a) presence or absence b) full or fractured c) type of filling material if obvious to the naked eye, i.e., metal or tooth-coloured iii) <u>Dental anomalies</u> <ul style="list-style-type: none"> a) diastema b) supernumerary teeth (mesiodens) c) rotation | <p>Both lower or mandibular anterior teeth and upper or maxillary teeth are assessed if visible on the image.</p> <p>Post-mortem photographs should consist of a frontal view, and right and left lateral sides with placement of an ABFO No. 2 scale to measure points e and f of dental anatomy (if observed).</p> |

| | | |
|--|--|---|
| Table continued | <ul style="list-style-type: none"> d) crowding e) macrodontia or microdontia f) others (please specify) iv) <u>Oral jewellery</u> <ul style="list-style-type: none"> a) presence or absence (mention cavity if missing jewel) b) type/colour of gemstone) | |
| Step 3: Superimposition method | <p>Important aspects to consider:</p> <ul style="list-style-type: none"> i) Software used <ul style="list-style-type: none"> a) Adobe® Photoshop® b) GIMP (GNU Image Manipulation Program) c) Others ii) Note the properties of the image provided (JPEG, TIFF, PNEG etc.) <ul style="list-style-type: none"> a) digitise the image if hard copy is produced b) suggested to re-scale image to 300dpi for standardisation throughout image analysis. iii) Smile analysis of the incisal edges can only be used if the anterior dentition is present. | <p>May be used even if incisal edges are fractured, attrited or have a dislodged restoration.</p> |
| <p>*Footnote</p> <ul style="list-style-type: none"> ▪ Examples of soft and hard tissue landmarks are nasion, glabella and gnathion. Please note other landmarks if observed. ▪ Latest version of software is recommended. | | |

Table 7 - Aspects to consider during selfie image analysis

CONCLUSION

Dental and non-dental observation with respective techniques regularly carried out by the experts were evaluated, thus, contributed to the recommendation of a more systematic method for dental identification using selfies. The features appraised included dental anatomy, dental restorations, and the use of craniofacial features. There was also consensus agreeing on the use of selfies as supporting AM evidence in dental identification.

The assessment of selfies and overall photographs are recommended to be included into official FO association guidelines as supplementary evidence in identifying individuals. Official checklists with an inventory of essential items that are a prerequisite for management of dental identifications, including selfies, are suggested. A list of recommendations on the assessment of selfie images is suggested to be used if this type of photograph is incorporated as part of recognised guidelines in the future.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to the academic staff and volunteers who participated in the study.

DECLARATION OF CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

SOURCES OF FUNDING

The authors received no financial support for the research, authorship, and/or publication of this article.

AUTHOR CONTRIBUTIONS

Title: *Exploring the Use of Selfies in Human Identification*

Author 1:

Conceived and designed the analysis, collected data, performed the analysis, wrote the paper.

Author 2:

Aided in conceiving the design and analysis, editing and reviewing paper, supervisor.

Author 3:

Aided in conceiving the design and analysis, editing and reviewing paper, supervisor.

REFERENCES

1. Adams CC, R; Evans, S. Forensic Odontology: An Essential Guide. Wiley Blackwell; 2013:chap 5.
<https://onlinelibrary.wiley.com/doi/book/10.1002/9781118526125>
2. Sweet DOC. Forensic dental identification. *Forensic Sci Int.* 2010;201(1):3-4. doi:10.1016/j.forsciint.2010.02.030
3. Tinoco RLR, Martins EC, Daruge E, Prado FB, Caria PHF. Dental anomalies and their value in human identification: a case report. *The Journal of forensic odonto-stomatology.* 2010;28(1):39.
4. Hinchliffe J. Forensic Odontology, part 1. Dental Identification. *British Dental Journal* 2012;210:Pg 219–224(2011).
5. Trengrove H. Operation earthquake 2011: Christchurch earthquake disaster victim identification. *The Journal of forensic odonto-stomatology.* 2011;29(2):1.
6. Bollinger SA, Brumit PC, Schrader BA, Senn DR. GrinLine Identification Using Digital Imaging and Adobe Photoshop*. *Journal of Forensic Sciences.* 2009;54(2):422-427. doi:10.1111/j.1556-4029.2008.00971.x
7. Bowers CM, Johansen RJ. Digital imaging methods as an aid in dental identification of human remains. *Journal of forensic sciences.* 2002;47(2):354. doi:10.1520/JFS15257J
8. Cardoza AR, Wood JD. Atypical Forensic Dental Identifications. *Journal of the California Dental Association.* 2015;43(6):303.
9. Jayaprakash PS, B; Mohd Yusop, R; Asmuni, HS Skull-Photo Superimposition: A Remedy to the Problem of Unidentified Dead in Malaysia. *Malaysian Journal of Forensic Sciences.* 2010;1(1):35-42.
10. Reesu GV, Woodsend B, Mânica S, Revie GF, Brown NL, Mossey PA. Automated Identification from Dental Data (AutoIDD): A new development in digital forensics. *Forensic Science International.* 2020;309doi:10.1016/j.forsciint.2020.110218
11. Wright FG, GS. The use of full spectrum digital photography for evidence collection and preservation in cases involving forensic odontology. *Forensic Science International.* 2010;201(1-3 September 2010):59-67.

12. Silva RF, M; Pedro Henrique Moreira Paulo Tolentino, PHMP; de Araujo Andrade, MGB; Rodrigues, LG; Franco, A. Forensic importance of intraoral photographs for human identification in dental autopsies: a case report. *Bioscience Journal*. 2017;Vol 33
13. Silva RF, Pereira SD, Prado FB, Daruge E. Forensic odontology identification using smile photograph analysis--case reports. *The Journal of forensic odonto-stomatology*. 2008;26(1):12.
14. Sorokowska A, Oleszkiewicz A, Frackowiak T, Pisanski K, Chmiel A, Sorokowski P. Selfies and personality: Who posts self-portrait photographs? *Personality and Individual Differences*. 2016;90:119-123.
doi:10.1016/j.paid.2015.10.037
15. Silva R, Franco A, Seixas J, Oliveira W, Picoli F. Positive identification of a decomposed human body through forensic anthropology and smile photographs - a case report. *European Journal of Forensic Sciences*. 2016;3(4):1. doi:10.5455/ejfs.205494
16. Nuzzolese E, Lupariello F, Di Vella G. Selfie identification app as a forensic tool for missing and unidentified persons. *Journal of forensic dental sciences*. 2018;10(2):75. doi:10.4103/jfo.jfds_80_17
17. Miranda GE, Freitas SGd, Maia LVdA, Melani RFH. An unusual method of forensic human identification: use of selfie photographs. *Forensic Science International*. 2016;263:e14-e17. doi:10.1016/j.forsciint.2016.04.028
18. Silva RF, Franco A, Souza JBd, Picoli FF, Mendes SDSC, Nunes FG. Human identification through the analysis of smile photographs. *The American journal of forensic medicine and pathology*. 2015;36(2):71.
doi:10.1097/PAF.000000000000148
19. British Association for Forensic Odontology. *British Association for Forensic Odontology*. 2/11, 2020. Accessed 2/11/2020, <https://www.bafo.org.uk/>
20. Oh SJ, Benenson R, Fritz M, Schiele B. Person Recognition in Personal Photo Collections. *IEEE transactions on pattern analysis and machine intelligence*. 2020;42(1):203-220. doi:10.1109/TPAMI.2018.2877588
21. Silva R. *Estudo Comparativo Entre Os Desempenhos De Graduandos Em Odontologia E Pós-Graduandos Emodontologia Legal Utilizando*

Fotografias De Sorriso Para A Identificação Humana. Faculty of Dentistry Piracicaba, State University of Campinas; 2011.

<https://www.semanticscholar.org/paper/Estudo-comparativo-entre-os-desempenhos-de-em-e-em->

[Silva/7995fe44ca2375c7b962d4c588d9b545d0ed1264](https://www.semanticscholar.org/paper/Estudo-comparativo-entre-os-desempenhos-de-em-e-em-Silva/7995fe44ca2375c7b962d4c588d9b545d0ed1264)

22. Angelakopoulos N, Franco A, Willems G, Fieuws S, Thevissen P. Clinically Detectable Dental Identifiers Observed in Intra-oral Photographs and Extra-oral Radiographs, Validated for Human Identification Purposes. *Journal of forensic sciences*. 2017;62(4):900-906. doi:10.1111/1556-4029.13310

23. Wang L, Mao J, Hu Y, Sheng W. Tooth identification based on teeth structure feature. *Systems science & control engineering*. 2020;8(1):521-533. doi:10.1080/21642583.2020.1825238

24. Reesu GV, Mânica S, Revie GF, Brown NL, Mossey PA. Forensic dental identification using two-dimensional photographs of a smile and three-dimensional dental models: A 2D-3D superimposition method. *Forensic Science International*. 2020/08/01/ 2020;313:110361.

doi:<https://doi.org/10.1016/j.forsciint.2020.110361>

25. Gaudio D, Olivieri L, De Angelis D, Poppa P, Galassi A, Cattaneo C. Reliability of Craniofacial Superimposition Using Three-Dimension Skull Model. *Journal of forensic sciences*. 2016;61(1):5-11. doi:10.1111/1556-4029.12856

26. Santoro V, Lubelli S, De Donno A, Inchingolo A, Lavecchia F, Introna F. Photogrammetric 3D Skull/Photo Superimposition: a pilot study. *Forensic science international*. 2017;273:168-174. doi:10.1016/j.forsciint.2017.02.006

27. Farrukh F, Mânica S. Fashion for a reason: Oral jewellery to aid forensic odontology. *Journal of forensic and legal medicine*. 2019;66:38-43. doi:10.1016/j.jflm.2019.06.002

28. Sallis C, Mânica S. Comparative dental analysis: should dentists release dental records? *Dental update*. 2021;48(2):148-151. doi:10.12968/denu.2021.48.2.148

29. Utomo H, Ruth MSMA, Wangsa LG, Salazar-Gamarra RE, Dib LL. Simple smartphone applications for superimposing 3D imagery in forensic dentistry. *Dental Journal*. 2020;53(1):50-56. doi:10.20473/j.djmkkg.v53.i1.p50-56