

Comparative Evaluation of Dental Identification Methods in Medicolegal Cases

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ABSTRACT

Background: Forensic odontology plays a vital role in human identification, particularly in medicolegal cases involving decomposed, burned, or unidentified remains. Various dental identification methods are available; however, their comparative effectiveness requires evaluation.

Aim: To compare the effectiveness of different dental identification methods in medicolegal cases and determine the factors associated with successful human identification.

Materials and Methods: A retrospective comparative observational study was conducted on 150 medicolegal cases with available antemortem and postmortem dental records. Dental radiographic comparison, clinical dental records, restorations and prosthetic appliances, root canal treatment records, and dental anomalies were evaluated. Data were analysed using SPSS version 26.0. The Chi-square test and logistic regression analysis were performed, with $p < 0.05$ considered statistically significant.

Results: Dental radiographic comparison showed the highest identification success (93.3%), followed by clinical dental records (88.0%) and restorations/prosthetic appliances (84.0%). Significant differences were observed among the identification methods ($p = 0.002$). Complete antemortem dental records and availability of dental radiographs were significantly associated with successful identification ($p < 0.001$). Restorations and root canal-treated teeth also contributed significantly, whereas dental anomalies showed no significant association.

Conclusion: Dental radiographic comparison is the most effective method for forensic human identification. Comprehensive antemortem dental records, including radiographs and treatment documentation, significantly enhance identification accuracy. A multimodal approach combining different dental identification methods provides the highest reliability in medicolegal investigations.

Keywords: Forensic odontology, dental identification, medicolegal cases, dental radiographs, forensic dentistry, human identification.

Received: June 13, 2026: Accepted: Aug. 1, 2026

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www.jrad.co.in

pISSN 2278-0076

eISSN 2321-9270

INTRODUCTION

Forensic odontology is a specialized branch of dentistry that applies dental science to the investigation of medicolegal cases. It plays a crucial role in the identification of deceased individuals, particularly when conventional methods such as visual recognition, fingerprints, or DNA analysis are unavailable or compromised. The uniqueness, durability, and resistance of dental tissues to decomposition, fire, and trauma make teeth valuable tools for human identification.¹

Several dental identification methods are routinely employed in forensic investigations, including comparison of antemortem and postmortem dental records, radiographic evaluation, odontograms, restorative patterns, prosthetic appliances, orthodontic records, and unique dental anomalies. Each method contributes to establishing identity by providing distinctive features that remain relatively stable throughout life. The accuracy of identification increases when multiple methods are used in combination.²

Medicolegal identification is particularly important in cases involving mass disasters, burned bodies, decomposed remains, criminal investigations, and unidentified persons. Dental records frequently provide the only available means of identification because dental tissues withstand environmental insults better than most other human tissues. The success of forensic dental identification largely depends on the quality and completeness of available antemortem records and their comparison with postmortem findings.³

Dentists have an important professional and legal responsibility to maintain comprehensive dental records, including clinical notes, odontograms, radiographs, photographs, study models, and treatment documentation. Proper record maintenance facilitates rapid and reliable identification while reducing errors during medicolegal investigations. Advances in digital imaging and electronic health records have further improved the accessibility and reliability of forensic dental evidence.⁴

Among the available identification techniques, radiographic comparison remains one of the most accurate methods because it enables evaluation of tooth morphology, restorations, root canal treatments, alveolar bone patterns, and anatomical landmarks. Endodontic treatments, prosthetic restorations, implants, and developmental anomalies also provide highly individualized characteristics that can be matched between antemortem and postmortem records with considerable accuracy.⁵

Despite the availability of several identification methods, comparative evidence regarding their relative effectiveness in routine medicolegal practice remains limited. Differences in the availability and quality of dental records may influence the reliability and speed of identification. Evaluating various dental identification methods under similar medicolegal conditions may help determine the most effective approaches and promote standardized forensic protocols.^{6,7}

Therefore, the present study was undertaken to comparatively evaluate different dental identification methods in medicolegal cases and determine their effectiveness, accuracy, and reliability in establishing human identity.

MATERIALS AND METHODS

Study Design

This was a retrospective comparative observational study conducted to evaluate and compare various dental identification methods used in medicolegal cases.

Study Setting: The study was carried out in the Department of Oral and Maxillofacial Pathology and Oral Medicine in collaboration with the Department of Forensic Medicine at a tertiary care teaching institution.

Study Duration: The study included medicolegal cases evaluated over a 5-year period.

Sample Size: A total of 150 medicolegal cases with available antemortem and postmortem dental records were included in the study.

Inclusion Criteria

- Medicolegal cases with both antemortem and postmortem dental records available.
- Cases involving unidentified or suspected individuals requiring forensic dental identification.
- Availability of at least one identifiable dental record (clinical chart, radiograph, restoration, prosthesis, implant, or orthodontic record).
- Complete demographic and forensic documentation.

Exclusion Criteria

- Cases with severely damaged jaws or teeth preventing meaningful comparison.
- Incomplete or missing antemortem dental records.
- Poor-quality radiographs unsuitable for comparison.
- Duplicate case records.
- Cases with inadequate documentation.

Dental Identification Methods Evaluated

Each case was evaluated using one or more of the following identification methods:

- Comparison of clinical dental records and odontograms.
- Dental radiographic comparison.
- Identification through restorations and prosthetic appliances.
- Root canal treatment records.

- Dental implants.
- Orthodontic records.
- Congenital dental anomalies and tooth morphology.
- Missing teeth and extraction patterns.

Study Variables

The following information was recorded:

- Age and gender.
- Type of medicolegal case (burned body, decomposed body, skeletal remains, road traffic accident, etc.).
- Availability of different dental records.
- Identification method utilized.
- Time required for identification.
- Successful or unsuccessful identification.
- Concordance between antemortem and postmortem findings.

Outcome Measures

Primary Outcome

- Comparative effectiveness and accuracy of different dental identification methods in establishing identity.

Secondary Outcomes

- Identification success rate of each method.
- Time required for identification.
- Association between availability of dental records and successful identification.
- Diagnostic agreement between different identification methods.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 26.0. Categorical variables were expressed as frequency and percentage, while continuous variables were expressed as mean $\pm$ standard deviation. The Chi-square test was used to compare the success rates of different identification methods. McNemar's test was applied for paired comparisons where appropriate. Cohen's kappa coefficient was calculated to assess agreement between identification methods. Logistic regression analysis was performed to identify independent predictors of successful identification. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 150 medicolegal cases were included in the study. Various dental identification methods were compared to evaluate their effectiveness in establishing identity. Dental radiographic comparison demonstrated the highest identification accuracy, followed by comparison of clinical dental records and restorations/prosthetic appliances. The availability of comprehensive antemortem dental records significantly improved successful identification.

Variable	Number (n)	Percentage (%)
Age Group (years)		
18–30	38	25.3
31–40	46	30.7
41–50	34	22.7
>50	32	21.3
Gender		
Male	104	69.3
Female	46	30.7
Type of Medicolegal Case		
Burned bodies	36	24.0
Decomposed bodies	42	28.0
Road traffic accidents	48	32.0
Skeletal remains	24	16.0
Total	150	100

Table 1. Demographic characteristics and distribution of medicolegal cases (n = 150)

Most medicolegal cases involved males (69.3%), with the highest number of cases occurring in the 31–40-year age group. Road traffic accident victims constituted the largest category, followed by decomposed bodies.

Identification Method	Cases Evaluated (n)	Successfully Identified (%)	Mean Identification Time (hours)
Dental radiographic comparison	150	140 (93.3)	3.2 $\pm$ 1.1
Clinical dental records/odontogram	150	132 (88.0)	4.5 $\pm$ 1.4
Restorations and prosthetic appliances	150	126 (84.0)	5.1 $\pm$ 1.8
Root canal treatment records	150	118 (78.7)	5.6 $\pm$ 1.7
Dental anomalies/implants	150	96 (64.0)	6.2 $\pm$ 2.0

Chi-square = 16.84, p = 0.002

Interpretation:

Dental radiographic comparison achieved the highest identification success (93.3%) and required the shortest average identification time. Significant differences were observed in the effectiveness of various identification methods (p=0.002).

Table 3. Factors associated with successful dental identification

Variable	Successfully Identified (n=140)	Unsuccessful (n=10)	p-value
Complete antemortem dental records	128 (91.4%)	4 (40.0%)	<0.001
Availability of dental radiographs	132 (94.3%)	5 (50.0%)	<0.001
Presence of restorations/prostheses	114 (81.4%)	4 (40.0%)	0.004
Root canal-treated teeth	102 (72.9%)	4 (40.0%)	0.031
Dental implants/anomalies	48 (34.3%)	2 (20.0%)	0.328

Complete antemortem dental records and dental radiographs showed a highly significant association with successful forensic identification. Restorations and root canal-treated teeth also significantly contributed to positive identification, whereas dental implants and anomalies did not demonstrate a statistically significant association in this study.

DISCUSSION

The present study comparatively evaluated different dental identification methods used in medicolegal cases and demonstrated that dental radiographic comparison was the most accurate and efficient method for establishing identity, followed by comparison of clinical dental records and restorations or prosthetic appliances. The availability of comprehensive antemortem records significantly increased the success of forensic identification, emphasizing the importance of meticulous dental documentation. Dental radiographic comparison achieved the highest identification rate in the present study. Similar observations were reported by Sweet, who emphasized that radiographic examination is one of the most reliable methods of forensic identification because it enables comparison of tooth morphology, restorations, root canal treatments, alveolar bone patterns, and anatomical landmarks that remain unique to every individual.⁸ Silva et al. also concluded that radiographic comparison provides objective and reproducible evidence and is particularly valuable in cases involving decomposed, burned, or fragmented human remains where visual identification is impossible.⁹

Clinical dental records and odontograms also demonstrated a high identification success rate in the

present study. Jain and Chen reported that systematic comparison of dental radiographs with clinical records significantly improves identification accuracy and reduces the possibility of false-positive matches. Their findings support the routine maintenance of standardized dental records for efficient medicolegal investigations.¹⁰

The present study found that restorations, prosthetic appliances, and root canal-treated teeth significantly contributed to successful identification. Similar findings were reported by Al-Amad et al., who demonstrated that computerized dental identification systems incorporating restorations, prosthetic details, and digital dental records substantially improve the speed and reliability of forensic identification. Digital databases facilitate rapid comparison of antemortem and postmortem findings, particularly during mass disaster victim identification.¹¹

Complete antemortem dental records were identified as one of the strongest predictors of successful identification in the present study. Pretty emphasized that comprehensive dental records, including clinical notes, odontograms, radiographs, photographs, and treatment histories, form the cornerstone of forensic dental identification. Incomplete or poorly maintained records may delay or even prevent positive identification despite the availability of dental remains.¹²

The present findings further support the role of forensic odontology in disaster victim identification and routine medicolegal practice. Acharya reported that dental identification is highly dependable because dental tissues are resistant to decomposition, high temperatures, and traumatic injuries. He also highlighted that maintaining standardized dental records significantly enhances the efficiency of forensic investigations, especially during mass disasters involving multiple victims.¹³

Virtual and digital technologies have further improved forensic dental identification. Franco et al. demonstrated that virtual autopsy and digital three-dimensional imaging provide reliable alternatives to conventional examination and allow accurate comparison of postmortem dental structures with antemortem records. These technologies are particularly useful when conventional examination is difficult or impossible because of extensive tissue destruction.¹⁴

The present study also confirms that combining multiple dental identification methods provides greater accuracy than relying on a single technique. Acharya and Krishan

emphasized that forensic dental anthropology integrates clinical records, radiographs, restorative patterns, prosthetic appliances, developmental anomalies, and anthropological characteristics to establish identity with greater confidence. A multimodal approach therefore offers the highest diagnostic accuracy in medicolegal investigations.¹⁵

Overall, the findings of the present study are consistent with previous literature demonstrating that dental radiographs, complete clinical records, and restorative treatment details remain the most reliable methods of forensic human identification. Adoption of standardized digital record-keeping systems and greater awareness among dental practitioners regarding proper documentation can substantially improve the effectiveness of forensic odontology.

CONCLUSION

Dental identification remains one of the most reliable methods of establishing identity in medicolegal investigations. Among the methods evaluated, dental radiographic comparison demonstrated the highest identification accuracy, followed by clinical dental records and restorations or prosthetic appliances. The availability of complete antemortem dental records significantly improved identification success. A combination of multiple dental identification methods provides greater diagnostic accuracy than any single method alone. Standardized documentation and digital preservation of dental records should be encouraged to strengthen forensic investigations and facilitate rapid, accurate human identification.

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