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Forensic value of orthodontic records: A scoping review of their role in human identification and age estimation

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Abstract

Forensic dentistry makes good use of some aspects of orthodontic practice, such as identification of orthodontic records, and estimating age. This scoping review focused on the contributions of orthodontists practicing forensic odontology and the forensic implications of orthodontic records. The available literature was reviewed to describe the relevance of clinical photographs, study models, radiographs, and treatment notes as well as growth indicators such as the eruption pattern and morphology of the dentition. The review indicated that some orthodontic records, and in particular the standardized photographs and radiographs, may also assist in antemortem-postmortem comparisons and age estimation of children and adolescents. Unfortunately, the information available is mostly of a descriptive nature and is lacking in the area of validation. Overall, the contribution of the forensic orthodontist is really valuable, and the records kept by orthodontists should be accurate, standardized, and easy to retrieve, but will remain under the jurisdiction of the forensic science protocols and will not be available based on the professional opinion of the orthodontist.

Keywords: Orthodontics; Forensic Odontology; Human Identification; Age Estimation; Radiographs.

1. Introduction

Forensic odontology uses dental science to answer legal questions. It is a vital tool for identifying human remains, estimating age, and documenting facial injuries for trial. Within this field, orthodontics plays an important role. Treating patients takes years, meaning doctors gather a series of patient's data over time. These files contain progress photos, radiographs, study models, and thorough appointment notes. Together, they record unique features of a person's mouth and skull that endure long after treatment finishes. So, when severe accidents, fires, or disasters render visual identification or fingerprinting impossible, orthodontic records step in to provide answers.[2]

Unlike standard dental charts that just capture fillings at a single moment, orthodontic records track an evolution across three clear stages: pre-treatment, mid-treatment, and post-treatment. This step-by-step timeline lets forensic investigators compare historical records against unidentified remains to find a match. Furthermore, because orthodontists track jaw development and tooth eruption routinely, their expertise naturally blends with forensic age estimation and facial profiling. Yet despite these clear connections, research on the orthodontist's forensic role remains spread thin across narrative reviews, case-oriented discussion, and general age-estimation texts rather than consolidated into large-scale empirical studies.[4]

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This scoping review aims to map current research on how orthodontists contribute to forensic odontology. It focuses specifically on the types of orthodontic evidence used, how records help with identification and age estimation, their value in facial reconstruction, proper record-keeping duties, existing evidence gaps, and key directions for future research and practice.

2. Methodology

2.1. Review design

We registered this scoping review on the Open Science Framework (OSF) to keep our methods transparent and unbiased.[5] We opted for a scoping review because the existing research is quite varied, drawing on expert opinions, clinical guidelines, and individual case studies instead of large clinical trials. Our goal was to map out everything written about orthodontists in forensic science while evaluating the overall quality of that evidence.

2.2. Search strategy

The literature search focused on publications obtained through web-based scholarly and professional sources using the keywords "orthodontist," "orthodontics," "forensic odontology," "human identification," and "dental age estimation." Additional source identification was done from the full-text review article on orthodontics in forensic odontology and the overview of forensic dental age estimation because these sources cited foundational literature, including early publications on the use of orthodontic records in human identification and subsequent discussions on cephalometric and radiographic applications.

2.3. Eligibility and source selection

Sources were included if they covered at least one of these topics:

- Orthodontic records used for forensic identification
- Orthodontic findings relevant to postmortem comparisons
- The role of orthodontics in age estimation
- Cephalometric or imaging data supporting facial reconstruction
- Guidelines and standards for forensic dental assessments

We excluded studies that focused solely on general forensic dentistry, unless they offered essential context on age estimation or record-keeping standards. Ultimately, our review focused on a selection of high-quality foundational papers: comprehensive reviews on forensic orthodontics, a guide to dental age estimation, official standards from the American Board of Forensic Odontology (ABFO), and relevant case studies.[2,4,6-9]

2.4. Data charting and synthesis

We grouped the gathered information into clear categories: record types, treatment phases, personal identification, age estimation, facial reconstruction, legal duties, and research gaps. Then, we summarized the findings descriptively to highlight where authors agree and where more data is needed.

3. Discussion

3.1. Evolution of the orthodontic role in forensic odontology

Research shows that orthodontics and forensic odontology have been linked for decades, with early discussions dating back to the 1970s and case reports showing how orthodontic records help rebuild identity after homicide or severe disfigurement.[8] Modern reviews continue to describe orthodontists as key contributors whenever identification requires comparing antemortem and postmortem records, or when treatment history reveals unique clues missed by other sources.[9] This role has grown even more critical as forensic teams increasingly rely on multiple lines of evidence during disaster victim identification, especially when fingerprints or facial recognition are degraded. Although dental identification is not meant to replace DNA or fingerprinting, the literature stresses that it can provide a rapid, relatively affordable, and often decisive way to compare key pieces of biological evidence.[10]

3.2. Why orthodontic records are especially valuable?

Unlike routine dental files, orthodontic records stand out because they are comprehensive, continuous, and highly standardized. They typically feature intraoral and extraoral photos, panoramic X-rays, lateral cephalograms, periapical or occlusal views, study models, treatment plans, extraction history, growth tracking, appliance details, and retainer protocol.[11] This multi-layered approach gives forensic examiners a powerful way to track both permanent features and structural changes in the dentition and jaw bones over extended periods. **(Table 1)**

Table 1 Description of orthodontic records and its forensic use

S. No.	Orthodontic record	Typical content	Potential forensic value
1.	Clinical photographs	Extraoral and intraoral views, facial symmetry, soft-tissue profile, and dentition.	Support visual comparison, recognition of asymmetry, scars, enamel defects, and morphology-based identifications.
2.	Panoramic and intraoral radiographs	Root shape, developing teeth, restorations, impactions, missing teeth, jaw relationships.	Permit detailed antemortem-postmortem comparison and are described as highly powerful tools for identification.
3.	Cephalograms	Standardized craniofacial hard- and soft-tissue relationships.	Useful for cephalometric comparison, superimposition, and possible support for facial approximation.
4.	Study casts or digital models	Arch form, malocclusion traits, palatal morphology, intercanine or intermolar width	Preserve morphological traits useful in comparative analysis and selected identification contexts.

Furthermore, orthodontic treatment leaves a lasting "signature" on every patient. Details like extraction gaps, closed spaces, appliance marks, root shape patterns, enamel wear, teeth alignment, and retainers can all help narrow down or confirm someone's identity when matched against their past dental records. In this sense, the orthodontic record is not only a passive archive but also a chronology of biological and treatment-induced change.[12]

3.3. Pretreatment, mid-treatment and post-treatment orthodontic records (Table 2)

Table 2 Treatment phases of orthodontic therapy and its forensic value

S. No.	Treatment phase	Common records	Forensic use
1.	Pretreatment	Initial photographs, study models, panoramic radiographs, cephalograms, baseline notes.	Documents original morphology before treatment-related alteration and supports baseline comparison.
2.	Mid-treatment	Progress photographs, updated radiographs, appliance records, treatment progress notes.	Helps identify active orthodontic care, treatment stage, and time-linked appliance signatures.
3.	Post-treatment	Final records, retention notes, post-treatment radiographs and models.	Captures corrected occlusion, retention status, and persistent treatment-related markers relevant after treatment completion.

Pretreatment records are among the most frequently discussed components in the literature because they document the patient before the treatment. Intraoral and facial photographs can capture visible morphology, asymmetries, scars, tooth position, fluorosis, enamel defects, fractures, wear patterns, and other distinguishing features that may survive or remain interpretable after death. Study models can preserve arch form, malocclusion characteristics, palatal morphology, intercanine width, and other morphological traits that may be useful in comparative analysis. Radiographs are repeatedly described as the most powerful comparative tool in forensic dental identification because they record internal and external morphology that can be matched against postmortem images.[13] They may reveal root shape, sinus outlines, developing teeth, impactions, restorations, endodontic treatment, missing teeth, and jaw relationships. When

these antemortem images are available and postmortem radiographs are taken with comparable angulation, the resulting comparison highly reliable for identification.[14]

The mid-treatment records present itself a special place because ongoing appliance therapy can function almost like a forensic signature. The specific brand of brackets, bands, wires, or expansion appliances can instantly tell investigators who a person might be and these features may be especially useful in mass fatality situations where rapid sorting is needed. It is also important because it links a specific developmental moment, allowing investigators to determine whether the person died before, during, or after completion of treatment.[15]

Post-treatment records may be more relevant than pretreatment records when death occurs after active orthodontic care has finished. All the existed orthodontic records may document corrected alignment, extraction outcomes, root resorption, residual enamel changes, retention status, and soft- or hard-tissue sequelae that supersede earlier malocclusion patterns. The reviewed literature also introduces the concept of "orthodontic scars," referring to treatment-related changes that can persist and therefore hold forensic value. Examples include enamel decalcification or white spot lesions, enamel wear or chips from bonding and debonding, gingival recession, shape changes between teeth, and root apex blunting visible on post-treatment radiograph. While a single mark might not confirm an identity, finding several of them together creates a highly reliable match.[9]

3.4. Radiographs and cephalometric in identification and facial reconstruction

Lateral cephalograms are incredibly valuable because they show the exact relationship between the skull bones and the soft tissues of the face. This precise layout allows forensic artists and computer software to reconstruct what a person looked like when alive.[16] This application is conceptually important because orthodontists are trained to analyse craniofacial proportions and developmental relationships with precision. As a result, they may contribute to interpretation of skeletal-dental relationships, assessment of facial pattern, and reconstruction workflows in conjunction with forensic odontologists, anthropologists, and imaging specialists.[3,17]

3.5. Age estimation and the orthodontic interface

Age estimation is a well-established area in forensic odontology and overlaps with orthodontics because orthodontists regularly evaluate dental development, eruption timing, and skeletal growth.[12] Dental methods are among the most reliable ways to estimate a person's chronological age during childhood and adolescence, because teeth change in predictable ways as a person grows. The orthodontic literature mentioned some useful features for age estimation such as developing teeth, radiographs, dental models, palatal shape, and lower canine characteristics—but it did not give a detailed step-by-step method.[15] For accurate forensic use, these orthodontic findings should be applied within validated forensic protocols. Forensic literature emphasizes dental examination as a primary tool for estimating age in juveniles and adolescents. The American Board of Forensic Odontology (ABFO) standards also stress the need for standardized methods and cautious interpretation when using dental data.[7]

3.6. Orthodontists as custodians of longitudinal forensic evidence

Orthodontists are guardians of antemortem evidence because they frequently monitor patients for months or years, recording treatment effects and developmental changes at various stages. When these records are carefully preserved, they transform into vital legal evidence playing a crucial role in identifying victims, solving criminal investigations, aid in civil cases, and supporting major disaster response efforts.[2] The literature emphasizes that radiographs should remain viewable over long periods and that records should be sufficiently organized to support forensic comparison. In our digital world, this means clinicians must safely store digital photos, 3D oral scans, and advanced 3D X-rays so they can be easily retrieved by the forensic authorities if needed.[18]

3.7. Strengths of the available literature

The literature that is currently available is helpful in explaining the biological and documentary basis for orthodontic relevance in forensic odontology. It provides a convincing explanation of why radiographs, cephalograms, serial records, and treatment-induced dental changes may aid in identification, and it places orthodontists in a multidisciplinary forensic framework rather than in isolation. Another strength is that orthodontic data may significantly benefit forensic investigation, particularly in age-related evaluation and personal identity. Even in situations where there is no high-level comparative research, the issue has practical credibility due to the overlap between the standard diagnostic techniques used in the specialty and the evidential requirements of forensic comparison.

3.8. Gaps and limitations in the evidence base

The evidences are dominated by narrative reviews and expert commentary rather than prospective validation studies, diagnostic accuracy studies, or multicenter investigations. Because of this, many of the claims about how useful these records are making perfect clinical sense, but they haven't actually been measured using hard statistics like sensitivity, specificity, or interobserver agreement. There is also a clear gap between hands-on, empirical research and general, theory-based discussions about identification. For instance, papers frequently point to features like study models, palatal rugae, intercanine width, lower canine traits, and cephalometric reconstructions. However, the current literature fails to provide a clear, unified hierarchy of evidence. Because of this, we still lack definitive proof regarding which orthodontic features are genuinely the most reliable, accurate, or reproducible when applied across diverse populations.

3.9. Clinical and academic implications

This research shows that practicing orthodontists must consider the legal implications of their work. They should create and maintain patient records not just to monitor treatment progress, but because these files could serve as critical forensic evidence down the road. Preserving standard X-rays, keeping detailed clinical notes, documenting extractions and wire adjustments, taking high-quality photos, and maintaining an accessible long-term archive are all professional duties with major clinical and legal impact.[19] For educators and researchers, the literature supports integrating forensic training directly into orthodontic curricula. Both students and faculty must recognize the true legal value of orthodontic records while understanding the ethical boundaries and limitations of forensic assessments. This training is particularly crucial in regions where formal forensic departments are still developing, yet vast repositories of orthodontic records are already readily available.[20]

3.10. Future aspects

Future research needs to move away from simple literature reviews and focus on standardized scientific experiments using orthodontic records. Key priority lies in testing how effectively different tools, such as radiographs, skull measurements, 3D digital models, advanced 3D scans, and physical markers like shortened roots or extracted teeth, actually identify a person in real forensic scenarios. There is also an exciting opportunity to bring this entire field into the present by fully integrating it with today's advanced digital tools.[17] Looking ahead, artificial intelligence tools could support forensic teams by automatically matching past and present radiographs, comparing skull measurements, identifying types of braces, and estimating a person's age from their files. However, before relying on this daily, we must ensure data is ethically sourced, thoroughly validated by outside experts, and meets strict courtroom standards. Moreover, orthodontists need better preparation to collaborate with forensic experts. Through university courses and ongoing professional training, they should learn to clearly explain their records' strengths and limits to judiciary.[21]

4. Conclusion

Orthodontists have a huge, untapped ability to help forensic teams. Their strongest tool is carefully creating and saving detailed patient records over time. While showing different stages of therapy makes it easier to identify people, this field still really needs stronger scientific studies and official digital systems. Most current literature relies on simple narrative review, so we need better quality tests, modern digital guidelines, and clear standard rules. Until those studies are done, the main lesson is simple: every working orthodontist must keep standardized, easy-to-find records, because those files might one day bring answers, justice, and safety to the public.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Balachander N, Babu NA, Jimson S, Priyadharsini C, Masthan KM. Evolution of forensic odontology: An overview. J Pharm Bioallied Sci. 2015 Apr;7(Suppl 1):S176-80. doi: 10.4103/0975-7406.155894.

[2] Rontogianni A, Mitsea A, Karayianni K. The role of orthodontics in children identification: a case report of two victims of mass disaster. J Forensic Odontostomatol. 2024 Apr 30;42(1):2-11. doi: 10.5281/zenodo.11061609.

[3] Wu W, Wang Y, Lu W, Yan J, Teng J, Nie L, Tang Y, Han B, Chen S, Zhang Y, Liang W, Liu X, Zhang Y. Measurement of three-dimensional facial changes after orthodontic extraction: a retrospective longitudinal study. Head Face Med. 2025 Nov 27;21(1):79. doi: 10.1186/s13005-025-00541-6.

[4] Reddy G, Reddy VP, Sharma M, Aggarwal M. Role of Orthodontics in Forensic Odontology- A Social Responsibility. J Clin Diagn Res. 2016 Apr;10(4):ZE01-3. doi: 10.7860/JCDR/2016/15798.7633.

[5] Open Science Framework [Internet]: Center for Open Science; [cited 2026 Jun 29]. Available from: https://osf.io/.

[6] Lambrou, P.; Kaklamanos, E.G.; Christodoulou, N.; Giannakopoulos, K. Orthodontics in Forensic Science: A Review of Its Contribution to Human Identification. *Forensic Sci.* **2026**, *6*, 18. Doi: 10.3390/forensicsci6010018

[7] ASFO. ASFO [Internet]. [cited 2026 Jun 29]. Available from: https://asfo.org/.

[8] Wilson TM, Jain S. Orthodontics as related to forensic odontology: a review. Indian J Forensic Odontol. 2019;19.

[9] Rath SK, Panda SM (2017) Orthodontic Forensic Science: The Unseen Part of our Profession . J Forensic Res 8: 378. doi: 10.4172/2157-7145.1000378

[10] Kolude B, Adeyemi BF, Taiwo JO, Sigbeku OF, Eze UO. The role of forensic dentist following mass disaster. Ann Ib Postgrad Med. 2010 Dec;8(2):111-7. doi: 10.4314/aipm.v8i2.71826.

[11] Lambrou P, Kaklamanos EG, Christodoulou N, Giannakopoulos K. Orthodontics in forensic science: a review of its contribution to human identification. Forensic Sci. 2026;6(1):18. doi:10.3390/forensicsci6010018.

[12] Lima SM, et al. Forensic value of orthodontic records for human identification: a systematic review. Acta Sci Health Sci. 2024;46(1):e64703. doi:10.4025/actascihealthsci.v46i1.64703.

[13] Sarode GS, Sarode SC, Choudhary S, Patil S, Anand R, Vyas H. Dental records of forensic odontological importance: Maintenance pattern among dental practitioners of Pune city. J Forensic Dent Sci. 2017 Jan-Apr;9(1):48. doi: 10.4103/jfo.jfds_1_16.

[14] Krishan K, Kanchan T, Garg AK. Dental Evidence in Forensic Identification - An Overview, Methodology and Present Status. Open Dent J. 2015 Jul 31;9:250-6. doi: 10.2174/1874210601509010250.

[15] Orthodontic records for forensic identification: a scoping review. *Spanish Journal of Legal Medicine*. 2022;48(7). doi:10.1016/j.remle.2022.01.001.

[16] Manigandan T, Sumathy C, Elumalai M, Sathasivasubramanian S, Kannan A. Forensic radiology in dentistry. J Pharm Bioallied Sci. 2015 Apr;7(Suppl 1):S260-4. doi: 10.4103/0975-7406.155944.

[17] Aulsebrook WA, İşcan MY, Slabbert JH, Becker P. Superimposition and reconstruction in forensic facial identification: a survey. *Forensic Sci Int*. 1995 Oct 30;75(2-3):101-120. doi:10.1016/0379-0738(95)01770-4.

[18] Radu CC, Hogea T, Caraşca C, Radu CM. Forensic Odontology in the Digital Era: A Narrative Review of Current Methods and Emerging Trends. Diagnostics (Basel). 2025 Oct 10;15(20):2550. doi: 10.3390/diagnostics15202550.

[19] Devadiga A. What's the deal with dental records for practicing dentists? Importance in general and forensic dentistry. J Forensic Dent Sci. 2014 Jan;6(1):9-15. doi: 10.4103/0975-1475.127764.

[20] Dinkar AD. Forensic odontology: trends in India. J Forensic Dent Sci. 2014 Jan;6(1):1-2. doi: 10.4103/0975-1475.127760.

[21] Vodanović M, Subašić M, Milošević DP, Galić I, Brkić H. Artificial intelligence in forensic medicine and forensic dentistry. J Forensic Odontostomatol. 2023 Aug 27;41(2):30-41.