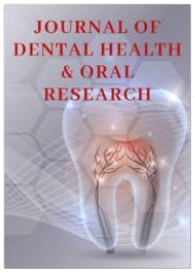

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Research Article

Adherence to Forensic Odontology Examination Standards at an Academic Dental Center

Kapadia U[1], Shah S[2], Chheda R[1], Patel P[3], Vyas-Patel J[4], Jahagirdar D[1], Vasudevan P[1], Vangala RM[3], Buch S[1], Nalliah RP[5,6*]

[1]Research Assistant, University of Michigan School of Dentistry, 1011 N, University Avenue, Ann Arbor, MI, 48109, USA

[2]Quality Analyst, University of Michigan School of Dentistry, 1011 N, University Avenue, Ann Arbor, MI, 48109, USA

[3]DDS Candidate, University of Michigan School of Dentistry, 1011 N, University Avenue, Ann Arbor, MI, 48109, USA

[4]Adjunct Faculty in Dental Hygiene, University of Michigan School of Dentistry, 1011 N, University Avenue, Ann Arbor, MI, 48109, USA

[5]Associate Dean for Patient Services, University of Michigan School of Dentistry, 1011 N, University Avenue, Ann Arbor, MI, 48109, USA

[6]Clinical Professor, University of Michigan School of Public Health, 1415 Washington Heights, Ann Arbor, MI, USA

***Correspondence author:** Romesh P Nalliah, DDS MHCM FRSPH FACD, Associate Dean for Patient Services, University of Michigan School of Dentistry 1011 N, University Avenue, Ann Arbor, MI, 48109, USA; E-mail: romeshn@umich.edu

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Abstract

Background: Forensic odontology is a vital branch of forensic science that involves the analysis and management of dental evidence in legal investigations. It plays a crucial role in identifying victims when DNA and other means of recognition are unavailable, such as in cases of fire, mass disasters and crimes. Dental records, including radiographs, bite marks, dental impressions and unique oral structures, serve as reliable tools for personal identification. This study evaluates the adherence to forensic odontology documentation standards at an academic dental center.

Methods: With two calibrated reviewers and a research protocol that was deemed exempt, we manually reviewed charts to compare documentation at the University of Michigan School of Dentistry with ideal forensic odontology standards. Results are shown in Table 1.

Results: Our findings demonstrate strong compliance except in relation to intraoral (only 5% of charts) and extraoral photography (0%). This highlights the importance of maintaining accurate and standardized dental records for legal and investigative purposes.

Conclusions: The research findings suggest that while radiographic documentation and dental notation are well-maintained, the lack of standardized intraoral and extraoral photographs remains a challenge. By improving forensic documentation practices, dental professionals can enhance their contribution to forensic investigations and legal proceedings.

Keywords: Forensic Odontology; Dental Center; Forensic Investigations

Introduction

Forensic Odontology, also known as Forensic Dentistry, is a branch of forensic anthropology concerned with the management and analysis of dental evidence in a medicolegal context [1]. Forensic odontology is critical in identifying victims when DNA is obliterated in intensive risk events for example, wildfires [2]. It can also be pivotal during assessments of abuse in legal proceedings, as well as identifying victims of large, catastrophic situations and is known as Disaster Victim Identification (DVI). Identification of the deceased notably helps relatives, as well as law enforcement organizations, during difficult circumstances [1]. Tooth structure is the hardest and most calcified tissue in the human body, remaining even after the deceased individual has been skeletonized, degraded or burned. As a result, teeth are more likely to be retrieved in mass mortality instances where other identification methods, such as fingerprints and facial characteristics, have been obliterated. Each tooth has a unique collection

of traits known as 'tooth class features', which serve as the foundation for identification, as well as age estimation through clinical assessment and radiography [3,4]. Both these methods work successfully in age determination, which contributes to the overall identification of the patient.

Over the years, dental identification has proven to be valuable and reliable. Still, the effectiveness of this procedure is based on the availability, adequateness and accuracy of Antemortem (AM) dental records in comparison with Post-Mortem (PM) dental findings [1]. However, when it comes to integrating forensic odontology standard documentation into our regular practice, dentists often fall short of the necessary data and forensic odontologists must work with incomplete information. Record-keeping is precision-oriented and can often be a prolonged process. This can be challenging for a busy practice that keeps its dental team alert. So, to maximize efficiency and accuracy, most dentists now use online databases to store patient information. Dental records can encompass a range of information, including dental casts, photographs, radiographs (such as panoramic and full mouth RadioVisioGraphy, i.e. RVGs), dentures, mouthguards/appliances and written records detailing patient-specific procedures [5]. Other traits that aid in identification include dental pathology, restorations, dental malformations and more. Lacking any of these elements can result in the absence of valuable information that could have aided forensic dentistry in solving crimes or estimating other details.

The arrangement of teeth in distinct oral cavities is unique to each individual, much like fingerprints [3]. Besides this, other features in an individual's oral cavity can also be used for identification. Some examples include intraoral records like palatal rugae identification, which are unique and can be used to identify edentulous individuals or lip prints, which are also unique but difficult to record due to the risk of smudging during the process [4,6]. Additionally, appliance-specific recordings that could be useful in forensics include labeled dentures (engravings or labels) and dental implants with laser-etched batch numbers/series [6]. Recording developmental anomalies is also crucial for identification, but it is often overlooked [7]. The use of unofficial abbreviations is also another common issue during documentation and creates confusion during post-mortem evaluations and when patient records are transferred between practitioners. While Electronic Health Records have addressed this issue, it is still prevalent in many practices.

For forensic dentistry to be successful, methods of recording information are crucial. Dentists own the records of a patient and are the designated legal guardians of the complete contents of the chart [8]. Patients do not have the right to the original but can review it or request a copy at any time [8]. Under the Health Insurance Portability and Accountability Act (HIPAA), patients have the right to access all electronic Protected Health Information and United States Core Data for Interoperability (USCDI) Version 1 definition of EHR has been expanded on October 6, 2022, to include all information regarding the patients including payment records as well as other information that is used to aid in the decision regarding the individual [9]. Before 2022, the patients were charged by healthcare facilities for these copies, now in many states, a healthcare facility must provide a patient or their legally authorized representative with one copy of the patient's medical record upon a written request beginning on January 1, 2022 [10]. This copy of the medical record can become an essential component in the process of identifying a victim during a disaster situation [10]. Dental records must be accurate and it would be ideal if they were standardized throughout the world. Documentation by Forensic Nurses (FNs) often varies highly depending on the state. Forensic exam reports, victim service referrals and the examinations themselves differ across states, counties and hospitals. Many exam forms are still completed on paper and are typically faxed or emailed to Law Enforcement Agencies (LEOs) and Victim Service Providers (VSPs). Such practices can create challenges during litigation, as forensic reports may lack sufficient data or fail to meet the legal standards required for court admissibility [11]. Accurate and thorough documentation of clinical exams following sexual assault has been linked to higher rates of trials, prosecutions and convictions of perpetrators. A study in South Africa found that cases with documented injuries were more likely to result in convictions. Beyond supporting legal justice, timely evidence collection can also have broader positive impacts, including empowering survivors, validating their experiences and strengthening their sense of agency [12].

Scholarly writings have described ideal data collection for a forensic odontology evaluation; however, there is no study comparing how any dental clinic compares to the ideal standard. The purpose of our study is to evaluate compliance with ideal documentation by forensic odontology standards at an Academic Dental Center.

Methodology

This study was done to compare examination documentation with ideal forensic odontology standards (Stow L, James H, Richards L. Australian oral health case notes: assessment of forensic relevance and adherence to recording guidelines. Aust Dent J. 2016 Jun;61(2):236-43. doi: 10.1111/adj.12350. PMID: 26219423) at the University of Michigan predoctoral clinics. Our study was approved by the University of Michigan's Medical School's Committee on Human Studies, which reviewed the study protocol and deemed it exempt (HUM00253928).

Data for this evaluation were taken from multiple internal Quality Assurance (QA) studies done annually at the University of Michigan's predoctoral dental clinics for the Commission of Dental Accreditation. The odontograms were reviewed by a trained dental reviewer (the School's Quality Assurance analyst). 200 odontograms were chosen, dating from 01/05/2022 through 01/27/2022. The review process included manually reviewing the odontograms, radiographs (full mouth X-ray series and panoramic X-ray) and treatment notes, to assess discrepancies in missing teeth, direct and indirect restorations, among others, to ascertain if the odontogram was current. If further guidance was quality assurance required, the reviewer met with a second reviewer to discuss the cases. The first metric in our results was sourced from this data.

To evaluate the diagnostic quality of the radiographs, patient cases from the periods January through April 2022 and January through April 2023 were chosen. Every 10th and 20th patient was selected and two calibrated dentist reviewers reviewed a total of 102 patient cases. The review process involved manually reviewing the patient chart and radiographs and checking for diagnostic quality of radiographs in terms of parameters such as coverage, overlap, cone cuts and presence of crestal bone. Each case was reviewed separately by the two reviewers and any conflicts in classification were resolved by a third reviewer. Results for metrics 2 through 6 are sourced from the quality assurance reports run in the Electronic Health Record (EHR) system- Axium by codes D150 and D140 for 205 patients for the given period.

Results

Table 1 shows the 6 parameters and sub-groups into which we assessed our data. It depicts the school performance values in percentages against the target metrics. The overall accuracy of performance of all the parameters is 95.42%.

	Documentation Standards	Performance Against the Parameters
1	Keep up-to-date panoramic or full mouth series of radiographs to help evaluate root canal obturations, bone height and bone morphology (if deemed clinically relevant).	82%
2	Record a complete odontogram, including documentation of all sound restorations and dental material	97.05%
3	Keep current intraoral photographs or dental casts that capture occlusal schemes.	5%
4	Keep current extraoral photographs of the smile line.	0%
5	Ensure dental notation is correct for teeth present/missing — evaluate the documentation accuracy at recall exams.	96.80%
6	Ensure dental records are completed as soon as practicable after patient care is delivered.	99.09%

Table 1: Shows the 6 parameters and sub-groups into which we assessed our data.

Discussion

Forensic dental identification is based on having good dental records. This study looked at six factors to assess how well records are kept at the University of Michigan School of Dentistry. The results showed that the school does an exceptional job of following documentation and clinical standards. However, there were some differences in the quality of intra- and extra-oral photos, highlighting areas where improvements could be made. Our findings revealed that only 5% of cases included current intraoral photographs or dental casts capturing occlusal schemes and no cases included extraoral photographs of the smile line. This underperformance creates a necessity for integrating standardized dental photography protocols into a routine. Dental

photography plays an important role in forensic odontology, providing detailed visual records that enhance identification accuracy, support legal proceedings and improve diagnostic outcomes [22-24]. Intraoral photography is essential for documenting unique features such as occlusal patterns, restorations and developmental anomalies, all of which are valuable for forensic identification. Extraoral photographs assist in facial recognition and smile analysis, which are vital for abuse cases. Not having dental photos can make it hard to identify someone, especially if other identification methods, like fingerprints, aren't usable. If dental photography were standardized across different practices, it would help ensure that there is thorough documentation in line with forensic standards.

Recent improvements in digital imaging (like I-Tero) and the way we use electronic health records have made it easier to include high-quality photos in patient records. These technologies help make the documentation process quicker, lower the chances of mistakes and make it easier to access data for forensic needs. Using standard photo techniques also helps keep image quality consistent, which is important for accurate forensic comparisons [24]. While other evaluated parameters, such as "Correct Dental Notation" with a compliance rate of 96.8% and "Timely Record Completion" at 99.09%, indicate strong institutional adherence to documentation protocols, improving radiographic update rates (currently at 82%) and integrating comprehensive photographic records remain priorities. Addressing these gaps will not only enhance patient care and diagnostic precision but also strengthen the institution's role in forensic odontology and legal investigations [17].

Conclusion

The results reflect a strong institutional framework prioritizing accuracy, timeliness and quality in clinical documentation, positioning the school as a leader in dental education and care delivery. While the University of Michigan School of Dentistry's dental record documentation meets or exceeds the target metrics in most areas, improving radiographic update rates remains a priority. The school can further enhance patient care, diagnostic precision and compliance with documentation standards by addressing this gap.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Data Availability Statement

Not applicable.

Ethical Statement

The project did not meet the definition of human subject research under the purview of the IRB according to federal regulations and therefore, was exempt.

Informed Consent Statement

Informed consent was taken for this study.

Authors' Contributions

All authors contributed equally to this paper.

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