



# Maintenance of Dental Records: A Survey among Italian Dentists with Implications for Forensic Odontology

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## Abstract

Dental records keeping is essential for the practicing dentist, not only for legal implications and malpractice insurance claims, but also for forensic applications in the identification of unidentified human remains. Objectives. The most common element of forensic dentistry that a general practitioner is likely to encounter is to supply antemortem records to forensic odontologists to narrow the search for missing individuals and to play a key role in the victim identification process following mass disasters or catastrophes. Methods. A pilot study was conducted on 138 private dentists who were questioned regarding their collecting and keeping dental records in their regular practice.

**Results:** All dental practitioners collect name, age, address, contact information, pertinent medical history, and chief complaint; 88% record dental anomalies, soft tissue findings, malocclusion, and parafunctional habits. 92% note the name of the manufactures and the batch or serial number of the dental implants used. 96% register details of the prosthesis constructed. 100% of the dental practitioners questioned keep a record of every treatment done, and store radiographs/photographs for a minimum of 10 years, but nobody regularly gives a copy of the radiographs to their patients.

**Conclusions:** Authors suggest improvements in the quality of dental record keeping as an essential part of the dentists' professional responsibility and the forensic dental identification.

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**Keywords:** Dental records; Dental Radiography; Human Identification; Forensic Odontology; Electronic health record.

## Introduction

Dental records are an essential component serving as an information source for dentists and the patients, in medicolegal, administrative financial function within general practice for quality assurance and audit. The ability of clinical practitioners to produce and maintain accurate dental records, which is the detailed document of the history of the illness, physical examination, diagnosis, treatment, and management of a patient and

is essential for good quality patient care as well as it being a legal obligation. With the worrying rise in malpractice of insurance claim cases, a thorough knowledge of dental record issues is essential for any practitioner, and with the increasing awareness among the public of legal issues surrounding health care, in forensic purposes [1,2]. The primary purpose of maintaining dental records is to deliver quality patient care and follow-up,

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but incomplete files may be harmful to the dentist, too. Nowadays patients are more and more aware and often seek relief in court. The dental files are an official document: based on the file the dentist may be prosecuted or cleared of alleged dental malpractice. A good file also enables the dentist to follow up the patient's dental health and makes it easier for another dentist, whom the patient was referred to, to follow-up on his treatment [3].

The important role of dentist treatment records for use in the determination of the identity of both living and deceased persons has been recognised and accepted internationally for many years. The identification of the living and of the dead is a human right to be guaranteed for ethical, cultural, religious, and economic reasons [4]. Not less important, it contributes to criminal investigations in case of violent and suspicious deaths. Identification by dental means is one of the fields of expertise of a Forensic Dentist (FD) and it is useful in single cases as well as in mass disasters, when a significant number of bodies are recovered at the same time. Dental identification can have three different applications: comparative identification, in which the post-mortem dental records are compared with ante-mortem records of an individual in order to establish whether both records correspond to the same person; the obtainment of dental information to narrow the search for an individual when the ante-mortem records are not available and there are no possible data referred to the identity of the subject; identification of victims following mass disasters or catastrophes [5,6].

The central role played by forensic odontology in personal identification is based on the unique characteristics and arrangements of the teeth: the pattern and combination of dental treatments, anatomic and pathologic features are hardly similar between different subjects.

Moreover, teeth are frequently the last and only remains to identify a victim, for instance in cases of advanced decomposition, mutilation, or incineration: as primary identifiers they can lead to the certain identification or exclusion of an individual without the aid of additional factors [5,7-9]. Although establishment of individual identity using forensic odontology had been extremely useful and reliable, it is totally dependent on the presence of ante-mortem records to compare them to the post-mortem dental data collected during the autopsy [10]. So, dental practitioners can make the difference: If incomplete dental files may obstruct forensic work, delaying identification and prolonging and mourning of relatives, high-quality and updated dental records are keystones in the dental identification process [11-15].

A dental record is the detailed document of the history of the illness, physical examination, diagnosis, treatment, and management of a patient, including instructions for home care and consent to treatment. The data may consist of several different elements, which include written notes, radiographs, study models, referral letters, consultants' reports, clinical photographs, results of special investigations, drug prescriptions, patient identification information, a comprehensive medical history, and a detailed description of the treatments performed over the years. It is essential that a practitioner maintains this large amount of information in an easily accessible and understandable manner to allow the identification of deceased individuals through comparison of ante-mortem and post-mortem records. However, from a forensic point of view, dentists often do not keep adequate files [16,17].

The aim of the present study was to analyse the quality of dental data kept by dentists and suggest improvements in dental record keeping enhancing human identification. The potential of an international electronic health record to collect and share clinical information, especially radiographic data, for forensic purposes is discussed too.

### Materials and methods

A pilot study was conducted on 138 private dentists who were questioned regarding their collecting and keeping dental records in their regular practice. The chronological age of the dental practitioners surveyed ranged from 30 to 64 years old with an average age of 52 years for males and 53 years for females. The questions gathered information about the patient's identification, complete medical history, alterations in tooth position, oral anatomical characteristics, description of pre-existing treatments, radiological examinations performed, photographic documentation, storage of casts, dental materials used in restoration and/or prosthesis, serial numbers of implants, updated dental chart. A descriptive analysis was carried out for the data. The answer to each question could be yes or no; answers that were left open were not considered for statistical analysis. Each question was analysed separately.

### Results

The results demonstrate that during the first visit all dental practitioners collect name, age, address, contact information, pertinent medical history, and chief complaint; 88% record dental anomalies, soft tissue findings, malocclusion, and parafunctional habits. Periodontal screening is recorded only by 56% of the dentists surveyed. 84% of the dental practitioners' record details of the materials used in fillings, their site and extension, and 64% record details of the materials used in endodontic treatments. Regarding periodontal, filling, and endodontic data, if we consider female dentists, the percentage increases as a sign of more accurate attention paid by them to clinical data recording.

92% of the dentists note the name of the manufactures and the batch or serial number of the dental implants used. 96% register details of the prosthesis constructed, but, in case of replacement prosthesis, only 48% make any mention of the condition and materials of the existing prosthesis. Regarding dental implant and prosthesis data the percentages are high for both, males, and females, probably because the delivery of certification and/or declaration of conformity is required.

100% of the dental practitioners questioned keep a record of every treatment done, however update records only when a treatment is done.

Diagnostic casts store is carried out by 76% of the dentists for a minimum of 10 years; 84% take photographs, but only in special cases. 80% of the dental practitioners surveyed take dental radiographs during the first visit; of these, only 18% take them in conventional method and 82% record them digitally, they are mostly male dentists perhaps due to their greater familiarity with technology. The total of the dentists who take radiographs/photographs store them for a minimum of 10 years, but nobody regularly gives a copy of the radiographs to their patients.

### Discussion

Although it is only a small sample of dentists, the results seem to suggest there should be a major uniformity and completeness in the collection of dental data. This sends an alarm for increasing the awareness among the dentists on the impor-

tance of maintaining dental records containing all the relevant details [18,19]. Written records, including medical and dental history, diagnosis, odontogram existing and planned treatment, periodontal and occlusion examination, intraoral and extraoral lesions, chart notes, lab prescriptions, appointments records, radiographs, photographs, diagnostic and study models, are the only available guidelines from which to deliberate in a professional liability lawsuit and must be contemporary and meticulous kept. It's mandatory to acquire a full tooth charting in first visit and update it at each subsequent visits; it's unacceptable to update dental records only when a treatment procedure is done. The digital data logging allows to store simply and automatically a lot of information; anyway, it must be considered that, when a digital data record is used, data entry may have a disadvantage: When the full tooth charting data is updated, often next data overlap the previous ones. Therefore, it would be relevant that the dental practitioner creates subsequent files for the same patient and maintains the patient's clinical history to be compared hand in hand with the radiographic investigations performed during the treatment.

During data acquisition, special attention should be paid to the description of root canal and cavity fillings, prosthesis, and dental implants, both pre-existing and new restorations, based on the current technical knowledge in dentistry.

As regards the cavity fillings, the large number of tooth-coloured composites, placed to answer the increase in the demand for aesthetic restorations, presents a challenge to forensic odontologists; in fact, resins can be difficult to recognize both clinically and radio-graphically because of their replicating tooth structure and colour that complicates task during dental identification [20-23]. Therefore, dentists must record position, size, design, materials used, and any other specific features, to simplify comparison of ante-mortem and post-mortem dental records [24-29].

Dental implants are components placed within the jaw bones to aid support for the dental prosthesis by means of a biological process of fusion called osteointegration. They are broadly classified based on their properties, implant design and attachment mechanisms; manufactures have different designs, and some implants also have name of the manufactures, batch, or serial numbers in them. These data, together with the requirements of a certification and/or declaration of conformity to be delivered to the patient can be useful not only in case of replacement, but also in identifying the victims by comparing with their ante-mortem records. Implant recognition software, radiographic recognition of dental implants, and assessment of batch numbers help the forensic odontologist [30,31].

The prosthodontists are playing a very important role in forensic investigatory as they are concerned with fabrication of various prosthesis which can serve as an important tool for personal identification. Since ancient time dental prosthesis have been used to identify victims of natural and mass disasters. First mention of dental forensics in American history was in 1776 when Paul Revere identified the body of general Joseph Warren by a missing maxillary canine tooth which was replaced by a piece of Walrus tusk as a pontic [32]; in 18<sup>th</sup> century, Cunningham proposed denture marking as a tool for forensic identification and it was brought into focus by Dr. Robert H. Griffiths during his tenure as president of the American Dental Association [33]. Denture marking is now accepted as a means of identifying dentures and persons in geriatric institutions or post-mortem during war, crimes, and civil unrest, natural and mass disasters,

and a lot of different methods for marking has been suggested of the complete dentures, removable partial dentures and fixed partial dentures [34,35].

Dental radiographs are a crucial aid to personal identification in forensic odontology. They are objective, morphologically specific recordings of features of an individual, where written dental records are not. This greatly increases the value of radiographic image comparison when it is used to determine if ante-mortem and post-mortem images derive from the same person. If written dental records are subjective, interpreted records that do not derive directly from an individual, and which may be subject to errors, inaccuracies and deliberate falsifications, radiographic images do derive directly from an individual and record exactly what is projected onto the image sensor during radiological examination. They are objective records that document detailed morphology of the dentition and surrounding bony structures. They may also record detailed morphological information about dental treatments including extractions, and restorations including root canal treatments, if they are present. This objectivity is of first importance in the determination of identity by comparison, and in other forensic applications such as age determination. In cases where dental radiographs are used for identification, distinctive features are sought and used for comparison between ante-mortem and post-mortem images. These may include the specific individual morphology of dental restorations, evidence of past trauma and/or surgical treatment such as healed fractures, surgical plates, absent teeth, and misaligned teeth. In the absence of restorations or evidence of other dental treatment (or together with them), anatomical features including tooth morphology (shapes, arrangement and relative sizes of teeth, roots, pulp chambers and root canals), pneumatic sinuses, and bone morphology including trabeculae, may be used [36-38]. To ensure the collection and storage of radiographic data for forensic purposes, it is essential to issue a copy to the patients. This should become a good daily clinical practice for all dentists to ensure the availability of the personal documentation and, finally, to limit radiation exposure. In Europe, the Council Directive 2013/59/Euratom [39], the last directive concerning basic safety standards for protection of the health against the dangers arising from exposure to ionizing radiation, which repeals the previous ones, defines "clinical responsibility" as responsibility of a practitioner for individual medical exposures, in particular, justification; optimisation; ... obtaining information, if appropriate, on previous examinations; providing existing medical radiological information and/or records to other practitioners and/or the referrer, as required; ...". Then, in article no. 55 paragraph d) it's reiterated that "the practitioner seeks, where practicable, to obtain previous diagnostic information or medical records relevant to the planned exposure and consider these data to avoid unnecessary exposure". With the Legislative Decree of 31 July 2020 n. 101 [40]. Italy implemented the European directive by defining the general principles of radiation protection for people also in the case of medical exposures, prohibiting unjustified exposure. Consistent with the European directive, the decree establishes that the prescribing physician, in order to avoid unnecessary exposure, must ensure that he is not able to obtain previous diagnostic information or medical documentation relevant to the expected exposure;

Digital technologies are powerful solutions to address those issues and to adapt health systems to future challenges. Digitising health records and creating systems that enable them to be securely accessed by citizens and securely shared within and

between the different actors in the health system (patients, their clinical teams in the community and hospital facilities) is an important step towards integrating digital technologies into health and care approaches [41-44]. In February 2019 the European Commission drafted Recommendations on a European Electronic Health Record (EHR) [45] exchange format, because, despite the norm of the Regulation 2016/679 of the European Parliament and of the Council [46] establishes that citizens have the right to access their personal data including those concerning their health, most of them cannot yet access their own by healthcare professionals, nor share them in a safe across borders. Therefore, main objectives of these Recommendations are to set out a framework for the development of an EHR exchange format to achieve secure, interoperable, cross-border access to, and exchange of, electronic health data, including medical imaging and reports, in the Union. To guarantee cross-border healthcare between the Member States of the European Union also through digital tools, the European Commission encourages Member States to ensure secure access to electronic health record systems at national level and it's engaged in the creation of a digital network capable of guaranteeing the interoperability of e-health services through the European Connecting Europe Facility program.

In Italy, already in September 2015, a Decree of the President of the Council of Ministers [47] has been issued to define the regulation on the subject of EHR, the set of digital health and socio-health data and documents generated by present and past clinical events concerning the patient, whose purpose is to promote continuity of care, allowing a rapid classification of the assisted person at the time of contact with the National Health System (NHS).

Currently, the electronic health record is present in all Italian regions, but unfortunately with different levels of operation, membership, and use, as well as differences in content and access methods. In Emilia-Romagna region this electronic tool has a reserved section where the citizen is allowed to enter personal data and documents relating to their care pathways, including those carried out at facilities outside the NHS. In other words, in this section it is possible to enter all the dental radiographic investigations performed also in private practices, which will be easily available in case of personal identification for an efficient comparison between ante-mortem and post-mortem data.

### Conclusions

Teeth and mouth carry individual characteristics that differ among different individuals. Dentists have a major role to play in keeping accurate dental records and providing all necessary information so that legal authorities may recognize malpractice, negligence, fraud or abuse, as well as identify human remains. The creation and dissemination of a complete dental record is desirable to ensure full and uniform dental data keeping. To this end dentists should be trained on detailed dental record maintenance and fundamentals of forensic odontology, to assist them and prepare them to tackle any kind of medicolegal scenarios, including forensic dental identification. Digital transformation of healthcare data will need the creation of systems that enable secure access and sharing of data among all actors of the health system.

### Ethics statement

This paper is a perspective, so it did not need ethical approval.

### Conflict of interest

The authors have no conflicts of interest associated with the material presented in this paper.

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### Author contributions

Both authors contributed equally to the planning, writing, and editing of the manuscript.

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