A study to determine the forensic quality of records and record keeping by dentists in the greater Cape Town area

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ABSTRACT

South African dentists have a legal and ethical obligation to maintain complete and comprehensive dental records. In addition to the legal and ethical requirements, dental records are also important in the case of medico-legal issues, quality assurance processes and forensic purposes. Valuable forensic evidence contained in dental records are used in the identification of victims of mass disasters, personal victim identification e.g. in severely decomposed or skeletonized remains where DNA or other biometric data are not available. The victim identification process is highly dependent on complete, legible and accurate dental records. A review of the literature however shows that dental record keeping practices are sub-optimal worldwide.

There is a paucity of studies in South Africa regards to dental record keeping practices. The aim of this study was to assess the record keeping practices of a sample of private practicing dentists in Cape Town and surrounding towns, for forensic dental purposes. Knowledge and awareness regards to forensic odontology as well as adherence to the guidelines prescribed by the Health Professional Council of South Africa were also assessed. This was a cross-sectional descriptive study, employing a researcher-administered questionnaire and a dental checklist for forensic valuable items in the dental file. The results were entered in a MS Excel spreadsheet and statistically analysed using IMB SPSS Statistics.

This study concluded that most of the dental records kept by Cape Town dentists are near to optimal and would be helpful during forensic odontology investigations. However, shortcomings in record keeping practices exists which may compromise the forensic accuracy of their dental records. The study also shows a significant difference in dental record keeping practices by dentists practicing in lower income areas in Cape Town, compared to those practicing in economic affluent areas. The dentists in this study adhered to most of the guidelines prescribed by the Health Professional Council of South Africa however, important medico-legal information was missing from most dental records. This study hopes to contribute to future comprehensive studies in the broader South Africa to determine the validity of dental records for forensic odontology purposes.

DECLARATION

I declare that "*A study to determine the forensic quality of records and record keeping by dentists in the greater Cape Town area*" is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Full name: Johan Frank Opperman   Date: 17 May 2018

Signed:

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LIST OF ABBREVIATIONS:

ADA: American Dental Association

BAFO: British Association of Forensic Odontology

CPD: Continuous Professional Development

CBCT: Cone Beam Computerized Tomography

DNA: Deoxyribonucleic Acid

DVI: Disaster Victim Identification

FDI: Fédération Dentaire Internationale

HPCSA: Health Professional Council of South Africa

IRS: Implant Recognition Software

mtDNA: mitochondrial DNA

NHS: National Health System, United Kingdom

OPG: Orthopantomogram

PCR: Polymerase Chain Reaction

SADA: South African Dental Association

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CHAPTER 1

Introduction

The British Association for Forensic Odontology (BAFO, www.bafo.org.uk) defines forensic odontology as "a branch of medicine that deals with the proper examination, handling and presentation of dental evidence in a court of law – in the interests of justice". Sheikh *et al.* (2011) advocates that dental findings should be presented in a manner that makes victim identification possible. Identification of human remains using dental evidence has become an important tool in forensic pathology. According to Perrier (Bowers, 2011) there are humanitarian, psychosocial, ethical and legal aspects to the human identification process. Identification of the deceased allows family members the opportunity to mourn and bury their beloved ones according to their cultural beliefs and religious practices, for consummation of legal proceedings such as life insurances, finalizing inheritance and to legally marry after the death of a spouse.

With the increase of natural and man-made disasters, bombing attacks and aviation disasters, the need for human identification has become even more critical. Dental evidence has played a major role in the identification of victims of the 2004 Thailand tsunami and the more recent 2014 Malaysia Airlines, Flight MH17 aviation accident, highlighting the need for maintaining adequate dental records. Dental identification is a multidisciplinary team effort involving law enforcement officials, forensic pathologists, forensic odontologists, forensic anthropologists, serologists, criminologists and other specialists deemed necessary (Pretty and Sweet, 2001). Forensic Odontologists are frequently requested to assist in the identification process – mainly in cases where human remains are grossly decomposed, skeletonised, burnt or fragmented.

Unidentified human remains at Medico-Legal Laboratories in South Africa constitutes a huge problem due to lack of storage space, as well as the financial burden of storing these bodies over long periods. A study by Evert (2011) showed that 7% to 10% of bodies at Medico-Legal Laboratories in Pretoria remained unidentified. Evert attributes this to the unavailability of fingerprints, poor fingerprinting techniques, advanced decomposition, difficulty obtaining reference sample for DNA analysis, severe burns or trauma, lack of availability and access to dental records and radiographic evidence. According to Evert, this number is very high compared to international statistics. The 2018 Global Crime Index (https://www.numbeo.com/crime/rankings_by_country.jsp) ranks South Africa fourth only

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after Honduras, with the Western Cape as the crime capital. This ranking can be ascribed to the high incidence of murders, gang-related violence, rape and sexual assault cases. The brutality and disfigurement associated with these crimes may hamper victim identification by means of visual or fingerprint recognition, as seen in muti murders and burned victims.

Dental identification compares the ante-mortem evidence as contained in dental records with the post-mortem findings. South African dentists have a legal and ethical duty to maintain dental records. The Health Professions Council of South Africa (HPCSA) prescribes guidelines for medical and dental practitioners on maintaining proper medical records. Adherence to these guidelines is however never checked and practice audits are lacking – one could argue that this may lead to sub-optimal record keeping. A review of the literature shows that dental record keeping practices and maintenance in most countries appear to be inadequate and dental records to be not very helpful in the forensic dental identification process.

There is no information available on record keeping practices in private general dental practices in South Africa. A quality assurance study by Kopsala (2000) - to assess completeness and adequacy of dental records at government dental clinics in Alexandra and the Department of Restorative Dentistry, University of the Witwatersrand - showed that general dental documentation was of poor quality and did not meet standard record keeping requirements. Similarly, van Niekerk and Bernitz (2003) retrospective investigation of forty dental records used in forensic identification cases in Pretoria, found that eight records had no written notes of the dental treatments received, and only two records had a complete charting of all dental treatment carried out. These two South African studies suggest that dentists do not comply with the requirements pertaining to dental charting and record keeping guidelines. This might indicate that dental records in South Africa would not be useful or reliable for forensic and medico-legal purposes.

This study aims to assess the validity of dental records of a sample of private dentists in Cape Town for use in human identification, and to evaluate adherence to the guidelines as prescribed by the HPCSA, Booklet 9: Guidelines on good practice in the health care profession. It is the first research project that explores the completeness and adequacy of dental records in private practice in South Africa.

Chapter Two is a comprehensive literature review that provides an introduction and background on Forensic Odontology and its applications, and discusses the maintenance of dental records in different parts of the world. The chapter also briefly discusses dentist's

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knowledge and awareness on Forensic Odontology, their exposure to the field and perceived barriers to optimal dental record keeping.

Chapter Three outlines the aims and objectives of this study.

Chapter Four presents the rationale for this study, the methodology applied, as well as the statistical analysis of the data.

Chapters Five and Six will conclude the study. Chapter Five will describe the results and Chapter Six will discuss the findings, draw conclusions and make recommendations.

CHAPTER 2

Literature review

2.1 Forensic Odontology Background

Modern day Forensic Odontology can be attributed to the work of Dr Oscar Amoëdo and Dr Paul Revere. Dr Amoëdo known as, "*The Father of Forensic Odontology*", was responsible for the identification of victims of a fire at the Bazar de la Charite in Paris, on May 4, 1897. This catastrophic disaster resulted in the loss of 126 lives, of which unique dental features identified 25 of the deceased (Bowers, 2011).

The first case of dental identification in America was that of Dr Joseph Warren, a medical practitioner who was fatally wounded in the Battle of Bunker Hill, 1775. Dr Paul Revere, his dentist, identified Warren's remains buried in a shallow grave by a dental bridge he constructed for Warren (Bowers, 2011).

2.2. Forensic Odontology and its application in the human identification process

The Royal College of Pathologists defines a mass disaster as "an episode in which the number of fatalities is more than that which can be dealt with using the normal mortuary facilities" (Bassindale, 2014). To illustrate the importance of Forensic Odontology as part of the greater field of Forensic Medicine, the following mass disasters will be briefly discussed: The 2004 Thailand tsunami, 2001 World Trade Centre Attack and the 1987 Helderberg Air Disaster.

2.2.1   Personal victim identification in natural and man-made disasters

The Thailand tsunami (2004)

The 2004 Thailand tsunami is a perfect example of a multinational mass disaster where dental identification played a major role in the identification of the deceased. On 26th December 2004 and earthquake measuring 9.0 on the Richter scale caused a huge tsunami that struck countries on the coast of the Indian Ocean leading, to the death of ± 250 000 people. Thailand, a favourite holiday destination for tourist from all over the world, was also struck by the tsunami, leaving approximately 5395 dead, which included locals as well as tourists from various other

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countries. Identification of the deceased began five days after the disaster and included DNA analysis, fingerprinting and dental examination. Local Thai dentists and dentists from the United States of America, Canada, Norway, Spain and the Netherlands participated in the human identification process.

The identification process was however hampered due to many factors. James (2005) found most of the dentists in Thailand did not keep adequate dental records and dental radiographs are not part of the routine dental visit. He concluded that a lack of experienced staff e.g. forensic dentists, and fingerprint experts, the different dental nomenclatures used by different countries and the difficulty in obtaining adequate ante-mortem dental records from most countries delayed the victim identification process. Despite of these limitations, dental evidence as a primary identifier contributed to 85% of positive victim identifications, while fingerprinting, DNA analysis and other physical characteristics (birthmarks, scars and tattoo's.) contributed 12.6%, 6.4% and 1.2% respectively.

Figure 1. A comparison in the victim identification process in the Thailand tsunami using different identification modalities - Germany and Sweden versus Thailand
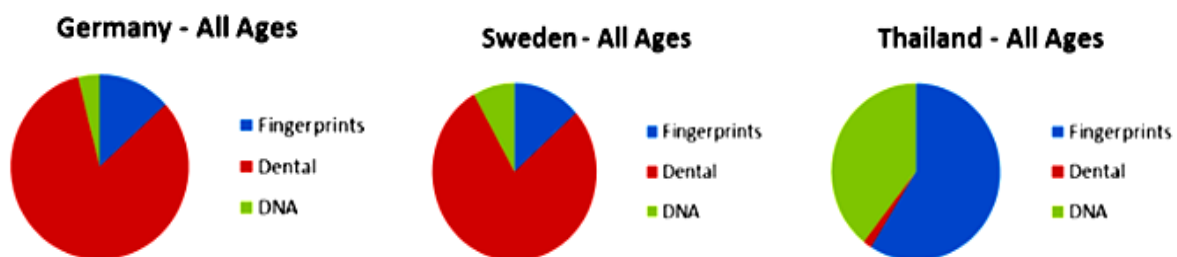
The results in Figure 1 suggest that European countries have a higher level of compliance when it comes to dental record keeping practices. A Danish study by Schou and Knudsen (2012) reported that forensic odontology alone was responsible for 70.3% of identifications of Danish victims in the Thailand tsunami and contributed to another 5.4% in combination with fingerprints. Fingerprints and DNA analysis contributed to a small extend to the identification process.

The World Trade Centre Attack (2001)

Dental records and dental radiology played a major role in the identification of victims of the World Trade Centre attack on September 11, 2001, which resulted mass fatalities. An official 2753 people from 27 different countries lost their lives in this massive terrorist attack. The

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Office of the Chief Medical Examiner report on victim identification by single modality showed that after DNA analysis (89%), dental radiology contributed to 5% of victim identification. Victim identification by multiple modalities however showed that dental radiology contributed to 76% of identifications, compared to DNA analysis (91%). One thousand one-hundred and thirteen (1113) victims of this tragic event however still need to be identified (Gill, 2005).

The Helderberg Air Disaster (1987)

On 28 November 1987, the *Helderberg*, a Boeing 747 from the South African Airways (SAA), carrying 159 passengers and crew, crashed in the Indian Ocean near Mauritius. Fifteen human remains were recovered from the sea of which only eight contained dental tissues. Ante-mortem dental records of the victims were collected form dentists in Johannesburg while post-mortem examinations were conducted in Mauritius. Five of the eight human remains were identified by restorative dental work and anatomical dental features (Ligthelm, 1994).

2.2.2 Bite Marks

Crimes such as murder, sexual assault and child abuse are commonly associated with the perpetrator biting his or her victim; or the victim biting the perpetrator in self-defence. Bite marks can also be left in food items e.g. cheese, apples or a piece of chocolate at the scene of the crime. Bite mark analysis involves the comparison of the perpetrator's dentition to the bite left on the victim or an object. This process includes the examination of the shape, size and position of individual teeth of the suspect, the fabrication of overlays or hand tracing from study casts and to match this with the bite mark(s) left on the victim (Annop *et al*., 2013). Due to individual uniqueness of the dentition, features such as spaces between teeth, missing teeth and angulated teeth, bite marks are reported to be reliable evidence in crime investigations. The use of bite marks as evidence is still a contentious debate, however many experts and defence lawyers agree that bite marks can be helpful in excluding a suspect, or determining that the suspect could be the one who inflicted the bite. See figure 2 for an illustration of a potential bite mark.

Figure 2. Soft tissue indentations made by the incisal edges of teeth of the upper and lower jaw of the perpetrator on the victim's skin

2.2.3 DNA analysis of saliva from bite marks and DNA extracted from teeth for personal victim identification

Saliva is deposited during the act of biting, making it a potential viable source for DNA analysis. The expertise of forensic DNA analysts and forensic odontologists is commonly used in bite mark analysis and human identification, where ante-mortem dental data is absent. Pretty (2008) described the double swabbing technique to maximize DNA recovery from a bite mark site. DNA is extracted from the source (saliva or dental pulp) and amplified using real-time polymerase chain reaction (PCR). Teeth are an excellent source of genomic DNA.

Genomic DNA is found in the nucleus of each cell and is the source of DNA in most forensic applications (Bowers, 2011). The structures of the enamel, dentine and the pulp complex persist after the body has decomposed. DNA can be extracted from calcified tissues, employing the cryogenic method. In addition to genomic DNA, cells also contain mitochondrial DNA (mtDNA). In cases where genomic DNA is too degraded, mtDNA may be present in sufficient quantities for analysis. mtDNA is maternally inherited, conferring the same mtDNA sequence, upon siblings and all their maternal relatives (Bowers, 2011). This is important implication for identification of individuals for which there is no ante-mortem comparison sample.

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2.2.4 Age Estimation

The development of the dentition can be used to determine the chronological age of an individual. Mincer concluded that the maxillary third molar formation was slightly advanced over the mandibular third molar and that root formation developed earlier in males than females (Silver and Souviron, 2009). Demirjian's eight-grade classification can be used to assess third molar formation and in this manner it can be established if an individual is 18 years of age. *Development of the Human Dentition* by Schour and Massler is still used by the American Dental Association (ADA) for guidance on age estimation. When the dentition is complete, age estimation becomes more difficult. This can be attributed to functional, degenerative and age-related changes in teeth e.g. attrition, periodontal disease, secondary dentine deposition and root transparency (Silver and Souviron, 2009). The Gustafson method then becomes a reliable method for age estimation, especially in older individuals.

2.2.5 Rugae print (rugoscopy) in human identification

In the case of an edentulous victim the identification process is much more limited than in the case of dentate victim. In cases where the body is exposed to extreme heat, the tongue acts as an insulator preventing distortion of the palatal rugae. Palatal rugae are unique to individuals but may show ethnic and geographic variations. Palatal rugae are therefore considered as an ideal forensic identification parameter, equivalent to that of a fingerprint (Jain and Chowdhary, 2014). The Brazilian aeronautic ministry has made rugoscopy mandatory for pilots, in the event of victim identification in a disaster (Mutalik *et al.*, 2013).

2.2.6 Denture identification

The law in most states in America mandates that removable denture appliances must have a patient identifier. Dental prosthesis and appliances such as complete or partial removable dentures, orthodontic appliances and dental implants are very helpful in victim identification. The identification methods may include a microchip, the last name or social security number embedded in the acrylic base of the removable prosthesis or denture bar coding. Ling *et al*. (2003) suggests that very fine markings of a few microns, to label the chrome-cobalt component of dentures and metal restorations, using a copper vapour laser (CVL). Nuzzolese *et al*. (2010) recommends that in the case of edentulous patients, a microchip, containing the patient's information should be inserted inside the patient denture.

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2.3 The dentition as forensic evidence

Combinations of dental characteristics are never the same in any two given individuals, making the human dentition unique. The physical properties of teeth and dental hard tissue, the fact that the dentition remains stable during the decomposing process, contribute to the success of forensic dental identification. Enamel is the hardest substance in the human body and the only exposed portion of the skeleton. Dental hard tissue is resistant to thermal damage when exposed to high temperatures, however may be destroyed at temperatures as high as 1000° C (Bowers, 2011).

The uniqueness of the dentition can be attributed to dental work specific to an individual e.g. crown and bridge work, the presence of dental implants, root canal treatment and restored or missing teeth. In addition to this, the shape and curvature of roots, anomalies such as dilacerations of roots, pulp chamber morphology, bone density and trabecular patterns as well as relationships to surrounding structures such as maxillary sinuses, adds to the uniqueness of the dentition (Bowers, 2011). Reporting on hard tissue findings e.g. exostosis, mandibular or palatine tori, the presence of a diastema and supernumerary teeth, increases the forensic value of the dental record.

Figure 3 and 4 show orthopantomograms of a patient who was rehabilitated with dental implants and dental restorations (crown and bridge, multiple fillings and root canal treatment). In the case of this patient being a victim of a crime or victim of a mass disaster, the orthopantomograms (figures 3 and 4) can be used to illustrate how dental evidence can aid in identification of the victim. Figure 3 will be taken as an ante-mortem radiograph and figure 4 as a post-mortem radiograph.

Figure 3. Ante-mortem orthopantomogram (*Radiograph used with permission of dentists*)
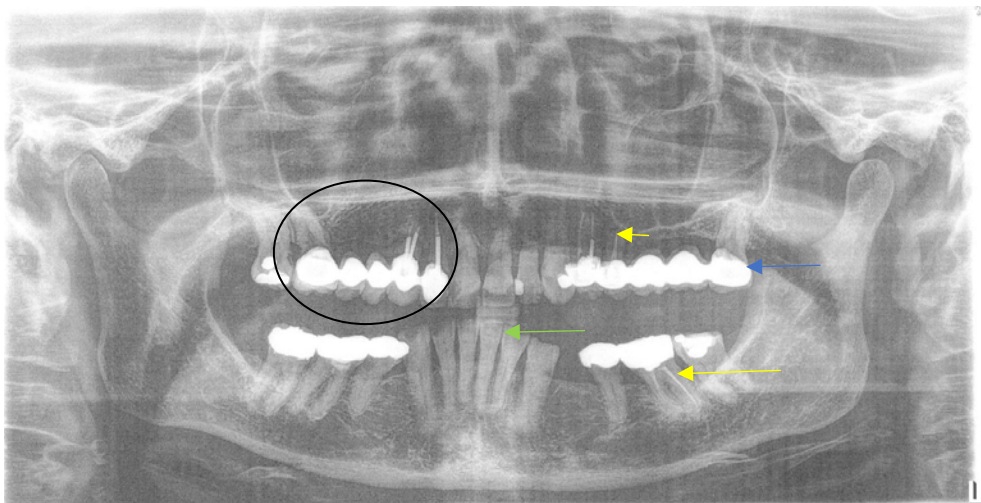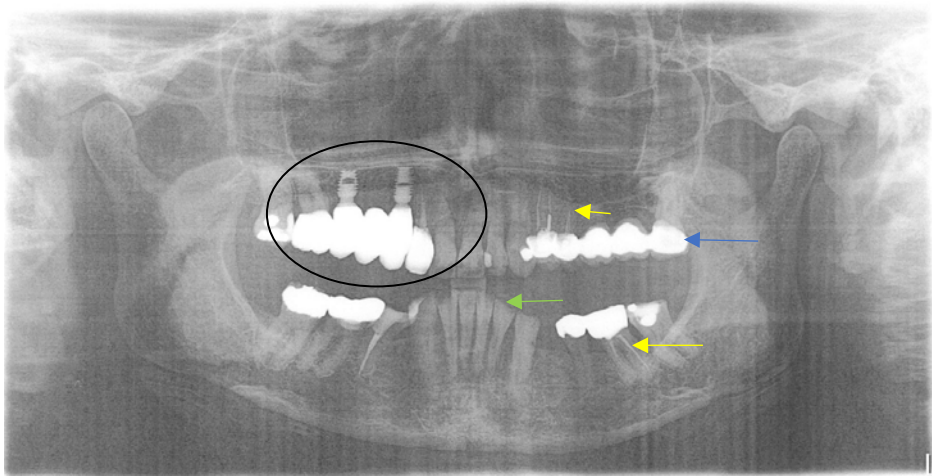

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Figure 4. Post-mortem orthopantomogram *(Radiograph used with permission of dentists)*

The ante-mortem data (fig. 3) from the dental file shows many similarities to the post-mortem evidence (fig. 4). Two implants were placed in the 13 and 15 positions in the right maxilla (fig. 4), replacing the defective 5-unit porcelain fused to metal (PFM) bridge in figure 3 (black circle). The ante and post-mortem radiographs also show additional dental evidence when compared. A 5-unit PFM bridge in the left maxilla (blue arrow), root canal treated teeth (yellow arrows); other restorative work (amalgam and composite fillings), extracted teeth as well as attrition of the occlusal surfaces of the anterior mandibular teeth (green arrow) noted in figure 3 are also present compared to figure 4. Root morphology and bone loss pattern are also valuable in the identification process. Comparing the two radiographs, enough concordant features are present to establishing a positive identification.

In mass disasters, the identification procedure follows recommendations as set in the Disaster Victim Identification (DVI) Guide; a manual published by the International Criminal Police Organization (Interpol) in 1984. The guide describes the collection of ante-mortem data (F1, yellow form, figure 5) by specialist using the Interpol DVI Ante Mortem Form matching this to the dental evidence recorded in the Post Mortem Form (F2, pink form, figure 5). The dental status of the deceased or missing person is recorded on the specific Interpol DVI form using international standardized terminology, nomenclature, codes and abbreviations. Ante-mortem and post-mortem data can be analysed and compared using computer programs of which Plass Data DVI System International software is an example, accelerating the identification process. The Plass Data System currently assists in the identification process by matching dental records in addition to physical and medical characteristics such as tattoos or orthopaedic prosthetics e.g. hip replacements.

Various researchers have questioned the number of concordant features required to establish a positive identification. Kieser-Nielsen (1977) suggests a minimum of 12 concordant features for a positive identification, while other researchers reported that only one identical radiographic feature (a single concordant point) may be sufficient to establish identity.

Phillips and Stuhlinger (2009) concluded that cases where accurate radiographic material are available for dental comparison, a positive identification can be established using less than 12 concordant features. The authors argue that "if the ante-mortem and post-mortem radiographic images of a compound amalgam restoration are exactly the same, then this feature is unique, and identification can be achieved by a single concordant feature".

According to Hill (1989) the emphasis placed on the number of concordant characteristics needed to establish a positive identification could be misleading and confusing to legal professionals and lay people.

Figure 5. Interpol DVI Ante Mortem Form (F1 yellow) and DVI Post Mortem Form (F2 pink)

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2.4 The importance of dental records in Forensic Odontology

Dental records are of paramount importance in patient care and management. Proper record keeping assists in communication between health care providers and ensures continuity and completeness of treatment. In addition complete dental records serve to protect practitioners in against malpractice suits, and are essential for dental audits, which is a vital part of quality control (Ireland *et al*., 2001).

A dental record is considered as a legal document, owned by the dentist, containing subjective and objective information about the patient (Devadiga, 2014). Dental records consist of written or electronic notes of the patient's personal details, complete medical history, treatment plan, radiographs and photographs or any other investigations during treatment (Berketa *et al*., 2011). The identification process is further enhanced if the records contain complete dental charts, comprehensive descriptions of teeth restored or removed dental anomalies, full mouth and single tooth radiographs, intra-and extra oral photos and study models (Stow *et al*., 2016). In addition to its legal and ethical obligations, dental records may also assist in forensic odontology. Dental identification is done by comparing data obtained from the deceased person to ante-mortem data contained in the dental record. The success of the human identification process by dental evidence is however highly dependent on the accessibility, accuracy and adequacy of dental case notes (Morgan, 2001).

2.5 Dental Record Keeping Practices and Guidelines on Retention of Records

Most clinicians believe that their record keeping is adequate, however a big discrepancy exists between dentists' perception of dental record adequacy and recommended structure and guidelines. A retrospective investigation of dental files at the University of Pretoria by Van Niekerk and Bernitz (2003) concluded that no form of standardised dental charting is practised in South Africa. The authors proposed that dental charting should be given more attention at under-graduate dental training.

A recent study by Gupta *et al*. (2016) showed that 78% of dentists practicing in Punjab and Uttar Pradesh, India were not maintaining any dental records. Astekar *et al*. (2011) found that only 38% of dentists in Rajasthan were aware of the importance of maintaining dental records and 62% of dentists did not maintain any form of patient record. Another study by Preethi *et al*. (2011) among dentists in Chennai found that 79% maintained dental records, however only 12% maintained complete dental records.

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Petro (2013) found that general record keeping in Sudan is poor compared to other countries. The author conducted a comparative study of record keeping practices in two major government clinics, two major government hospitals and two private clinics in Khartoum. This study showed a total absence of complete dental charting prior to treatment in government clinics, only 8.3 % in private clinics and only 50% in government hospitals. Recording of the name of the treating practitioner was missing in most of the private (15%) and government hospitals (50%), however 100% present in government clinics. Dental records examined in government clinics contained no radiographs while 50% of records in government hospitals contained radiographs of a good quality. Medical history was variably present with 50% of records in government hospitals containing a medical history. Only 16% of dental records in private clinics contained a medical history while the medical history was absent in all government clinic records examined.

A follow up study by Petro *et al.* (2015) to compare record keeping practices between students training at various dental academic teaching hospitals and private dentists in Khartoum showed that dental students are more aware of maintenance of dental records for medico-legal purposes and are more likely to maintain accurate records. This can be attributed to students being taught ideal record keeping practices in the undergraduate curriculum which is strictly regulated by the administration of the faculty.

A survey to determine the relevance of recorded case note items for dental identification by registered Australian Specialist Forensic Odontologists concluded that many sampled case notes lacked details identified as being valuable by forensic specialists and as specified by professional record keeping guidelines (Stow *et al.*, 2016).

A Belgium study to deduce the quality of the average dental record kept by Belgian dentists concluded that ante-mortem records were often incomplete, outdated and sometimes illegible. The study showed that younger dentists keep their records updated and store most of their radiographs and dental files indefinitely, especially when working with a digital recording system (Dierickx *et al.,* 2006).

Morgan (2001) concluded that general dental practitioners in the United Kingdom kept poor records with most records being inadequate lacking basic clinical findings and treatment plans. These finding were in line with other studies carried out in the United States, Australia and Scandinavia.

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Every medical and dental practitioner must comply with the professional guidelines on record keeping practices (Health Professional Council of South Africa, Booklet 9: Guidelines on the keeping of patient records, Table 1). The HPCSA recommends that dental practitioners should retain records for not less than six (6) years from the date they become dormant. In the case of minors or patients who are *non-compos mentis*, it is recommended that records are kept for longer – for minors until the patient 25th birthday and for mentally incompetent patient the record must be kept for the duration of the patient's life. Many indemnity organizations recommend retention of all records for at least 10 to 12 years or longer (Naidoo, 2013). The Occupational Health and Safety Act (Act No. 85 of 1993) stipulates that health records should be kept for a period of twenty (20) years after treatment. According to the National Health Service (NHS) in England, community dental records should be maintained for a period of 11 years for adults and children or until the patient is 25 years old, whichever is longer. A Swedish study found that nearly 40% of the aspects investigated in dental patient records did not follow the National Board of Health and Welfare's given instructions regarding documentation. The dental patient records constituted poor ante-mortem material for forensic odontology (Solheim *et al*., 1992; Rasmusson *et al*. 1994).

Table 1. HPCSA guidelines on the essential components constituting an adequate medical or dental record (Health Professional Council of South Africa, Booklet 9: Guidelines on the keeping of patient records).

i.	Documentation of the personal of the patient e.g. name, date of birth, identification number, home or postal addresses and contact details.
ii.	Complete medical history, including allergies and idiosyncrasies.
iii.	The time, date and place of every consultation.
iv.	Assessment of the patient's condition.
v.	Make notes on the proposed clinical management of the patient.
vi.	Medication and dosage prescribed.
vii.	Note details of the referral specialist, if any.
viii.	The patient's reaction to treatment or medication, including adverse effects.
ix.	Test results.
x.	Imaging investigation results (Radiographs, Computerized Tomography etc.)
xi.	Information on the times that the patient was booked off from work and the relevant reasons.
xii.	Written proof of informed consent.

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2.6 Knowledge, Awareness and Perceptions of dentist regards to Forensic Odontology

A study by Al-Azari *et al*. (2016) reported that Australian dentists have a high expectation of the forensic value of their dental records. Their study showed that personal information and details of restorative work were recorded at high levels. Tooth anomalies, photography, additional patient details and denture markings were recorded inadequately. Increased workload, lack of experience, lack of refresher courses and lack of quality check personnel were perceived as barriers for keeping accurate and complete dental records.

Osborne *et al.* (2000) study to determine Minnesota dentists perception of the adequacy of their dental documentation revealed that 85% of dentists felt their record keeping were adequate, while information was found to be absent in 9.4 to 87.1%. The study showed that there is a discrepancy in what dentists perceived to be adequate record keeping as to the guidelines and structures the American Dental Association (ADA) recommends.

An Indian study by Shetty and Raviprakash (2011) reported that almost all the participants were familiar with the subject of forensic odontology. Scientific journals as their main source of knowledge were cited by 50% of participants, whereas others cited the internet and newspapers. A comparative study by Gambhir *et al*. (2016) reported that the knowledge and awareness of forensic odontology among Indian dentists were inadequate with considerably low attitude and practice scores. The respondents had little knowledge about the practical application of forensic odontology in routine practice.

A study conducted by Ugbodago *et al*. (2015) to determine the awareness and knowledge of forensic odontology among a sample of Nigerian dentists by means of a pre-validated questionnaire showed that ninety-five-point one percent (95.1%) claimed that they kept adequate dental records, however most dentists scored very low on the knowledge and awareness questions. The authors argued that the low knowledge and awareness score could be assigned to the fact that many of the respondents reported to not have had Forensic Odontology as part of their undergraduate academic curriculum. Recently Forensic Odontology has been re-introduced into the Oral pathology under-graduate programme in some Nigerian dental schools.

CHAPTER 3

This chapter describes the aims and objectives for this study.

3.3.1 AIMS

The aim of this study is to assess the awareness and knowledge of a sample of dentists in Cape Town on forensic odontology as well as to assess whether dentists maintain detailed and comprehensive dental records for possible forensic use.

3.3.2 OBJECTIVES

- To assess the knowledge, awareness and exposure of dentists to forensic odontology.

- To determine the completeness and adequacy of dental records for forensic identification purposes.

- To assess adherence and compare findings to the Health Professional Council of South Africa prescribed guidelines (HPCSA, Booklet 9).

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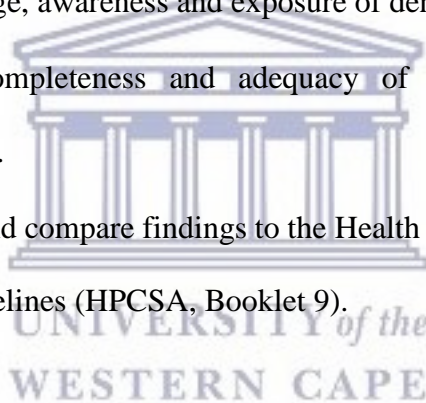
CHAPTER 4

METHODOLOGY

4.1 Rationale for the study

There is limited statistical data regards to dental record keeping practices in South Africa. Adherence to the HPCSA prescribed guidelines by health professionals has not been monitored regularly in the past. The study is a first in South Africa and aims to assess the validity of dental records of private dental practitioners, to determine the completeness and adequacy for forensic victim identification.

4.2 Study design

This is a cross-sectional descriptive study of dental record keeping practices of a sample of dental practitioners in the greater Cape Town area for forensic odontology purposes.

4.3 Material and Methods

A Participant Information letter outlining the nature of the research project was mailed electronically to one hundred and fifty private general dental practitioners in Cape Town and surrounding towns. The hundred and fifty dentists comprised of practitioners working for the four largest group practices in Cape Town and those working in practices comprising of one to three dentists per practice. The initial participant response rate utilizing electronic emailing was very low. Only four dentists (2.7%) replied to the initial invitation to participate. The primary researcher contacted various practitioners on the original emailed list and conducted private visits to fifty practices on the list. After consultation with fifty of the practitioners, thirty four dentists consented to participate. The response rate increased significantly to 22.7%. Data collection started the first week of October 2107 and finished in the second week of November 2017.

The research was conducted employing:

(1) A researcher-administered questionnaire (*Appendix 1*) and

(2) A checklist (*Appendix 2*) of relevant dental data as contained in the dental records that proved to be useful in the dental identification process.

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The researcher-administered questionnaire was designed using a modified version of the questionnaire used by Al-Azri *et al.* (2016). The questionnaire comprised open-ended and closed-ended questions and collected data on dentists' socio-demographic status, knowledge, awareness and exposure to forensic odontology, as well as indicating barriers to optimal dental record keeping practices.

Knowledge and Awareness were assessed by correct identification of seven possible applications that had relevance to forensic odontology. The response to the knowledge and awareness questions was calculated for each respondent. A knowledge score based on the most correct answers were calculated out of a score of seven correct answers.

Exposure to forensic odontology was assessed at undergraduate and post-graduate level, continuous professional development activities (CPD), reading journals of Forensic Odontology and previous request to submit records for human identification.

Perceived barriers to optimal record keeping is reported as frequencies and percentages of respondents who reported each barrier as either "Agree" or "Disagree".

The dental checklist was constructed using twenty-one items deemed by Stow, James and Richards (2016) as forensically valuable, to ascertain the completeness and adequacy of dental records and usefulness in dental identification.

Ten records for each dentist were examined and recordings were correlated with twenty-one items on the dental checklist considered forensic valuable. To ensure confidentiality and anonymity, the researcher allocated a number to each dentist and each patient record, with only the primary researcher having access to this information. The dental records were retrieved from records stored in cabinets or electronically. To ensure randomization, every 20th consecutive patient record was selected for analysis.

4.4 Sample size

Thirty four (34) dentists participated in the researcher-administered questionnaire and 340 dental records were examined for completeness, accuracy and for forensic relevant items.

The geographic distribution of the 34 dental practices in this study are shown in Fig.6

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4.5 Inclusion and Exclusion criteria

Only dentists working in private practice were included in this study.

Dental specialists, dentists working in government hospitals and clinics, dental therapists and dental hygienists were excluded from this study**.**

4.6 Validity and Reliability

The primary researcher was solely responsible for data collection, ensuring standardization in the data collection.

4.7 Data Analysis

The data was entered in a MS Excel spreadsheet and analysed using IBM SPSS Statistics. A descriptive analysis was performed employing variable frequency percentages, 95% confidence intervals and cross tabulation.

4.8 Ethical Consideration

Approval to conduct this study was obtained from the Human Research Ethics Committee of the University of the Western Cape (BM 16 /5/16).

Consent to access dental records of patients was obtained from the dentists. The research was undertaken in a manner that ensured anonymity and confidentiality of both the dentist and patient. The dentists were given the right to withdraw from the study at any time.

4.9 Funding

No funding was needed to perform this study.

The primary researcher carried the administrative cost incurred during the research.

CHAPTER 5

RESULTS

The overall response rate was 22.7% (34 out of 150 dentists). All the practitioners were in private general dental practices and most practiced in urban areas.

Figure 6 indicates the geographic distribution of the 34 dental practices in this study.

Table 2 describes the demographics of the 34 participants.

Table 2. Demographics of dentists in the study

		Frequency	Percentage %
Gender	Male	19	55.9
	Female	15	44.1
Age (mean=36.61)	25 - <35	16	47.06
	35 - <45	12	35.30
	45 - <55	3	8.82
	55 and above	3	8.82
Years since graduation	0 – 5 years	9	26.47
	6 – 10 years	9	26.47
	11 – 15 years	9	26.47
	16 – 20 years	4	11.76
	More than 20 years	3	8.83

The mean age of the participating dentists is 36.62 years. Most of the participants are between the ages of 25 and 45 and there are more males than females (55.9% versus 44.1%) who participated.

The majority of the dentists practised between 6 years and 15 years. Three of the dentists are 55 years and older, and have been practicing for 20 years and more.

Four of the dentists were recent graduates (qualified between one and two years).

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Figure 6. Geographic distribution of dental practices in this study

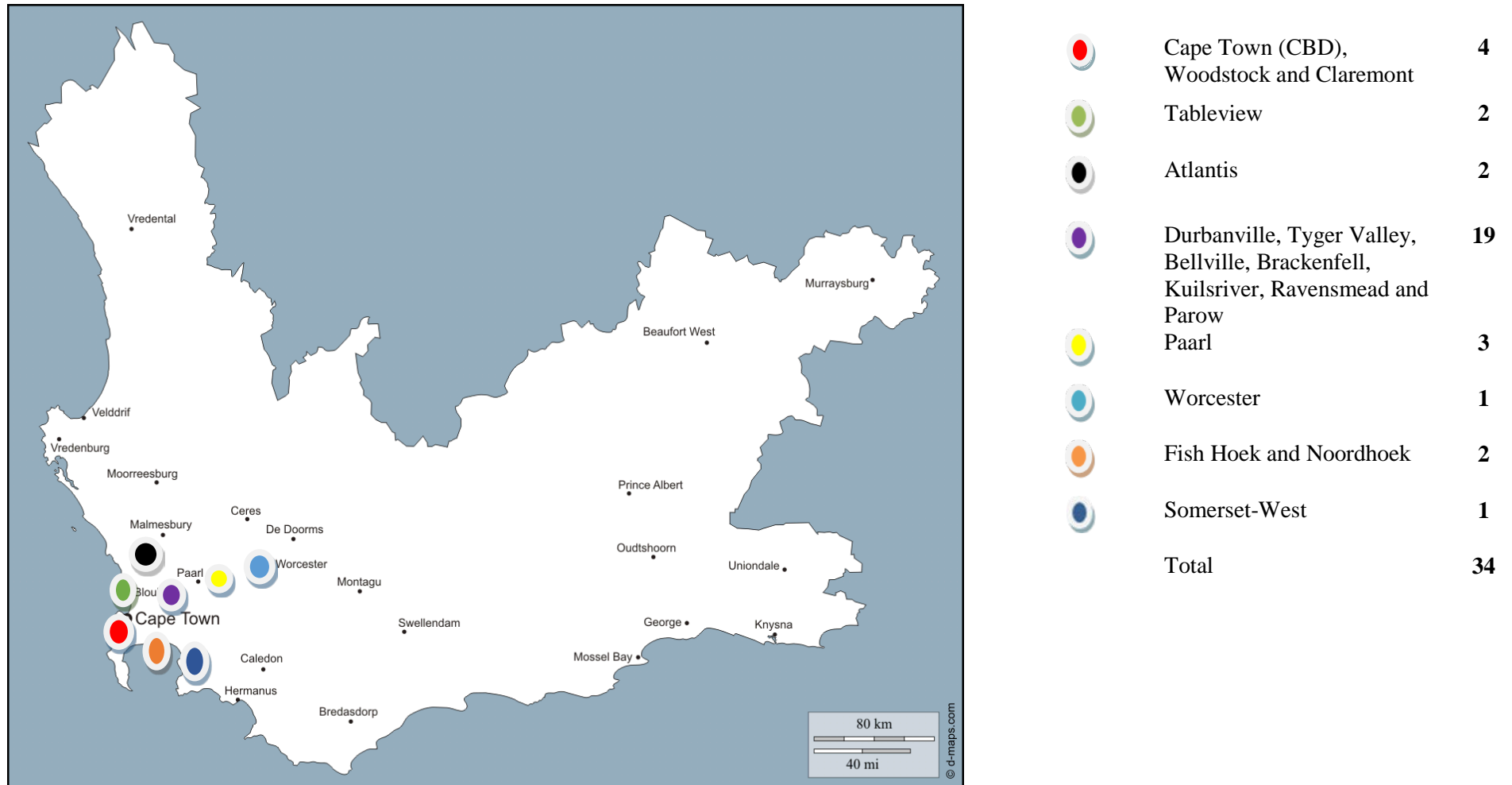|		
🔴	Cape Town (CBD), Woodstock and Claremont	**4**
🟢	Tableview	**2**
⚫	Atlantis	**2**
🟣	Durbanville, Tyger Valley, Bellville, Brackenfell, Kuilsriver, Ravensmead and Parow	**19**
🟡	Paarl	**3**
🔵	Worcester	**1**
🟠	Fish Hoek and Noordhoek	**2**
🔵	Somerset-West	**1**
	Total	**34**

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Table 3 shows the results of the assessment of the dentists' response to seven possible applications of forensic odontology assessed during the researcher-administered questionnaire.

Table 3. Assessing knowledge and awareness concerning forensic odontology

	Total dentists 34	Percentage %	95% CI
Identification of victims of mass disaster	34	100	89.7-100.0
Personal victim identification	34	100	89.7-100.0
Personal victim identification by DNA extracted from teeth	0	0	*
Age estimation	11	32.4	17.4-50.5
Bite mark analysis	9	26.5	12.9-44.4
Child abuse	1	2.9	0.1—15.3
Medico-legal	13	38.2	22.2-56.4
Mean number of correct answers out of a score of 7 = **3**			

*CI cannot be calculated

The mean for total correct answers out of 7 correct answers = **3**

All 34 dentists (100%) were aware that forensic odontology can be applied in victim identification in mass disasters and personal victim identification. Almost 38% of dentists identified the use of forensic odontology in medico-legal cases, while only 26.5% identified bite mark analysis as valuable forensic evidence.

None of the dentists identified DNA extracted from teeth as a possible means to aid in human identification and only 2.9% knew that forensic odontology could be applied in child abuse cases.

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Age estimation using dental evidence (radiographs and eruption charts) was identified by 32.4% of participants.

Figure 7 demonstrates the exposure of dentists at under-graduate, post-graduate, through CPDs, reading of dental journals and previous requests to provide dental records for victim identification.

Figure 7. Assessing previous exposure to forensic dentistry
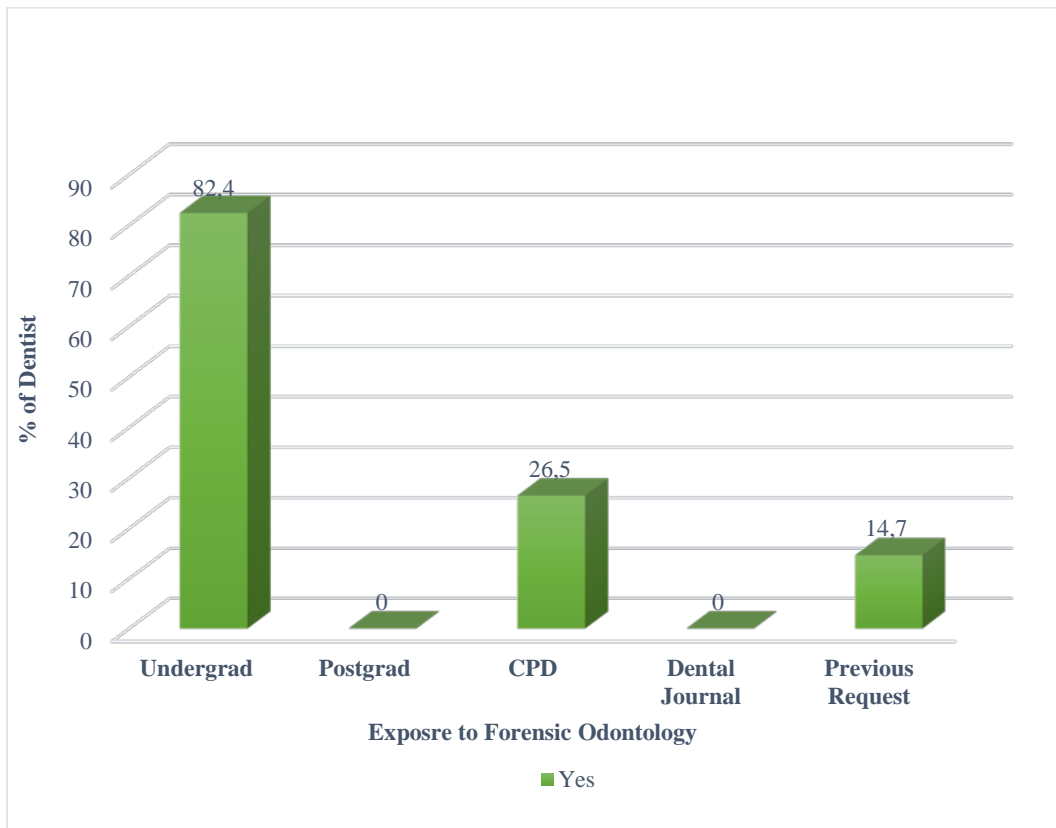
A significant number of the dentists reported exposure to forensic odontology at under-graduate level (82.4%), while 26.5% reported to have attended CPD's where forensically related topics were discussed. None of the dentists indicates exposure at a post-graduate level or having read forensic journals to update their knowledge on forensic odontology. The dentists who had under-graduate exposure did better in the knowledge and awareness component of the questionnaire compared to the recent graduates who had no under-graduate exposure.

Five of the dentists (14.7%) report having had previous request to supply dental records for forensic purposes. One request was for the identification of a victim of a car crash who burned

beyond visual recognition. The victim was identified through a chrome-cobalt partial denture constructed by his dentist. Other requests were for burned and missing victims and one request for a victim of drowning.

Figure 8 displays the response of dentists on how they rate the value of their dental records for forensic identification purposes.

Figure 8. Assessing perceived forensic value of dental records
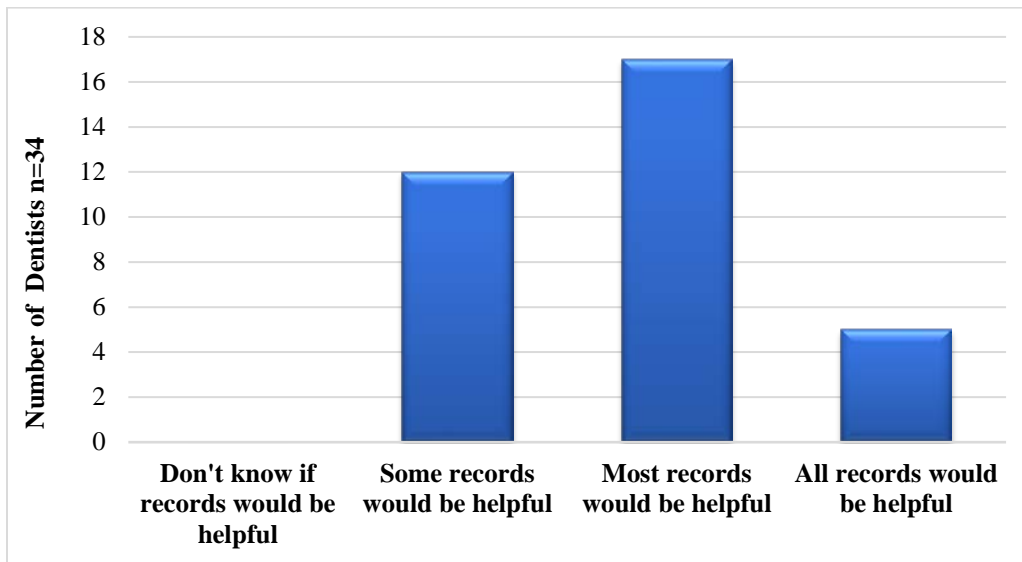
Half of the practitioners indicated that most of their records would be helpful in forensic identification while 35.3% indicated some of their records would be helpful. 14.7% indicated all records would be helpful.

The dentists who reported that most or all of their records would be helpful in the victim identification process were those who made use of written notes and odontograms.

Dentists who used dental codes felt that some of their records would be helpful.

None of the participants believed that their records would not be helpful.

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Figure 9 reports on barriers dentists perceive for not maintaining complete and adequate dental records.

Figure 9. Determining barriers to keeping accurate and complete dental records
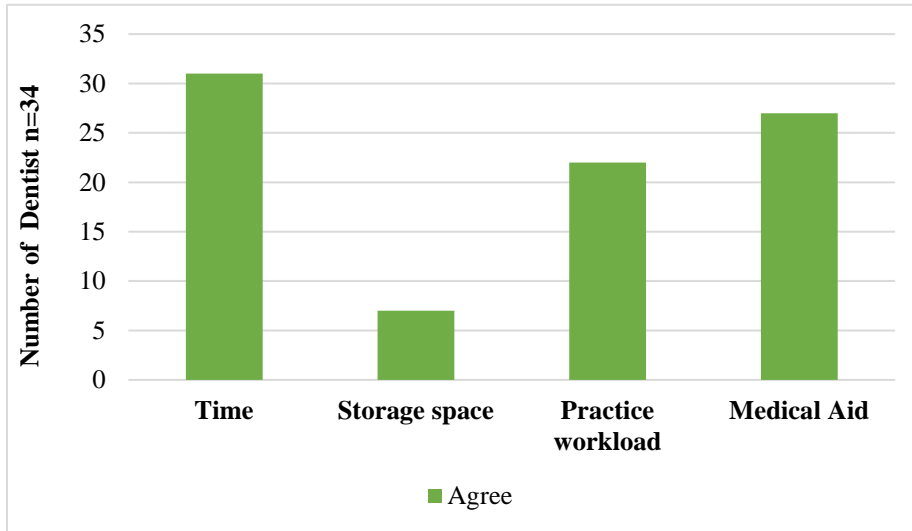
Most dentists felt that lack of time between consultations and increased practice workload are barriers to optimal dental record keeping. Restrictions by some private medical schemes on the number of radiographs that can be taken per patient was also reported to be a barrier.

Only 17.6% saw storage space as a barrier. Most dentists had enough storage space and dental records are filed either in cabinets in a separate room or cupboards in the dental office.

Table 4 demonstrates the frequency of pre-printed forms versus computerized dental records in 340 dental records studied. Most dentists employ pre-printed forms for recording dental case notes (97.1%). The pre-printed forms are kept in files, stored in cabinets in alphabetical order, compared to computerized record keeping (2.9%). Only one of the dentists used a computerized record keeping system (Exact Dental Software).

Table 4. Pre-printed forms vs Computerized Dental Record Keeping

	Frequency	Percentage
Pre-printed	330	97.1
Computerised	10	2.9

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Figure 10 shows the accuracy and completeness of the dental record by noting the presence or absence of relevant patient information. This information is valuable in the identification process and is also prescribed by the HPCSA's record keeping guidelines.

Figure 10. Assessing accuracy and completeness of dental records for forensic purposes
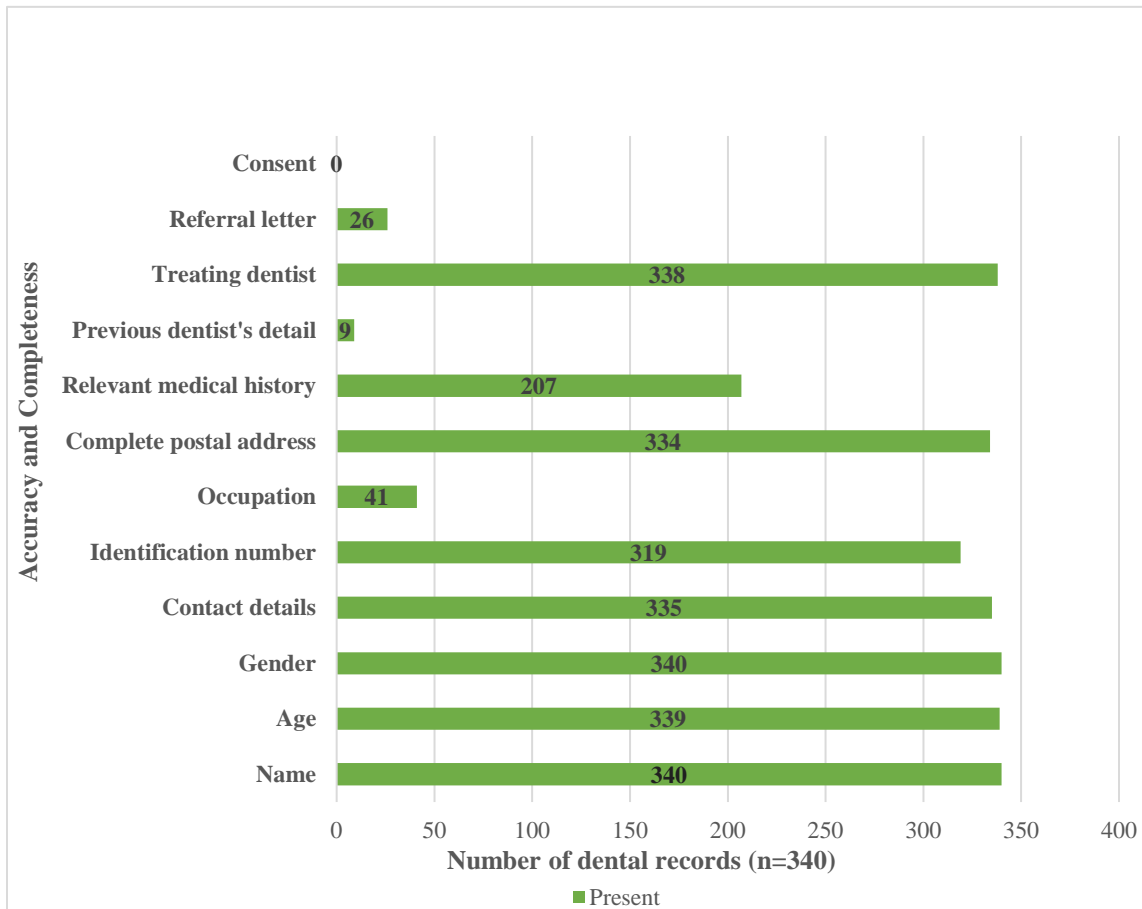
The name of the patient (100%), age (99.7%), gender (100%), identification number (93.8%), address (98.2%) and contact details (98.5%) were recorded at very high levels. Medical history was recorded at 60.9%, while the occupation of patients was recorded in only 12.1% of cases. The name of the treating dentist was present at high levels (99.4%); however, details of previous dentists are only noted in 2.6% cases and referral letters to specialists only present in 7.6% of cases. Consent to treatment by the patient was significantly absent in 100% of cases.

Figure 11 displays the presence or absence of data, which when present; contribute to a high success rate of identification.

Figure 11. Assessing forensic valuable dental items in dental records
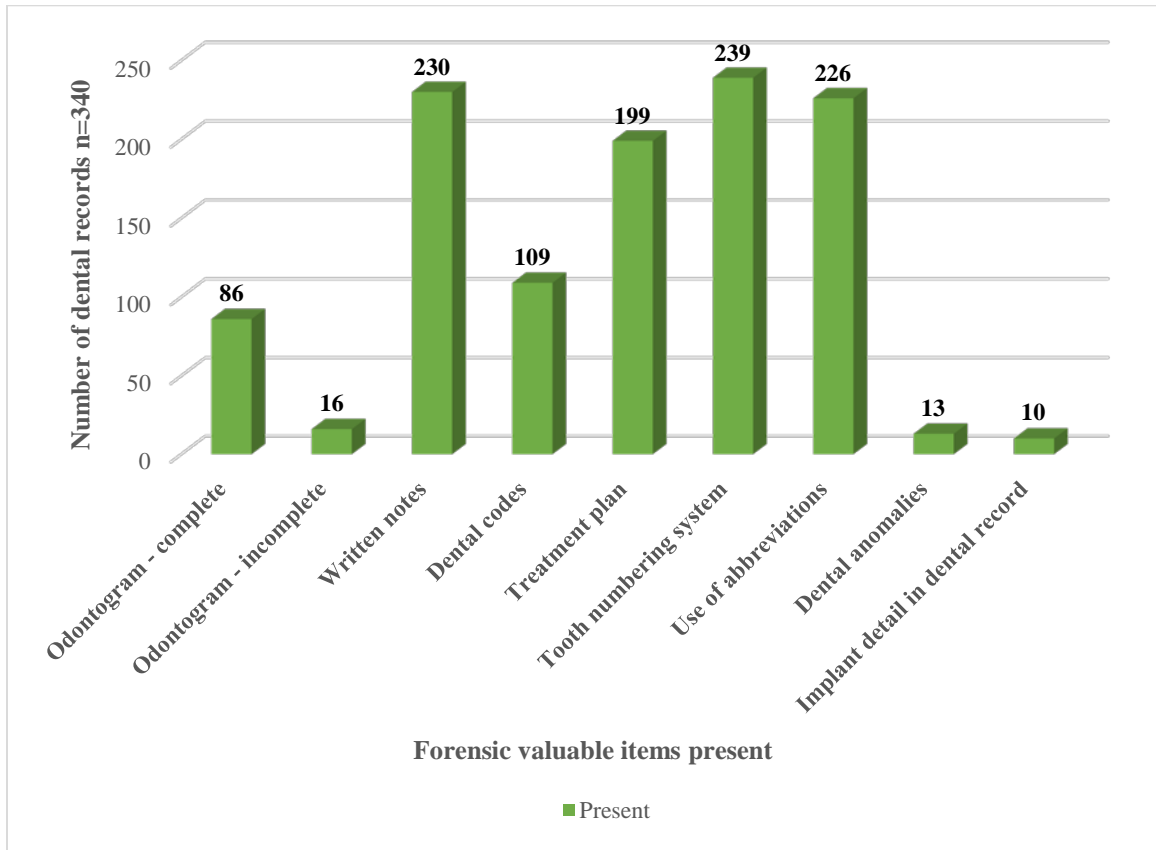
Complete odontograms (dental charts) were present in 86 dental files (25.3%), while incomplete odontograms were present in 16 files (4.7%) and written notes in 230 (67.6%) files. The use of dental codes only was present in 109 files (32.1%).

A treatment plan describing current and future treatment(s) was absent in 141 files (41.5%). Most dentists (70%) used the FDI tooth numbering system. Abbreviations were noted in 66.5% of the dental files. The presence of dental anomalies e.g. presence of diastema, tori or dilacerated roots were recorded at low levels. Inscriptions such as the presence of tori, dilacerated roots and supernumerary teeth were noted in only thirteen of the dental records.

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Denture identification (denture markings) were absent in all the records analysed. Implant detail (e.g. manufacturer and brand name, width and length, as well as serial number) was noted in the dental records of all 10 patients who underwent implant treatment.

Twenty-three of the participants (67.6%) indicated they use intra- and extra-oral dental photography, especially of patients undergoing orthodontic treatment and cosmetic dental work.

Study models (dental casts) are retained for less than 3 years in 61.8% of cases. However, 38.2 % of dentists reported to keep study models for 5 years and longer.

Table 5 compares the use of digital radiography to analogue radiography in the 34 dental practices in this study.

Table 5. Digital vs. Analogue (Automated) Radiographic Imaging

	Digital	**Analogue**
Present	307	50
Absent	33	290
Total	340	340
Percentage %	**90.3**	**14.7**

Digital radiographic imaging is used in most practices (90.3%). Automated/Analogue radiographs are present in a minority of dental files (14.7%). Some dental records contained a combination of automated and digital radiographs. This was especially noted in older practices where dentists switched from analogue (automated) to digital radiography. Access to digital radiographs is password controlled and backups are made daily.

The name of the patient and date on which radiograph was taken were recorded at high frequencies. In nine (9) of the dental records the patient's name and date when radiograph was taken were absent. The radiograph(s) was stapled either to the patient's case notes or loose lying within brown envelopes in the dental file. The absence of radiographs in 57 of the dental files can be attributed to mostly cases where patients were treated with complete upper and lower dentures.

Figure 12 demonstrates the different types and quantity of radiographic imaging present in the 340 dental records examined.

Figure 12. Type and quantity of radiograph present in 340 dental records examined
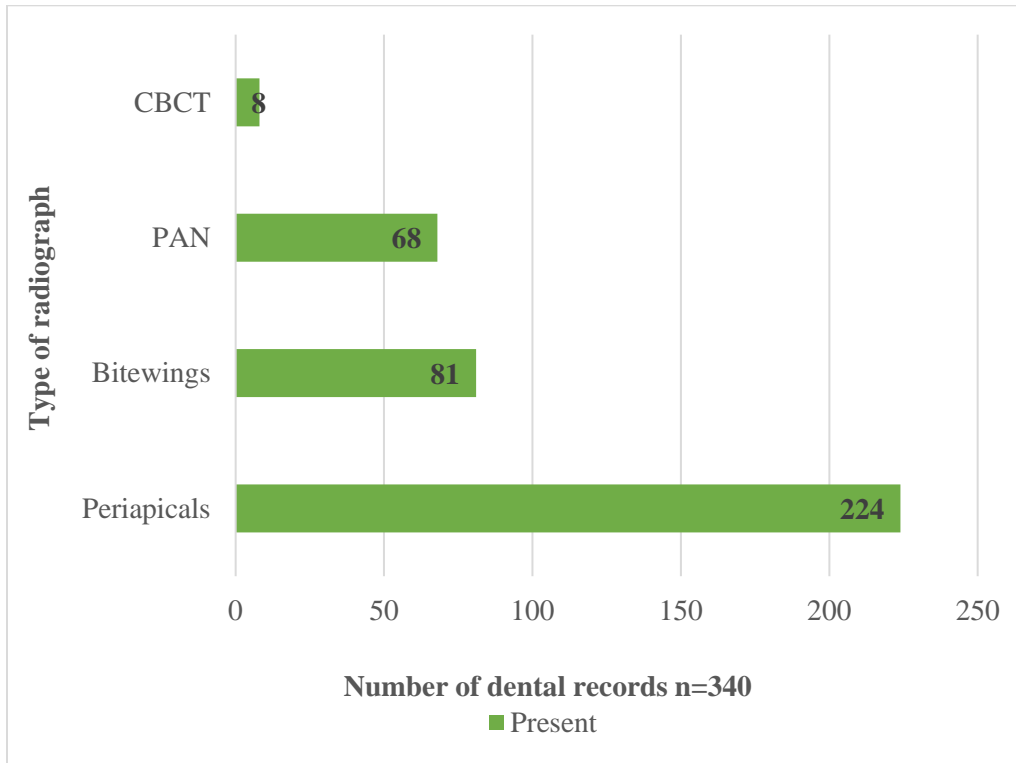
Periapical radiographs were present in 224 (65.9%) of dental records while bitewing radiographs were present in 81 dental records (23.8%). Orthopantomography (OPGs) were present in 68 (20%) and Cone Beam Computerized Tomography (CBCT) in 8 (2.4%) dental records respectively.

Bitewing and OPGs were present in especially in dental records of children undergoing orthodontic treatment. Ten dental records contained a history of implant placement. CBCTs were present in all the patients who underwent dental implant treatment.

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Table 6 shows the response to the question regarding the retention of dental records, compared to the period stipulated by the HPCSA.

Table 6. Retention of dental records**.**

Retention of dental records	Total of dentists	Percentage %
0 - 5 years	22	64.7
6 - 9 years	7	20.6
10 and more years	5	14.7

Most dentists (64.7 %) indicated that records should be retained for between 0 – 5 years, about 20.6% indicated between 6 - 9 years and 14.7% indicated that dental records should be retained for 10 years and more.

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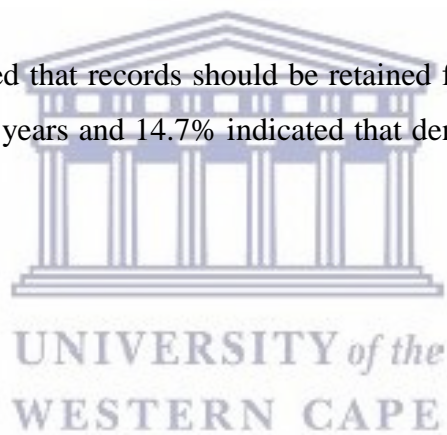
CHAPTER 6

6.1 DISCUSSION

Dental comparison is used in the identification of victims of mass disasters, victims of crime and man-made disasters, where biometric data is unavailable. Proper dental identification however necessitates complete and accurate dental records. The aim of this study was to assess whether a sample of dentists in the greater Cape Town maintained detailed and comprehensive dental records for possible forensic use. In addition to the completeness of records, knowledge and awareness on forensic odontology were also assessed.

The results from the researcher-administered questionnaire conclude that most dentists in this study have a reasonable awareness and knowledge of forensic dentistry. This can be attributed to the fact that a majority of dentists reported to have had exposure to Forensic Odontology at an under-graduate level, while some indicated Continuous Professional Development (CPD) courses where forensic odontology was discussed. Interestingly, none of the dentists has post-graduate exposure or read scientific journals on forensic odontology. Compared to Al-Azri *et al*. (2016) study, reporting more than 50% of Australian dentists attended CPD courses on Forensic Odontology and almost 30% have had post-graduate exposure. Shetty and Raviprakash (2011) reported that 50% of participants in their Indian study indicated scientific journals to be their main source of information. The researcher-administered questionnaire however shows that most dentists failed to indicate the use of forensic odontology in child abuse and medico-legal cases. This is of great concern as dentists confronted with a possible child abuse case may not recognize signs of abuse, or worse, fail to report these incidences to the necessary authorities.

Regarding the perceived forensic value of their dental records, half of the dentists (50%) in this study felt that most of their records would be helpful in victim identification, while a few (14.7%) indicated all their records would be helpful. A comparative study by Osborne *et al*. (2000) revealed that 85% of Minnesota's dentists felt that their record keeping would be helpful. The results may be an indication that the dentists in the Cape Town do not have very high expectations of the forensic value of their dental records.

Success of the dental identification process is enhanced when dental records contain detailed inscriptions of the diagnosis, treatment plan, radiographic images and description of dental hard

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tissue anomalies (Stow *et al*., 2016). In this study most of dental records examined contained comprehensive patient data and treatment details. The patient's name, gender, identification number, address, medical history and name of the treating dentists were recorded at high frequencies (see Figure 9). Although not all dental records contained an odontogram most dentists in this study use written notes in association with dental codes (see figure 10). In cases of written notes the inscriptions were legible and detailed. The number of odontograms (dental charts) are however concerning, with only 30% of case files containing odontograms, some being incomplete and not updated regularly with each visit (see figure 13). This study shows that dentists practicing in lower income areas (as stipulated in the City of Cape Town Socio-Economic Profile, 2016) tend to use mostly dental codes and take less intra-oral radiographs compared to their colleagues practicing in higher income areas. Patients residing in lower income areas do not necessarily have access to private health care and dental treatment costs are mostly covered by the patient. This may be a possible reason for the lack of radiographs in dental records. Accessibility to dental records is ensured as most dentists employ pre-printed forms to record dental and dental records are stored alphabetically in a filing cabinet or a separate filing room. A comparative study by Dierickx *et al*. (2006) showed that most Belgium dentists used a digital record keeping system, ensuring accessibility to records indefinitely. The same study also showed that young male dentists practicing in larger cities maintained their files better than older males and females and that less completed files were found with the increasing age of the practitioner. This study however showed no significant difference between the record keeping practices of young and older dentists or between male or female dentists.

Proper descriptions of dental anomalies (e.g. rotated or supernumerary teeth, cusp of Carrabelli etc.) and hard tissue abnormalities (e.g. attrition on teeth, bone loss etc.) increases the forensic value of the dental record. This study found that these features are recorded at low frequencies, similar to the Australian study by Al-Azari *et al.* (2016*)*.

Comparing intra-oral and extra-oral photography with post-mortem evidence are very helpful in the victim identification process. Sixty-seven percent of dentists in this study made use of digital extra and intra-oral photography, mostly present in cosmetic dental cases and in young children undergoing orthodontic treatment.

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Figure 13 shows an example of a detailed and comprehensive dental record comprising a completed odontogram with written notes from one of the patients' records assessed in this study. *(The information shown is used with consent of the dentist. For confidentiality reasons, the patient's details are deleted)*

Comparison of ante-mortem and post-mortem dental radiographs are extremely valuable in the identification process. This study found that most of the dental practices in this study employ digital radiology, with only one practice still using automated radiographs. Most of the dental records contained good quality radiographs (tooth number is specified, date when radiograph was taken and patient's name in case of automated radiographs) that can be used in forensic victim identification. Periapical radiographs are present in most of the case notes investigated in this study, while bitewing radiographs and orthopantomograms (OPGS) are present in dental records

of mostly children and young adults. This contrasts with the dental records examined in the Thailand tsunami where most of records lacked radiographs, hampering the victim identification process. Bite wings and OPGs are extremely helpful in the identification and chronological age estimation of young children, especially those in the mixed dentition stage.

Oral rehabilitation using dental implants are increasingly used in dental practices. It can be assumed that in a mass disaster, several victims could have one or more dental implants. The dental files examined in this study show inscriptions of the implant manufacturer, brand and serial number in all the case notes with implant rehabilitation, accompanied with a CBCT or orthopantomogram (figure 14 shows an example of such a case note). Dental implants have high physical properties and are resistant to thermal insult, however lacks specific uniqueness, limiting its use identification. Dental implant recognition is widely used in forensic odontology. An increasing number of patients are treated with dental implants, with more than 460 different implant systems worldwide (Berketa *et al.*, 2014). The authors proposed that dental implant manufactures should insert serial numbers on each implant that is patient specific. This serial number, implant brand and manufacturers details should be entered in the patients' dental record. Nuzzolese *et al.* (2008) advocated the use of Implant Recognition software (IRS) to aid in the identification process. The IRS works on the principle of identifying the manufactures and implant design by radiographic recognition.

Figure 14. Implant description in a patients' record examined in this study (Used with permission of the dentist). The information in the dental record shows the date when dental implants were placed (blue) 25.11.15, the implant details e.g. manufacturer details (AnyRidge ®) (yellow) and LOT (batch) number, length and width as well as the serial number (SN) (green).

An important aspect of forensic odontology is denture markings, especially in the identification process of partial or fully edentulous victims. Recovery of the dental prosthesis containing a denture marking may assist with identification of the victim, especially in severely decomposed or fragmented skeletal remains, or where the body is incinerated and the dental prosthesis (chrome-cobalt) is still intact. Of great concern is that only a few records in this study contained denture prescriptions and none of the dentists uses a denture identification system.

Almost all the dentists in this study use abbreviations and the FDI tooth numbering system in their records. Tooth numbering systems vary worldwide as seen in the Helderberg Air Disaster in 1987 and Thailand tsunami in 2004. During the identification process in the Helderberg Air Disaster, Lighthelm (1994) found that the variation in record-keeping practices and abbreviations used in different countries posed a major problem. The author emphasized the need for international standardization of dental charting.

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6.2 CONCLUSIONS

The initial response to participate in this study was sub-optimal (2.7%). A personal approach (dental practice visits and explaining the purpose of research to the practitioners) increased the response rate to 22%.

This study concludes that most dental records kept by Cape Town dentists are near to optimal and will be helpful during forensic odontology investigations. Contrary to what was found in the literature, most of the records examined in this study are found to be forensically adequate, containing comprehensive patient details, written notes, odontograms and digital radiographs. Some shortcomings however do exist e.g. incomplete odontograms, lack of notation of dental anomalies and hard tissue descriptions, compromising the accuracy and forensic value of the dental records. Access to records is ensured due to most dentists storing dental records in filing cabinets.

Exposure to Forensic dentistry at an under-graduate may have contributed to dentists keeping better records. Dentists who qualified after Forensic Dentistry Module was phased out of the under-graduate university curriculum however did not do as well in the knowledge and awareness questions compared to those who had been exposed at an under-graduate level.

The dental practitioners in this study seem to follow most of the Health Professional Council of South Africa guidelines however, important aspects e.g. informed consent by the patient and a complete medical history are a missing in most of records examined. An alarmingly sixty-four percent of dentists did not know that dental records should be retained for 6 years or more. Regards to the medico-legal aspect of forensic odontology, patients are more aware of their legal rights and an increase in medico-legal/malpractice suits are seen worldwide. Incomplete and inaccurate dental records may render the practitioner unable to defend himself/herself in the case of a malpractice suit. The results found may question whether dentists are familiar with all the prescribed HPCSA guidelines, as well as the medico-legal value of their dental records.

The study sample was small due to most dentists' unwillingness to participate in the research project. Dentists who refused to participate might arguably be those who do not keep adequate dental records and not want their records scrutinized. The findings of this study therefore should not be extrapolated to the general dental population.

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To the author's knowledge this study is the first in South Africa that assesses forensic knowledge and dental record adequacy for forensic purposes of records of a sample of private general dental practitioners. The author hopes that the results of this study can contribute towards future comprehensive studies to determine the forensic value of dental records kept by undergraduate dental students, private practitioners and dental specialists.

6.3 RECOMMENDATIONS

    i.   Forensic Odontology should be re-introduced as a module in the undergraduate dental curriculum.

    ii.   Continuous Professional Development (CPD) courses specific to the field of Forensic Odontology should be offered to increase awareness and knowledge as well as good record keeping practices regards to forensic odontology and to make dentists aware of the medico-legal value of their dental records.

    iii.   The HPCSA guidelines on dental record keeping should be revised so that the guidelines are dentistry specific and addresses forensic needs.

    iv.   Dental charting should be made mandatory.

    v.   Legislation making denture labelling mandatory should be implemented.

    vi.   Regular audits and quality checks of dental practices by the Health Professional Council and Private Medical Schemes should be implemented to ensure adherence to record keeping guidelines and best clinical practice.

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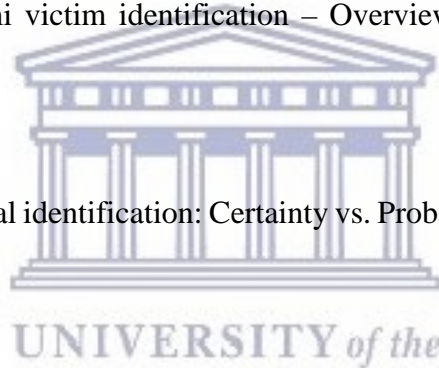
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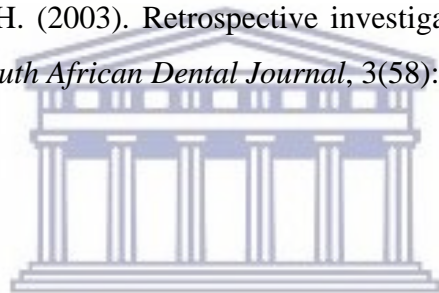
Dentists' Socio-demographics

Gender: Male or Female

Age:

Years since graduation:

1. **Assessing knowledge and awareness of forensic odontology.**

The participants will be asked on the applications of forensic odontology. The primary researcher will tick the appropriate answer(s) and will score the participant out of a total of 7.

1. Identification of victims of mass disasters
2. Personal victim identification by dental comparison
3. Personal victim identification by DNA extracted from teeth
4. Age estimation
5. Child abuse
6. Bite mark analysis
7. Medico-legal

Score: / 7

2. **Exposure to forensic odontology.**

The primary researcher will tick the appropriate answer.

- At undergraduate level?   Yes   or   No

- At post-graduate level?   Yes   or   No

- Through Continuous Professional Development (CPD)?   Yes   or   No

- Journals of Forensic Odontology   Yes   or   No

- Previous request to provide dental records for forensic odontology?   Yes   or   No

3. **Perception of the forensic value of dental records.**

The primary researcher will tick the appropriate answer.

- Do not know if records would be helpful

- Some records would be helpful

- Most records would be helpful

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- All records would be helpful

4. Perceived barriers to keeping accurate and complete dental records.

The primary researcher will tick the appropriate responds.

Lack of time: Agree   or   Disagree

Lack of storage space: Agree   or   Disagree

Increased workload in practice: Agree   or   Disagree

Restrictions by Medical Aids: Agree   or   Disagree

5. How long does the HPCSA require you to retain your dental records?

Answer: years

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Record maintenance:

- Pre-printed forms   Yes   or   No
- Electronic   Yes   or   No

The researcher will note the *presence or absence* of following detail in the patient's dental record:

Personal details

- Name   Present   or   Absent
- Age   Present   or   Absent
- Gender   Present   or   Absent
- Contact details   Present   or   Absent
- Identification number   Present   or   Absent
- Occupation   Present   or   Absent
- Complete Postal Address   Present   or   Absent
- Relevant medical history, medications and medical practitioners' details.
  Present   or   Absent
- Previous dentist's details.   Present   or   Absent
- Referral letter or Specialist consultation letter etc.   Present or   Absent

Dental information:

- Odontogram or Written notes: Present   or   Absent
- Proposed treatment plan: Present   or   Absent
- Tooth numbering system used: FDI   or   Other
- Use of abbreviations   Present   or   Absent
- Noting dental anomalies (diastema, rotated teeth, etc.) and hard tissue abnormalities (tori etc).
  Present   or   Absent

Radiographs: (tick the appropriate)

- Digital or Analogue (Automated)?

Type:

- Periapicals   Present   or   Absent
- Bitewings   Present   or   Absent
- Orthopantomogram (OPG)   Present   or   Absent
- Cone Beam Computer Tomography (CBCT) Present   or   Absent

Patient name and date on automated radiographs. Yes   or   No

Are radiographs kept in the patient's file?   Yes   or   No

Implant manufacturer's detail, serial number and implant brand noted in dental file?   Yes   or   No

Use denture markings or any denture identification system?   Yes   or   No

Duration study models / study casts are kept.   Answer: …   months

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Use extra-oral or intra-oral photographs of patients?   Yes   or   No

Storage:

Cabinet:

- Customized serial number or alphabetically according to surname?   Yes   or   No

Computerized:

- Password accessed?   Yes   or   No
- Are regular back-ups made on hard drive?   Yes   or   No

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