The Effective Accuracy of Dental Records in Forensic Dental Identification in Sudan

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Abstract

In Sudan there are currently no programmes targeting dentists to improve their own knowledge about how they can be part of human identification by keeping good dental records. In addition, no guidelines are stated by the health authorities about making, keeping and retention of dental records. The aim of this research was to assess the accuracy of dental records drawn up by the general dentists in Sudan with regard to forensic dental identification and compare these records to an ideal dental record. Dental records of 180 patients obtained from six sites (major dental sectors) were reviewed and compared with an ideal dental record. The data was captured in Excel and statistically analyzed.

The results showed that two third of the dentists do not undertake full tooth charting prior to treatment and sometimes this is not shown in their dental records; The dentist name who examined and treated the patient was clearly mentioned in 55.6% of the dental records examined. Dentists in Sudan do not request many radiographs but they depend mainly on intra oral periapical views (PV) and Orthopantomographs (OPG) with a fair to good quality. The medical history was recorded in 44% of the total number of records examined.

The quality of dental records in this study was poor in general dental practices but was fair in governmental hospitals. An integrated education programmes to increase the awareness of the dentists in Sudan about accurate record keeping is recommended. Clear guide lines from the health authorities for dental recording system should be developed.

Declaration

I, the undersigned, hereby declare that the work contained in this dissertation is my original work and that it has not been previously in its entirety or in part submitted at any university for a degree.

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WALEED PETRO

Dedication

This thesis is dedicated to my mother and father, to whom I am deeply and forever indebted for their love, support and encouragement in various ways without which it could not have been possible to complete this study.

My brothers and sisters, for their continuous encouragement given to me during the entire duration of my study.

My friends who encouraged me during my study period.

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LIST OF ABBREVIATIONS

FMH	Federal Ministry of Health
KS	Khartoum State
SPSS	Social package of statistical analyses
NHS	National Health Services
MHKS	Ministry of Health Khartoum State
USA	United States of America
UK	United Kingdom
OMF	Oral and Maxillo Facial
DNA	Deoxyribose Nucleic Acid
PV	Periapical view
OPG	Orthopantomograph
FDI	Federation Dentaire Internationale
CT	Computed tomography

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CHAPTER 1

INTRODUCTION

Sudan is a very big country situated in Africa and its capital is Khartoum situated at the confluence of the Blue Nile and White Nile. In terms of total area, Sudan is one of the largest African and Arab countries, covering 1.8 million sq km. The official language is Arabic.

With this very large surface area many dental services of good quality must be provided, and registration forms must be well documented to facilitate adequate dental treatment but also has implications in dental identification. Dental records (Antemortem records) are what are created every day in practice and can include radiographs, written notes and study casts.

Forensic Dentistry is that branch of dentistry that deals with examination of dental evidence and with the proper evaluation, and presentation of dental findings in the interest of law. (Dayal 1998). Forensic dental identification can be done using all aspects of dentistry and DNA, but it depends largely on the availability of accurate records. An ideal dental record makes identification easier for forensic dentists and also helps in providing good quality dental treatment.

A dental recording system in Sudan is still an optional choice in dental clinics and hospitals leading to the absence of a clear and mandatory system for dental registration and dental record keeping. Hence it is a developing country where little attention is given to dental record keeping. There are only a few guidelines that are provided by the health authorities to the clinics for dental recording; this requires a small amount of data about the patients such as the personal data, diagnosis and treatment.

The forensic dentist needs a proper dental recording system in order to get positive identification results in the attempt to identify decomposed individuals or victims of a mass disaster. Increased mortality rates due to accidents have introduced many challenges in identifying dead victims and a great need has emerged for forensic odontology science and services in Sudan.

CHAPTER 2

LITERATURE REVIEW

Forensic dentistry is concerned with the application of dentistry to solve issues in relation to the law. It is mainly oriented towards identification of humans in disaster situations (Charangowda, 2010). Forensic odontology also plays a role in identification of victims of crimes through dental records. One of its most important roles is the identifying deceased individuals in various stages of decomposition. This is highly dependent on the dental records of the victim before death; this is referred to as the ante mortem record. A post mortem dental record is complied from the autopsy and used to compare the characteristics of an individual (Pretty and Sweet, 2001). Forensic dentistry also plays a major role in the judicial setting that can be accepted by the law (Shekar and Reddy, 2009). The forensic team for identification consists of a forensic pathologist, forensic anthropologist, forensic odontologist, serologist, criminalist and other specialist if needed (Shekar and Reddy, 2009).

A general dental practitioner plays an important role in supplying ante mortem records to assist in the identification of an individual. The comparison between ante mortem and post mortem records is the tool of identification (American Board of Forensic Odontology, 1994).

A dental record is an official document of the history of illness, along with examination, diagnosis, treatment and management of an individual. It is compulsory for a dentist to produce an individual file of dental records for each person. The dental practitioner must be aware of the importance of a dental record due to legal circumstances and the maintenance of an accurate record ensures a high quality of patient health care and service in addition to its provision of ongoing care for a patient. It is also critical in the event of a malpractice insurance claim (American Dental Association, 2010) (Charangowda, 2010).

Clinical records are fundamental to the process of the delivery of dental care, contributing to the diagnosis, planning and correct sequencing of treatment. They need to be accurate and comprehensive (Jerge and Orlowski, 1985). They should give a clear picture of the progress of oral diseases and treatment. Additional to patient care, clinical records also fulfill medico legal and identification purposes (Morgan 2001), it is essential that the information must be kept as clear as possible, and it is important to register the date of entry of any additional new information and sign it. No abbreviated information must be contained within the records. In multiple procedures involving more than one dentist, each procedure carried out by the individual dentist must be registered clearly in the record, along with the date, either handwritten in ink or computer printed. It is essential that the record is easily accessed and read (Collins, 1996). The notes should contain personal data, dental history along with precise clinical examination and accurate charting, differential or definitive diagnosis, treatment planning, informed consent, medical history revealing any sort of systemic disease, cardiac disorders, family medical history, pregnancy, medical treatment and physical and emotional tolerance for procedures (Collins, 1996) (Morgan, 2001) (Yadav and Singh, 2011).

Primary purpose of maintaining dental records is to be able to provide high quality care and follow up. They can also be beneficial in forensic purposes as well as help in teaching and research, in addition to its benefit in legal matters (Charangowda, 2010).

Kolude (2010) suggested that a dental record can be categorized according to its quality into five grades: Grade zero: no information, Grade one: information without written records, Grade two: written records only, Grade three: records combined without radiographs, Grade four: records combined with bite-wings, Grade five: records with full tooth charting and radiographs. The quality of dental records for the purposes of identification vary from inadequate to extremely useful; this was the conclusion after a study held in USA to assess the usefulness of dental charting in forensic dental identification. Their findings was that 56% of the dentists included in the study felt that full tooth chartings and written notes are extremely useful in dental identification (Delattre and Stimson, 1999).

Regarding the maintenance of dental records, the use of electronic records is superior in maintaining dental records. Many dental clinics use the traditional paper charts, labeled with the following information; patient's surname, first name and middle name. Then the files are arranged in a manner for easy accessibility such as in a lateral, open-shelf filing system (Charangowda, 2010). Regardless of the activity of the record, it must be maintained carefully not to be lost, damaged or destroyed (American Dental Association, 2010). Dental records aid in assessing the quality of care provided to the patient. An accurate and complete record gives information to another healthcare provider without prior knowledge of the patient's dental experience, it also aids in providing information to the legal authorities that will help in the identification of a dead or a missing person. Thus the most important element to be supplied by a general practitioner to a forensic odontologist is the ante mortem records (Platt and Yewe-Dyer, 1995) (Morgan, 2001).

Dental record discrepancies can complicate treatment and identification. An unexplained discrepancy is when the tooth is mentioned to have been extracted in ante-mortem records and is present in postmortem records or the change in the extent or size of a restoration (Shekar and Reddy 2009).

According to the NHS (National Health Services) in the UK, a full period of two years is essential for keeping the dental records. It also states that the records, photographic and radiographic images, along with the study casts should be kept after finalizing any course of treatment. Its suggested that treatment records, radiographic images, study casts and any additional information is to be kept for a maximum of 11 years after finalizing the treatment. The record of a child must be retained for to 25 years where appropriate. Regarding orthodontic models, only the pre and post treatment models need to be retained for a period of 5 years. It is not necessary to retain records of any intermediate stages (Charangowda, 2010).

Microfilm and microfiche maybe the tools for preserving the dental record, along with either a records storage service or scanned for electronic storage in computers. It is more advantageous to store records electronically as they occupy less space than paper records. In some cases, diagnostic and treatment casts may be photographed for storage purposes. Dental practitioners should consult their attorney, prior to converting the records to any of the methods mentioned (Charangowda, 2010).

Important and valuable information may be provided by an accurate dental history that can be beneficial to the dentist before initiating the appropriate treatment. Health histories are mandatory to be taken initially and updated when necessary, thus maintaining the current health histories of patients. This provides an initial point for the dental team to be able to fulfill its professional obligations (American Dental Association, 2010).

Hinchliffe (2011) studied the problems that hamper dental identification such as no international system for charting and terminology, the quality of radiographs and / or inaccurate records. To overcome such problems, standardization of registration forms was suggested. Delattre (2007) mentioned in his study conducted in the USA that most dental records acquired from the dental clinics for dental identification are not returned to the dental clinics and are kept by the investigating agencies.

The legal aspects must be strictly regarded when giving access of dental records to a forensic dentist; firstly patient privacy and secondly the dentist's protection when releasing patient records. The dentist from whom the record is obtained should be in contact with the forensic dentist to explain any discrepancy in the records (Delattre, 2007).

Since the early days, the identification of human remains has been a matter of concern to civilized nations. Death from natural causes or due to criminal activities has always created the problem of identifying the victims for compassionate or for judicial purposes (Deadman, 1964). Each and every human being has certain characteristics and these identity characteristics must be known and recorded for postmortem identification and the issuing of a death certificate (Shekar and Reddy, 2009).

Dental identification aids in identification of individuals who are visually unrecognizable or in the absence of fingerprints due to disastrous accidents (Pretty and Sweet, 2001). When bodies are completely decomposed, the methods of dental identification are used because dental tissues are able to withstand prolonged decomposition as well as high degrees of temperature, humidity and pressure. (Fereira *et al* 2008; Nedel *et al* 2009).

The dental identification of large numbers of individuals in mass disasters is hazardous both physically and emotionally. It poses the same requirements of routine comparative dental identification, but problems are more focused and much larger. Many confounding factors exist in the identification process. But the most important determinant of success is preparedness (Kolude, 2010).

Luntz L and Luntz P (1972) presented a case from 1775 about two friends Dr. Paul Revere who made a fixed bridge for his friend Dr. Joseph Warren. When his friend Joseph was killed in the battle of Bunker Hill, his body was buried in a mass grave by the British army. One year after the withdrawal of the army from Massachusetts, people there wished to give a proper burial to Dr. Joseph Warren. The decomposed body of Dr. Warren in the mass grave was identified by his friend Paul Revere through a fixed bridge. This is thought to be the first case of identification by a dentist (Shekar and Reddy, 2009). The bodies of Hitler and his mistress Eva Braun where identified by his dentist Dr. Kathe Hensrman using dental records (Shekar and Reddy, 2009). In another case reported by Shekar and Reddy (2009), General Zia-ul-haq (late president of Pakistan) died in a plane crash in 1988; he was identified by his dentition.

Certain criteria must kept in mind during examination of remains for identification; are these human remains and what can be obtained with regard to the age, sex and race (Deadman, 1964).

Ratnakar and Singaraju (2010) studied dental radiographs as means of identification and they found the crown and root morphology aided in identification, but a sufficient number of ante-mortem radiographs must be available to study accurate morphological and pathological alterations for identification purposes.

Phillips and Stuhlinger (2009) queried whether 12 concordant features as advocated by Keser Nelson are necessary for dental identification. Their research showed that only one accurate duplicate radiographic feature of a restoration was necessary for a positive identification. Several factors can limit the availability of comparable data among children. There is no clinical indication for dental radiography for children before the age of five and the normal maturational stages such as exfoliation of deciduous teeth and eruption of permanent teeth are not accurate enough. However this can aid in age estimation at death (Espelid *et al* 2003). Fridell and Ahlquist (2006) conducted a study in order to investigate the manual matching of radiographic images in children of different age groups without fillings. To see if radiographic expertise plays a role in radiographic comparison, they found that both dental practitioners and OMF (Oral and Maxillo Facial) radiologists are most likely to match bitewings images of children without fillings.

The frontal sinus, an extra oral image, is also beneficial as each person possesses a unique shape and size that can be used for identification (Fridell and Ahlquist, 2006). Computed tomography (CT) has advantages instead of plain films in comparison for dental identification. Computed tomography previews data in three dimensions, is metrically accurate and can simulate plain film radiograph. The disadvantage is the presence of metallic restorations that lead to artifact which in turn leads to difficulty in interpreting the images (Forrest, 2012).

In case of edentulous person Nuzzolese *et al* (2010) suggested that a micro-chip that contains personal information could help in identification; these microchips can be inserted inside the denture without interfering with any function of the denture. In this micro-chip medical and dental history can be stored to facilitate identification. The micro-chip is inserted parallel to the occlusal plane and covered with auto polymerizing acrylic resin.

Fixed dentures can be very useful in identification if during lab procedure the technician carves the initials of the patient on the lingual surface of each denture (Kamath and Kamath, 2005). They also suggested that a label in the denture by writing the name of the patient or hospital number in the label. It is easy and not expensive and aids in dental identification.

CHAPTER 3

AIM AND OBJECTIVES

3.1 Aim

The aim of the study was to assess the accuracy of dental records drawn up by the general dentists in Sudan with regard to forensic dental identification.

3.2 Objectives

1- To determine the quality of the dental records of Sudanese dentists compared to an ideal dental record form

2. To test the comprehensive accuracy of the average dental record for Identification purposes.

CHAPTER 4

METHODOLOGY

4.1 Introduction

This chapter presents the research design and methodology adopted in the study. The research method chosen was related to the aims and the objectives of study.

4.2 Study design

This study was a cross-sectional study**.**

4.3 Study site

This study took place in Khartoum State; by visiting major dental clinics, two governmental hospitals, two governmental clinics and two private dental centres.

An ideal dental record document was compiled and used as a comparison document.

4.4 Sample size

Dental records of 30 patients, at each of the six sites were reviewed and compared with a dental record modified from ideal dental record of the American Academy of Pediatric Dentistry (appendix 1).

The dental records of the 180 patients reviewed were randomly selected from the six sites by reviewing the active dental records given by the dental assistant.

4.5 Validity and reliability

The researcher was the only person involved in data collection, thereby ensuring standardization in the data collection.

4.6 Data analysis

Data was gathered, categorized and coded then entered into the computer. The data was captured in Excel. Basic descriptive statistics were done using the Excel environment.

4.7 Ethical considerations

The protocol was submitted to the Senate Research Ethics Committee of the University of Western Cape for ethical approval and permission to carry out the study was sought from the Ministry of Health Khartoum State (MHKS) (appendix 3).

The dental records of patients were used in this study. The permission of the Senior Dentist of each clinic was obtained to review these records. The names of the patients were kept confidential.

Data collection sheet: (Ideal Dental Record)

(Based on the dental record from the American Academy of Pediatric Dentistry, 2012)

Hospital / Clinic name: .....

File number: .....

Personal details of patient	
Name	☐
Address	☐
Telephone Number: Home/ Work	☐
Date of Birth	☐
Sex	☐
Occupation	☐
Employer	☐
Medical/Dental insurance fund	☐
Family/Next of kin	☐
Ethnic group	☐
Medical History	
Name of Doctor	☐
Address of Doctor	☐
Telephone number of Doctor	☐
Relevant Diseases, allergies and medications	☐
Radiographs	

	☐
Dental History	
Name of Dentist/s	☐
Address of Dentist	☐
Telephone number of Dentist	☐
Radiographs	☐
Odontogram of previous dental restorative work/ extractions	☐
Main Dental Complaint	
Date of first dental Consultation/ Examination	☐
Time of first Consultation	☐
Name of Dentist who examined patient	☐
Dental Examination Details	
Odontogram with details of previous restoration, caries and missing teeth etc..	☐
Dental radiographs (Pantomograph, periapical, bitewing, Occlusal plane)	☐
Date/s of radiograph/s	☐
Name of radiograph/s	☐
Quality of radiograph/s	☐
Oral hygiene status	☐
Dental Abnormalities	☐
Facial Abnormalities	☐
Relevant habits affecting teeth/jaws	☐
Treatment Plan Details	
Restorative Dentistry	☐
Prothetic Dentistry	☐
Maxilo-Facial / Oral surgery	☐
Orthodontic Dentistry	☐
Oral Medicine / Pathology	☐

Other Notes

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CHAPTER 5

RESULTS

The results of this study are presented as tables and graphs. One hundred and eighty (180) dental records were examined from six sites including two major governmental hospitals, two major governmental clinics and two private dental centers covering Khartoum state the capital of Sudan containing more than the half population of Sudan.

The records were drawn up by specialized dentists and general dental practitioners, These records were compared to an ideal dental record.

5.1 Complete dental charting prior to treatment

Complete dental charting was examined prior to treatment and the completeness thereof; it was found that (80.6 %) of dentists do not do the complete dental charting as shown in (Table 1).

Table (1): Complete dental charting prior to treatment

		Frequency	Percent
Complete dental charting presence	Present	35	19.4%
	Not present	145	80.6%
Complete dental charting completeness	complete	35	19.4%
	Not complete	145	80.6%
	Total	**180**	**100%**

The table 1 shows that dental charting was present in the dental records in 19.4% of the records examined. Of the 180 records 145 were incompletely filled out.

5.2 Name of the dentist who examined and treated the patient

As shown in (Table 2) (55.6%) of the dentists write their name and sign the record after examining and treating the patients while (44%) do not.

Table (2): Dentist Name who examined and treated the patient

	Frequency	Percent
Available	100	55.6%
Not available	80	44.4%
Total	**180**	**100%**

Table 2 shows 55.6% of the records examined had dentist name written on it

5.3 Radiograph type and quality

Dentists at all the examined sites use only two type of radiographs: intra oral periapical view (PV) and Orthopantomograph (OPG). These radiographs were found in fifty one dental records out of 180 records; (PV) was used more frequently and was found in 28 records while (OPG) was found in 14 as shown in (Table 3). The quality of the radiographs varied; 41 out of 51 radiograph examined were of good quality as shown in (Table 3).

Table (3): Radiograph type and quality

		Frequency
Radiograph type	PV	28
	OPG	14
	PV + OPG	9
	No radiographs	129
Radiograph quality	Good	41
	poor	10
	Not radiographs	129
Total		**180**

PV = periapical view, OPG= Orthopantomograph

The table 3 shows the types and quality of radiographs used by the dentists in this study.

5.4 Medical history of the patient

Of the 180 dental records examined 40 (22.2%) contained a medical history; 140 records had no medical history (Table 4)

Table (4): Medical history availability

	Frequency	Percent
Available	40	22.2%
Not available	140	77.8%
Total	**180**	**100%**

Table 4. Availability of medical history in patient record.

5.5 The presence of an odontogram in different dental clinics

Of all the clinics, 35(19.4%) out of 180 dental records contained an odontogram. In private clinics only 5 records contained an odontogram, while it was totally absent in governmental clinics, whereas the governmental hospitals records show that 30 out of 60(50%) records examined have full tooth charting system (Table 5).

Table (5): The Presence of odontogram in different clinics

	Present	Not present	Total
Private	5 (8.3%)	55(91.7%)	60(100%)
Governmental clinics	0	60(100.0%)	60(100%)
Governmental hospitals	30(50.0%)	30(50.0%)	60(100%)
Total	**35(19.4%)**	**145(80.6%)**	**180(100%)**

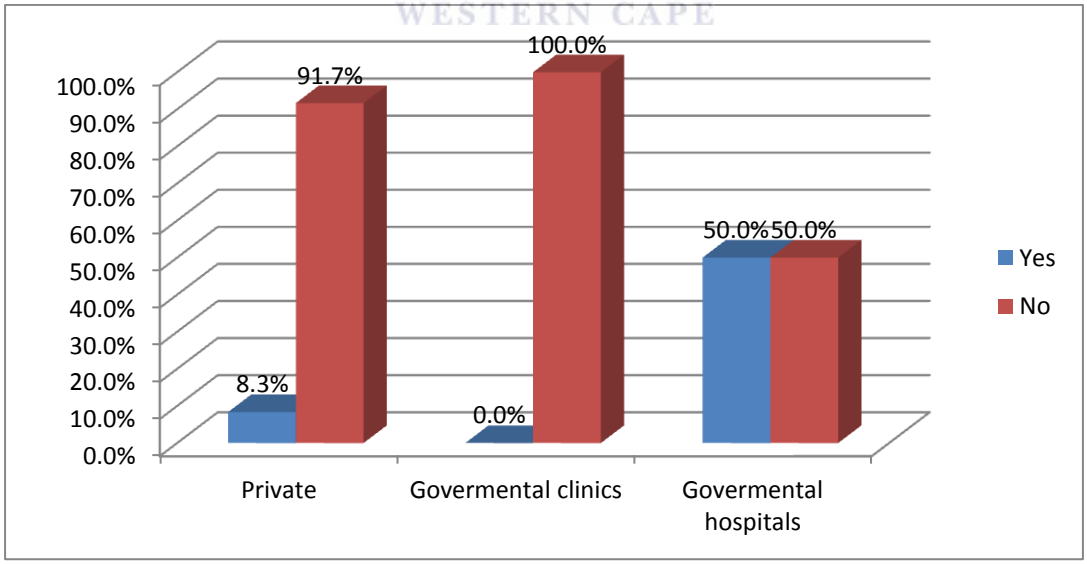

Figure (1): full tooth charting prior to treatment in private practice, governmental clinics and governmental hospitals.

5.6 The completion of the odontogram by the dentist in different dental clinics

A complete full tooth charting in private dental centers was present in 5 (8.3%) out of 60 records, It was absent in the governmental clinics records but was present in 30 (50%) of governmental hospitals. Of the total number of records examined a completed tooth charting was present in 35(19.4%) out of 180 records (Table 6).

Table (6): Full tooth charting completeness in different clinics

	Yes	No	Total
Private	5(8.3%)	55(91.7%)	60(100%)
Governmental clinics	0	60(100.0%)	60(100%)
Governmental hospitals	30(50.0%)	30(50.0%)	60(100%)
Total	**35(19.4%)**	**145(80.6%)**	**180(100%)**

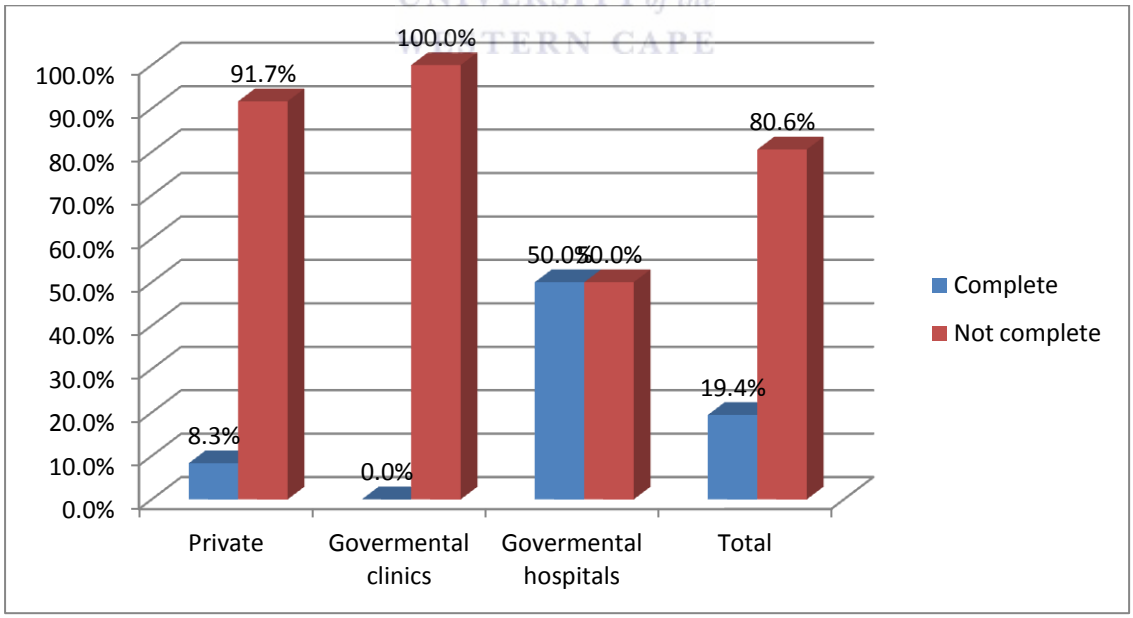

Figure (2): Tooth charting completeness in private practice, governmental clinics and governmental hospitals. (No odontogram was present in governmental clinics)

5.7 The recorded name of the dentist in each clinic

The name of the dentists who examined and treated the patient in the private clinics were written in 10 out of 60(10%) of the records, while in the governmental clinics all records showed the name of the dentist 60 (100%), only 30 (50%) of the records in the governmental hospitals showed the recorded name of the dentist. Of all the records examined 55.6% had the name of treating dentist in the records (Table 7).

Table 7: Name of dentist who examined the patient and type of clinic

	Dentist Name available	Dentist Name not available	Total
Private	10 (16.7%)	50 (83.3%)	**60 (100%)**
Governmental clinics	60 (100%)	0	**60 (100%)**
Governmental hospitals	30 (50%)	30 (50%)	**60 (100%)**
Total	**100 (55.6%)**	**80 (44.4%)**	**180 (100%)**

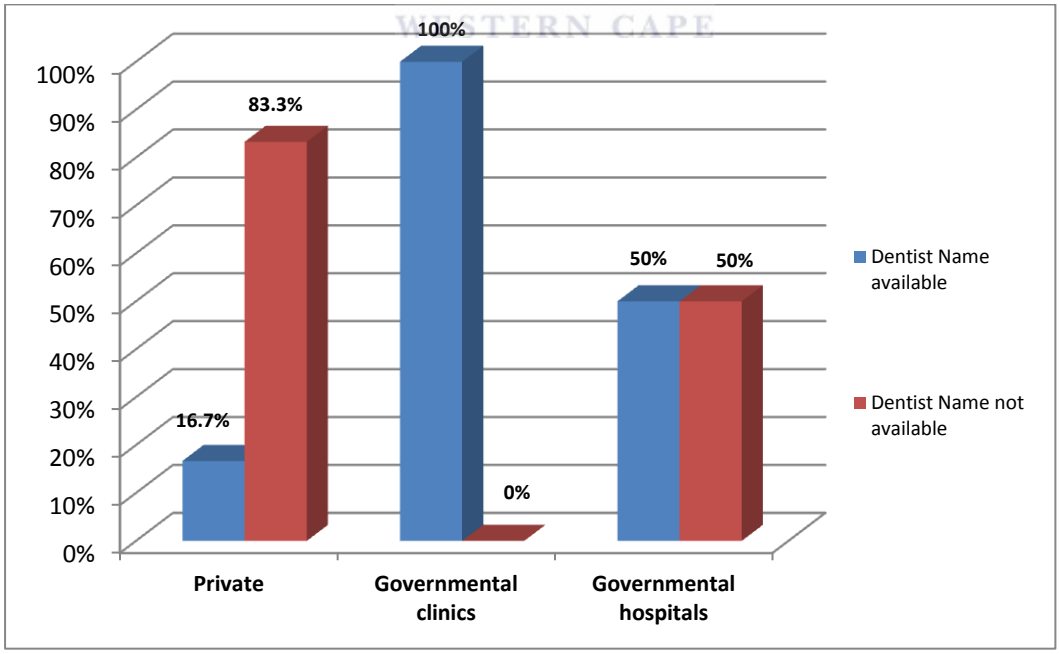

Figure (3): Name of dentist who examined the patient availability in private practice, governmental clinics and governmental hospitals.

5.8 Radiograph type in different dental clinics

Most of the dentists request intra oral periapical views (PV) radiographs and/or an Orthopantomograph (OPG).

In the private centers 60 records examined and they contained 15 periapical view (PV), 5 (OPG) and one of the records contain both (PV+OPG). In governmental clinics no radiographs were found in the records examined, patients take their radiographs with them. In governmental hospitals of the 60 records examined they contained 13 periapical view (PV) radiographs, 9 (OPG) and 8 records contained both (PV+OPG), Of the total number of records examined 129 records had no radiographs (Table 8).

Table (8): Radiograph type requested in different clinics

	PV	OPG	PV + OPG	No radiograph	Total
Private	15	5	1	39	**60**
Governmental clinics	0	0	0	60	**60**
Governmental hospitals	13	9	8	30	**60**
Total	**28**	**14**	**9**	**129**	**180**

PV = periapical view, OPG= Orthopantomograph

5.9 Radiograph quality in different dental clinics

Fifty one radiographs (PV+OPG) were examined for quality from the clinics. The governmental clinics were excluded from this assessment as no radiographs were available.

The quality of the 21 radiographs in private clinics showed 13 to be good and 8 to be poor, while in governmental hospitals 28 were good and 2 poor as shown in (Table 9).

Table (9): Radiograph quality in different clinics

	Good	poor	Total
Private	13	8	**21**
Governmental hospitals	28	2	**30**
Total	**41**	**10**	**51**

Table 9 shows that 41 out of 51 radiographs examined were of good quality

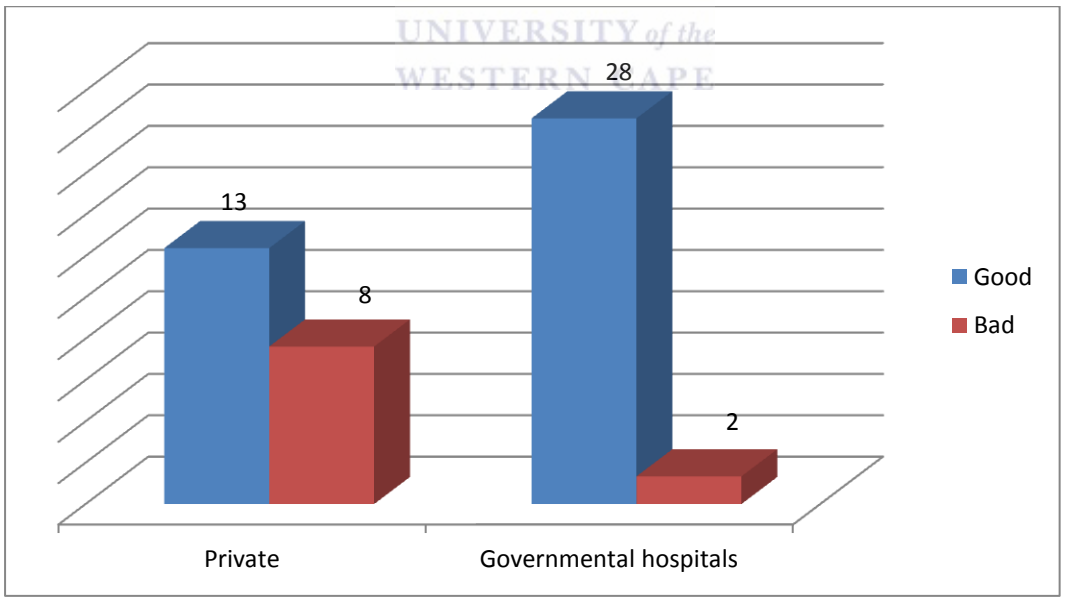

Figure (4): Radiograph quality in private sectors and governmental hospitals.

5.10 Medical history and type of clinic

The availability of a written medical history for each patient in the private clinic was found to be 10 (16.7%) out of 60 records, the governmental clinics had no medical history and 50% of governmental hospital records had a medical history. Of the total number of dental records examined 40 out of 180 records (22.2%) had a medical history of the patient (Table 10).

Table (10): Medical history availability in different clinics

	Available	Not available	Total
Private	10(16.7%)	50(83.3%)	60(100%)
Governmental clinics	0(0%)	60(100%)	60(100%)
Governmental hospitals	30(50%)	30(50%)	60(100%)
Total	40(22.2%)	140(77.8%)	180(100%)

Table 10 shows that 40 of the 180 records examined had medical history

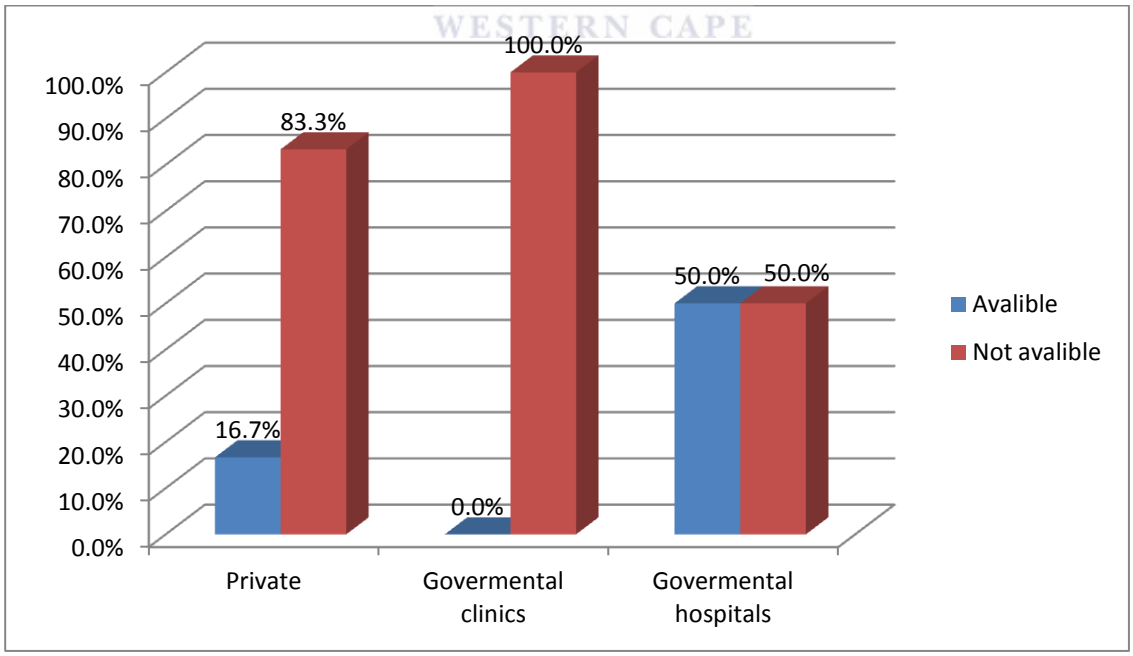

Figure (5): Medical history availability in private practice, governmental clinics and governmental hospitals.

CHAPTER 6

DISCUSSION

The present study, to the best of the researcher's knowledge, is the first one to assess the accuracy of dental records in Sudan in relation of forensic dental identification. Sudan is a developing country as there is lack attention given to forensic odontology and its role in identification. This study was carried in Sudan to assess the accuracy of dental records drawn up by the general dentists with regard to the possible use in forensic dental identification. Dental records in all the study sites contained mainly financial information, insurance claims and payment vouchers except in governmental hospitals. This may be due to the greed of private sector and their concern about their financial status and outcome as they would rather use their time treating more patients for more income rather than taking a long, detailed history.

This study showed a total absence of complete dental charting prior to treatment in governmental clinics, with only 8.3% in private centers which is supposed to supply better patient care and good quality treatment. Governmental hospitals showed only 50% of the records had a dental charting. Regarding register of name of examining dentist, in governmental clinics was very satisfactory as 100% of records have had dentist's name registered, while private clinics had only 15% of their records containing dentists name and 50% in governmental hospitals.

With regard to the presence of radiographs the records of the governmental clinics contained no radiographs as these were given to the patients; 50% in governmental hospitals had good quality of radiographs compared to the private centers; out of the 21 radiographs examined 13 were of good quality.

A medical history of the patient was relatively well documented in the records examined in the governmental hospitals scoring 50%; only 16.7% was found in private centers and an absence of a medical history in the governmental clinics, this is because there is no provision made in the records for medical history in governmental clinics and due to the orientation of the private sectors towards financial income and saving time by taking a brief history.

In (Khartoum) Sudan dental records are filed in the stores of the clinics and hospitals with no clear guidelines from the health authorities about the duration of maintaining dental records. The American Dental Association stated that inactive dental records must be kept for at least seven years and in a case of children maintain it until the age of twenty eight years (American Dental Association 2010). In India 93% of the dentists retain their dental records for less than seven years (Preethi, *et al*, 2011). In United Kingdom NHS states that dental records must be retained for a minimum of two years after finishing the course of treatment and in the case of children retained till he/she grows up to twenty five years of age (Charangowda, 2010), In Belgium 65% of dentists keep there dental records permanently while 14% keep them for less than 10 years (Dierickx *et al*, 2006).

80% of records examined lacked complete dental charting when compared to a study in Belgium that revieled that 47% of dentists do not use charts at all (Dierickx et al, 2006). In (Chennai) India, only 12% of the dentists in this city maintain completed dental charting records (Preethi *et al*, 2011), this was low compared to a study conducted in the USA where 56% of the dentists assumed that good dental charting and written records are useful in identification process (Delattre and Stimson, 1999). A study in the UK showed that 70% of the dentists complete the full tooth charting (Morgan, 2001).

The presence of dental radiographs in the records examined in this study was very poor with only 29% of the total records examined having good quality of radiographs. The question arises; does the dentist not request radiographs for examination? In the governmental clinics the author found that patients take their radiographs with them after treatment is completed. In a comparison study conducted in Belgium more than 85% of the dentists request full mouth radiographs in the first visit and keep it in the patient records (Dierickx *et al*, 2006).

Recording a medical history by the dentists in the Sudan was found to be very neglected and only 22% of dental records examined mentioned the medical history of the patient. This was poor when compared to a study in UK where more than 51% of the dentist take the medical history of the patient (Ireland *et al*, 2001) Almost the same percent was found in a study held in Finland (Helminen *et al*, 1998). It was low

when compared to the study in UK by Morgan where more than 44% of the dentists complete their medical history section (Morgan, 2001).

With regard to the name of the dentist who examined and treated the patient in the dental record, it was found that 55.6% of the dentist in Sudan write their name after treating and examining the patients which was low when compared to study conducted in UK where 97% of the dentists write their name after making the diagnosis and treatment plan (Ireland *et al*, 2001).

The general record keeping in Sudan is poor compared to other countries. It is important to increase the awareness of the private dentists with regards to the importance of keeping good dental records to enhance the health care treatment as well as avoid medico legal issues. In governmental clinics awareness about medical history must be increased.

Chapter 7

Conclusion

General dentists are required to help in the post-mortem identification process. Therefore increasing the awareness of the dentist about documenting accurate dental records is mandatory as this is to be considered one of the important responsibilities of the dentist to toward their patients. These records can be referred to in the future by the practitioner himself or medico-legal departments with regards to identification of a deceased body and thus aiding the identification process leading to positive identification.

This study was conducted using the records six dental facilities testing the accuracy of dental records, and revealed overall poor quality of the dental records. The quality of dental records can be improved if the health authorities in Sudan standardized the guidelines for record keeping and retention and strictly enforce the working sectors whether private or public to obey their guidelines and restrict usage of the dental record as a financial document.

By making more money available and accepting Forensic Dentistry as a new field of specialty this will improve dental record keeping and improve the quality of dental treatment. It will also improve the accuracy of dental records for forensic purposes.

In conclusion, the standard of dental record keeping is poor in Sudan and needs to be addressed. Medical history records need also to be addressed especially in the governmental clinics.

7.1 Recommendations

1- Dental students should be educated to keep good records in future by enhancing the importance of maintaining accurate records for both treatment and dento-legal reasons.

2-Clear guide lines should be given from the dental authorities in Sudan for dental recording system and having these guidelines strictly adherered to.

3- Introducing the subject of Forensic odontology as a separate branch in the field of dentistry.

4-Charts and recording systems must be standardized.

5-Further research should be undertaken in other areas in Sudan and adjacent countries to assess the quality of dental records.

6- Governmental clinics must record the medical history of the patient in their dental records.

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Appendix 1: Ideal dental record requirements

Guideline on dental record- keeping (American Academy of Paediatric Dentistry 2012)

Dental history	Clinical examination
A-Previous dentist, address, telephone number Family dentist Date of last visit B-Date of last dental radiographs, number and type taken. C-Family history of caries, including parents and siblings History of smoking D-Medications or disorders that would impair dental treatment. E-Injuries to teeth and jaws, including TMJ trauma F-Dental pain and infections G-Habits (past and present) such as finger, thumb, or lip sucking, bruxism, clenching H-Diet and dietary habits Sodas, fruit juice, beverages amount, frequency I-Oral hygiene Frequency of brushing, flossing J-Fluoride exposure Systemic supplementation—tablets, drops Topical—toothpaste, rinses, prescription K-Previous orthodontic treatment L-Dental charting(Drawing up the fillings , crowns , bridge; odontogram)	A-General health B-Vital signs **C-Extra-oral examination** i-Facial features ii-Symmetry iii-Pathologies iv-Skin health v-Temporomandibular joint/disorder (TMJ/TMD) **D-Intra-oral soft tissue examination** 1-Pathologies noted on : Tongue/ Roof of mouth Frenum / Floor of mouth Tonsils/pharynx/ Lips 2-Oral hygiene and periodontal assessment 3-Bone level discrepancies that are pathologic 4-Recession/inadequate attached gingiva 5-Mobility/ Bleeding/suppuration 6-Furcation involvement 7-Canine relationships, Molar relationships 8-Overjet/ Overbite 9-Crossbite Alignment/ Crowding 10-Centric relation/centric occlusion discrepancy 11-Influence of oral habits 12-Appliances present **E-Intraoral hard tissue examination** *Teeth present *Supernumerary/missing teeth *Over-retained primary teeth *Ankylosed teeth *Ectopic eruption *Anomalies/pathologies noted *Tooth size, shape discrepancies *Tooth discoloration, Enamel hypoplasia *Congenital defects, Existing restorations *Defective restorations Caries *Pulpal pathology Traumatic injuries *Third molars **F-Radiographic examination** *Developmental anomalies *Eruptive patterns/tooth positions/root resorption *Crestal alveolar bone level *Pulpal/furcation/periapical pathology *Caries—presence, *demineralization/remineralization *Existing pulpal therapy/restorations *Traumatic injury *Calculus deposits

Appendix 2

Ethical approval: University of Western Cape

Office of the Deputy Dean
Postgraduate Studies and Research
Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE
Private Bag X1, Tygerberg 7505
Cape Town
SOUTH AFRICA

Date: 7 June 2013

For Attention: Dr W Petro
Diagnostic Sciences

Dear Dr Petro

STUDY PROJECT: Effectiveness of dental records in forensic dental identification in Sudan

PROJECT REGISTRATION NUMBER: 13/5/27

ETHICS: Approved

At a meeting of the Senate Research Committee held on Friday 7th June 2013 the above project was approved. This project is therefore now registered and you can proceed with the study. Please quote the above-mentioned project title and registration number in all further correspondence. Please carefully read the Standards and Guidance for Researchers below before carrying out your study.

Patients participating in a research project at the Tygerberg and Mitchells Plain Oral Health Centres will not be treated free of charge as the Provincial Administration of the Western Cape does not support research financially.

Due to the heavy workload auxiliary staff of the Oral Health Centres cannot offer assistance with research projects.

Yours sincerely

Professor Sudeshni Naidoo

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Ministry of Health- Khartoum State approval

وزارة الصحة - ولاية الخرطوم
Ministry of Health - Khartoum State
أدارة صحة الفم والأسنان
Oral Health Directorate

Ref.KhS/MH/44/3 Date 29/4/2013

To whom it may concern

This to certify that Ministry of health-Khartoum state –Oral health directorate approved Dr.Waleed Petro to conduct his research at our governmental dental centers and clinics, by giving him access to our dental records.

Title of research (Effectiveness of dental records in forensic dental identification in Sudan).

Ministry of Health - Khartoum State
Date
Oral Health Directorate

Dr. Isam Mohamed Ahmed Idriss

Director of oral health directorate

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