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SECTION IDENTIFICATION

Discrimination Potential of Root Canal Treated Tooth in Forensic Dentistry

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ABSTRACT

Forensic Odontology is a vital component of forensic science and one branch involves the application of dental science to the identification of unknown human remains. The aim of this study is to investigate the discriminatory potential for identification of the radiographic morphology of obturated single root canals. Thirty periapical radiographs of patients having endodontic treatment of single rooted canals were selected randomly from the data bank of the digital X- ray system present in the restorative department, University of Science and Technology, Sudan. The post-operative radiographs were considered as an ant-mortem data "Set 1". Ten radiographs from the thirty were reprinted, labelled from (A-J) and considered as a post-mortem data "Set 2". This post-mortem group of 10 radiographs "Set 2" would be compared with the ante-mortem group of 30 radiographs comprising "Set 1". These two sets of radiographs would be examined by 40 dentally trained personnel. The thirty radiographs comprising "Set 1" and the 10 radiographs comprising "Set 2" were provided to each of the examiners who were asked to match the individual post-mortem radiographs ("Set 2") with the ante-mortem radiographs ("Set1"). The result demonstrated that 34 examiners achieved a success rate of 100%, 4 examiners achieved a success rate of 97.5% (1 mismatch) and 2 examiners achieved a success rate of 95% (2 mismatches). The radiographic images of obturated single-rooted teeth in this study were shown to have highly- specific morphological features. It is proposed that, in cases where the ante and post-mortem radiographs of a single-rooted obturated canal show similar morphology, this commonality of morphology can be used as a tool in the identification process.

KEYWORDS: root canal treatment, identification, forensic dentistry.

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INTRODUCTION

Dental Comparison is the main method used for the identification of victims in cases of mass disaster where there are large numbers of victims. Forensic dentistry plays a basic role in the identification of individuals who cannot be identified by routine methods.[1] Forensic dental identification depends mainly on the recognition of common concordant features by comparison of ante-mortem and post-mortem dental records with no irreconcilable differences demonstrated between the two sets of records. [2]

The vital role of Forensic Odontology in identification is based on the unique characteristics and arrangements of the teeth of different individuals. [3] Although establishment of individual identity by the use of forensic odontology had been extremely useful and reliable, it is totally dependent on the presence of ante-mortem records. [4]

Keiser-Nielsen assigned 12 concordant features between ante-mortem and post-mortem dental records to establish positive identification; [2] although this is not an accepted universal standard. Keiser-Nielsen considered an extraordinary feature occurring in more than 10% of circumstances, could consider as a unique feature to make a positive identification. [2] Obtaining ante-mortem dental information from written dental records is commonly used but it is unreliable as a "stand alone" method because of the possibility of the inclusion of recording errors or misinterpretation. Capturing and recording ante-mortem dental data, including the morphological features of teeth, surrounding structures and physical details before and after any dental treatment is well recognised as being an optimal way to preserve dental information. Dental radiographs are ideal as one of the tools for this purpose. The radiographic images captured from a patient can be duplicated precisely in the future should this prove necessary and the process of duplication is non-operator specific. Against this background radiographic imaging became an extremely significant role in the comparison process in personal forensic identification. [5]

Dental radiology has played a key role in the identification of victims in many cases. In 1973, the identification of 73% of the 35 burned victims in Hotel Hafnia, Denmark was achieved by eight dental surgeons forming part of the identification team. [6] The identification of American victims of Operation Desert Storm was largely dependent on forensic dental radiology. 244 out of the 251 victims were identified based on the availability of dental records including panoramic radiographic images. [7]

Several studies using dental radiographs are recorded regarding the successful use of dental restorations for the purpose of identification. In relation to the pattern of the amalgam restoration, the measure of uniqueness of patterns of amalgam restoration in the upper and lower dentition was investigated by Philips who found that patterns of amalgam restoration in the first molar were relatively common and therefore had a low measure of uniqueness. However if the pattern of the amalgam restoration in the first molar was combined with the patterns in one or more other teeth, then uniqueness increased markedly and improved the likelihood of identification of that person. [8]

In a study by Borman and Grondahi (1990), the radiographic appearance of teeth and restorations of two sets of bite-

wing radiographs were compared by seven dentally-trained observers. The question asked was whether the radiographic image of a single compound amalgam restoration

in a posterior teeth was unique. All seven observers were asked to identify all of the cases where simple restorations were present. The results showed that mistakes were made by a total of five of the seven observers. [9]

The relatively recent trend for aesthetic dentistry has resulted in the introduction of tooth-coloured composite materials to replace amalgam. This has opened up a new area of research regarding the radiographic assessment of composite materials for purposes of identification. Nonetheless if it can be demonstrated that both the ante and post-mortem radiographs of a single composite restoration in the same tooth show the same morphology, this uniqueness can be used for purposes of identification. [10, 11]

Post-operative endodontic radiographs provide a rich source of information that may be a unique identifying feature for a particular tooth and individual. This is because of the rare frequency of variation between the radiographic appearance of an endodontic filling compared to that of an intra- coronal restoration. [5]

Bonavilla et al (2008) conducted a study to evaluate which endodontic obturation materials were capable of withstanding high temperatures such as those to which an incinerated victim would have been exposed. This information was used to compile a database regarding the use of root canal filling materials as an aid in forensic identification. [12]

Savio C. et al carried out a study to evaluate the radiographic appearance of unrestored teeth, restored teeth and endodontically treated teeth after exposure to different ranges of high temperatures. The outcome showed significant retention of radiographic appearance and features of endodontic treatment were recognizable up until 1100 C. [13]

The aim of this present study is to investigate the discriminatory potential of the radiographic appearance of obturated single root canals for purposes of identifications.

MATERIALS AND METHODS

This was a cross-sectional hospital-based study conducted in the dental hospital of the Faculty of Dentistry, University of Science and Technology in Sudan. Thirty periapical radiographs of patients having endodontic treatment of single-rooted canals were selected randomly from the data bank of the digital x- ray system present in the restorative department. The post-operative radiographs were printed, the crown area was cut from the radiographs, labelled from (1 – 30) and considered as an ant-mortem data “Set 1” (Figure 1, 2).

Ten radiographs from the thirty were reprinted, labelled from (A-J) and considered as a post-mortem data “Set 2” (Figure 3). This post-mortem group of radiographs “Set 2” would be compared with the thirty radiographs comprising “Set 1”.

Fig.1: A sample radiograph represents set (1)

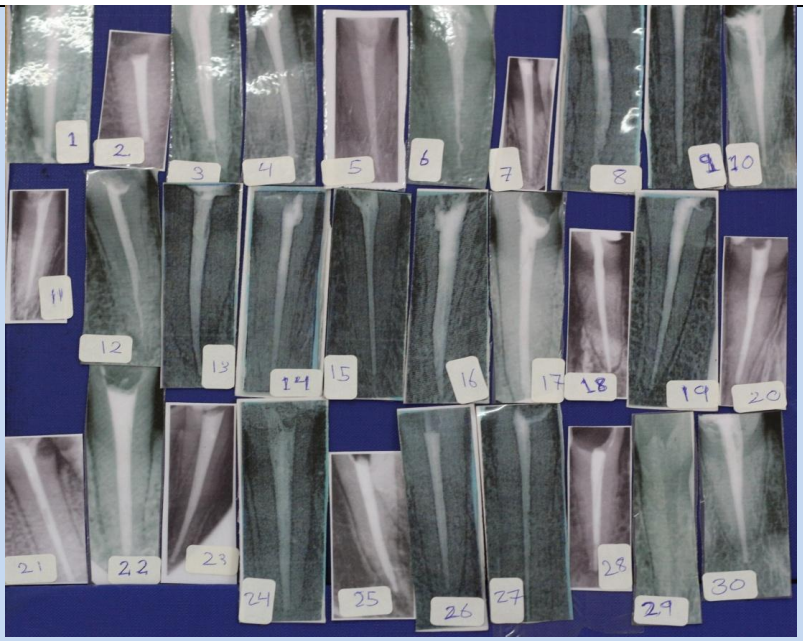

Fig.2: Radiographs represent ante-mortem labelled from (1-30)

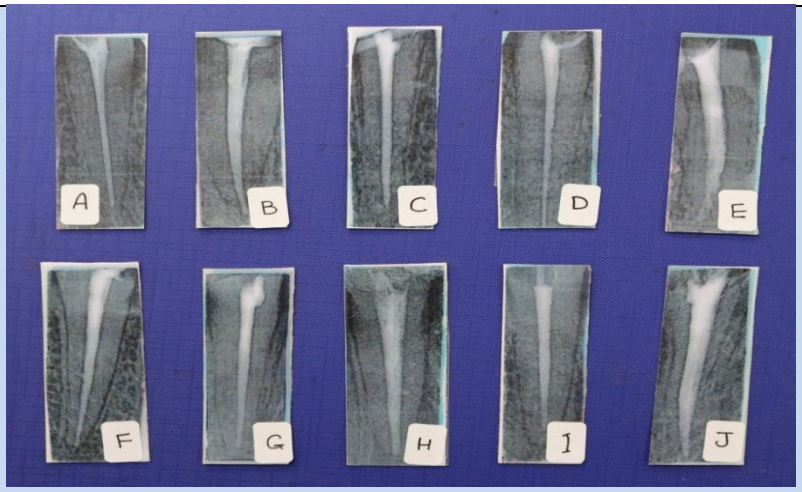

Fig.3: Radiographs represent post-mortem labelled from (A-J)

Both sets of radiographs were examined by 40 dentally trained personnel. The thirty radiographs comprising "Set 1" and the 10 radiographs comprising "Set 2" were supplied to each of the examiners who were required to match the individual post-

mortem radiographs ("Set 2") with the ante-mortem radiographs ("Set1"). The examiners included three Maxilla-Facial Surgeons, one Periodontist, two Orthodontists, two Endodontists, three Paedodontists, three Prosthdontists, thirteen General Practitioners, nine Dental Assistants and four Dental Laboratory Technicians. Their success rates of matching the radiographic images were recorded.

Descriptive statistical analysis was performed using SPSS version 21 to obtain the means and standard deviations of the scores of the examiners. The One way ANOVA Test was used to compare the mean scores among the different categories of participants involved in the study. This research was approved by the Research and Ethics Committee of the Faculty of

Dentistry, University of Science and Technology, Sudan.

RESULTS

34 examiners achieved a success rate of 100%, 4 examiners achieved a success rate of 97.5% (1 mismatch) and 2 examiners achieved a success rate of 95% (2 mismatches). Of the four examiners who achieved a success rate of 97.5% (1 mismatch) two were Specialists (one Maxillo-Facial Surgeon and one Endodontist) and two were Auxiliary Staff (one Dental Assistant and one Laboratory Technician). Of the two examiners who achieved a success rate of 95% (2 mismatches) both were Specialists (Maxillo-Facial Surgeon and Endodontist). (Table 1)

The mean score of the participants was 9.78 $\pm$ 0.53. The minimum gained score as 8 while the maximum was 10. The most frequent score was 10. (Table 2)

Based on the category of the observers, the percentage of full identification among General Dentists was the highest (100 %), followed by Auxiliary staff (84.6%). Specialists had the lowest score (71.4%). (Table 3)

Statistical analysis showed a significant difference in the mean score of Specialists when compared with that of General Dentists and other Auxiliary Staff (P = 0.038). The mean score of the Specialists was significantly lower than that the General Dentists and Auxiliary Staff (Dental Assistants and Laboratory Technicians). The General Dentists achieved the highest mean score of 10. (Table 4)

Table 1: The Results of the Examiners

Examiner	Specialty	Score out of 10
1	Maxillofacial surgeon	8
2	Maxillofacial surgeon	9
3	Maxillofacial surgeon	10
4	Orthodontist	10
5	Orthodontist	10
6	Paedodontist	10
7	Paedodontist	10
8	Paedodontist	10
9	Endodontist	9
10	Endodontist	8
11	Prosthdontist	10

12	Prosthdontist	10
13	Prosthdontist	10
14	Periodontist	10
15	General dentist	10
16	General dentist	10
17	General dentist	10
18	General dentist	10
19	General dentist	10
20	General dentist	10
21	General dentist	10
22	General dentist	10
23	General dentist	10
24	General dentist	10
25	General dentist	10
26	General dentist	10
27	General dentist	10
28	Dental assistant	10
29	Dental assistant	10
30	Dental assistant	9
31	Dental assistant	10
32	Dental assistant	10
33	Dental assistant	10
34	Dental assistant	10
35	Dental assistant	10
36	Dental assistant	10
37	Laboratory technician	10
38	Laboratory technician	10
39	Laboratory technician	9
40	Laboratory technician	10

Table 2: General Score Statistics

Mean	9.78
Median	10
Mode	10
Std. Deviation	0.53
Minimum	8
Maximum	10

Table 3: Identification successful rate among participants

Category	Percentage (%)
Specialist	71.4
General Dentist	100
Auxiliary staff	84.6

Table 4: Comparison of scores between professions

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	P value
					Lower	Upper			
Specialist	14	9.6	0.76	0.203	9.06	9.94	8	10	0.038*
General Dentist	13	10	0	0	10	10	10	10	
Auxiliary staff	13	9.85	0.376	0.104	9.62	10.07	9	10	
Total	40	9.78	0.53	0.084	9.61	9.94	8	10	

*P-*value is significant*

DISCUSSION

This study demonstrated that 34 out of the 40 dentally trained examiners were able to match the 10 radiographic images of obturated single-rooted canals from "Set 1" and "Set 2" of the same tooth with a success rate of 100%. This group of 34 represented 85 % of the total of the sample size of examiners who participated in the study. Statistically the chance of being able to correctly match the 10 radiographs from "Set1" (30 radiographs) to their counterparts in "Set 2" (10 radiographs) represents a chance in 1 in 30,045,015 [8] and it is unlikely that this outcome could be ascribed to chance. The indication was that the discriminatory characteristics of the radiographic images of obturated single root canals is so significant that it could be unique and used as a tool for purposes of identification.

This finding confirmed that endodontically-treated teeth are an important tool for purposes of identification. [5] Many other studies have also highlighted the importance of radiography in human identification by, for example, comparison of trabecular bone patterns, comparison of the morphology of the frontal sinus and comparison of the bones of the maxilla. [14, 15] It is proposed that an endodontically-treated tooth should be considered as a comparative ante and post-mortem landmark for purposes of identification.

Based on the category of the observers, the percentage of full identification among General Dentists was the highest (100 %), followed by Auxiliary staff (84.6%). Specialists had the lowest score (71.4%). (Table 3) Moreover, the specialists had significantly the lowest mean score among all participants (p value). This suggests that comparing the general pattern of the obturated canal and the surrounded bone in ante and post-mortem radiographs might depend more on general outlines rather than the presence of detailed features upon which Specialists can tend to focus.

It is common practice that, during forensic comparison between radiographic images, the similarities of the features that are common in both images are compared. [5] Failure to match the radiographs by some of the examiners could be as a result of different positioning of the tube of the X-ray machine when the ante and post-mortem X-rays were captured and the consequent difference between the orientation of the images. [5] Further research is needed.

The results of this study demonstrate that the morphology of an obturated single root canal is easily identifiable by comparison

of ante and post-mortem radiographs. Obturation of single-rooted teeth using gutta-percha creates a unique pattern that can be easily recognised using radiographs. This study also suggests that it is highly unlikely for two obturated single-root canals to have exactly the same radiographic appearance.

CONCLUSION

The radiographic images of the obturated canals of single-rooted teeth in this study were shown to have highly specific morphological features that could act as a potential aid for purposes of identification. The discriminatory potential of the unique morphology of the obturated canal of a single-rooted tooth could be used for evidence-based decision making in Forensic Dentistry.

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