ISSN 2219-6749

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The Journal of Forensic Odonto-Stomatology

Volume 11, n. 2 - Dec 1993

OFFICIAL PUBLICATION OF THE
INTERNATIONAL ORGANIZATION FOR
FORENSIC ODONTO-STOMATOLOGY

Contents

DENTURE MARKING

A study of temperature resistance of different metal bands for ID-marking

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ABSTRACT

Dentures are not always marked. In Sweden legislation now exists to enforce it. This study was undertaken to establish the frequency of marked dentures, the incidence of edentulousness and a temperature resistance test of three possible marking bands.

Patients from two long-term units were included in the study (n=58). Observation of the dental status included absence of teeth, some teeth present and influence of dentures, complete, partial, upper or lower. Marking of the dentures was also recorded. Three different types of steel bands (Jasch; Remanit; ID-band) were exposed to temperature levels of 1100, 1200 and 1300°C. Of a total of 58 patients 64% were edentulous and only 17 of the patients could be identified by means of the denture markings. None of the metal bands had readable markings at 1200 and 1300°C, but at 1100°C the ID-band and the Jasch band were readable, but not the Remanit band.

Key words: Identification, denture marking, edentulous, long-term care, forensic odontology.

INTRODUCTION

Denture marking is important for two main reasons, the first being in health care institutions because many dentures are lost and never returned to their owners and the second being the possibility of identifying deceased persons, particularly when decomposition of the body has taken place. The importance of the teeth and the oral cavity in identification has been known for a long time[1]. The identification of a victim by denture is however a more recent phenomenon[2]. In this case the murderer had tried to dispose of the body by sulphuric acid but a denture

remained and unfortunately for the murderer the missing person's dentist was able to recognize his repair work on the denture. More recently, in a 22 year-old murder case, Thomas and Kohler[3] pointed out the importance of denture marking because the remains included a complete denture which was unmarked and the victim had to be identified with difficulty, using circumstantial evidence. Denture marking can thus be a vital help in identifying victims of homicide, suicide and mass disasters.

In Sweden, in contrast to some other countries it is not possible to trace a denture to a specific dental technician because for many years the manufacturing procedure for dentures has been standardized and dentures do not have individual characteristics. On the other hand as early as 1963 Johanson[4] described a method of marking dentures with a stainless steel band placed lingually in the molar area and embedded in the base of the denture. The metal band is marked with an identification number consisting of S for Sweden and the birth date followed by a number given at birth, for example S-130904-1737. According to the Swedish National Board of Health and Welfare (SOFS(M) 1986:25)[5] all patients should be offered the chance to have their dentures marked with an identity number. The patient may, however, refuse the marking.

In other countries different methods for marking dentures are being used[6,7,8] but some of those methods do not include the use of a fire resistant band. In contrast, the metal ID-band (SDI, Upplands Vasby, Sweden) is said to resist 1300°C for ten minutes[9]. Recently the ID-band was introduced to the United States and the brochure states this temperature resistance but the latest Swedish guideline (SOFS(M) 1986: 25)[5] does not state any requirements for temperature resistance.

Dentures which are not expelled from the oral cavity during fire will not easily be destroyed because of the protective effect of the surrounding soft tissues. If, on the other hand, the denture is destroyed the ID-band should remain intact. A forensic odontologist could be well placed to recognise and retrieve the small metal band after a fire.

There were several aims of this study. The first was to study the prevalence of dentate and edentulous patients in longterm care units. Secondly, to investigate the frequency of denture marks and whether they comply with the recommendations of the Swedish National Board of Health and Welfare. Thirdly, to analyse temperature resistance of three different metal bands for ID-marking presently used in Sweden.

MATERIALS AND METHODS

Clinical data

Patients from two longterm units (Vasa hospital and Graberget, Goteborg), Sweden) in two wards were included in the study and examined in February 1991. At admission to the hospital the patients are offered dental care and receive it on a regular basis. The number of patients participating in this study was 58 (23 men and 35 women) and the age and gender are shown in Fig. 1. Recording of the dental status included presence or absence of teeth, presence of upper and/or lower complete or partial dentures and the marking of the dentures.

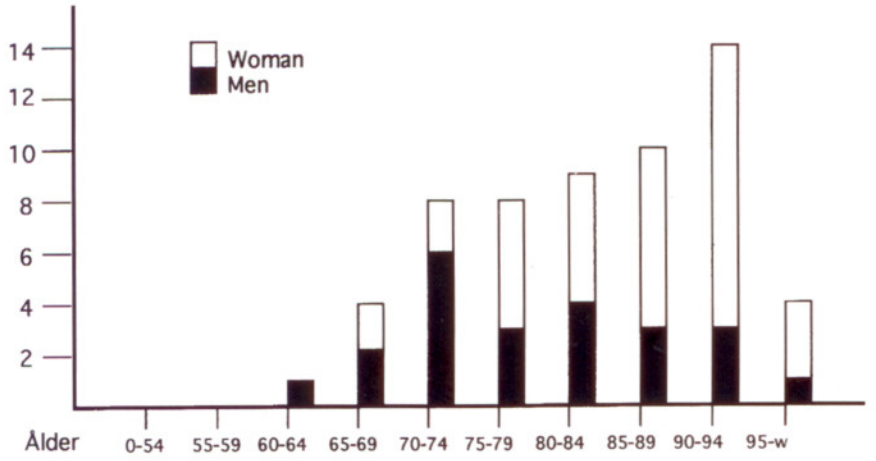

Fig 1 Sex and age of the longterm care patients (N=58).

Experimental data

Three different types of steel bands, Jasch (Sjodings, Stockholm Sweden), ID-band (SDI, Upplands Vasby, Sweden) and Remanit (Dentaurum, Pforzheim), Germany) (Table 1) were embedded in methylmethacrylate resin. The size of each test piece of acrylic resin was 5x12x30 mm and the bands were marked according to the instructions mentioned above. All samples of each of three types of bands were exposed to temperature levels of 1100, 1200 and 1300°C for 10 minutes. Acrylic blocks with the bands were placed in open non-combustible ceramic containers with the metallic band facing upwards (Fig. 2) and the

Table 1 Tested metal bands

Type	Producer	Product
ID-BAND	SDI	Metal band for ID-marking
JASCH	Sjödings	Metal band for ID-marking
REMANIT	Dentaurum	Metal band for ortodontic use

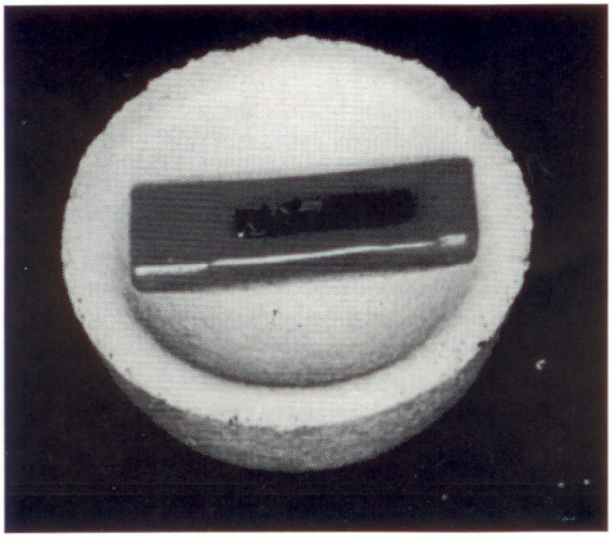

Fig. 2
The specimen placed in a non-combustible container.

specimens were in the furnaces either one or three at a time. The acrylic resin ignited spontaneously after a few seconds and was totally destroyed after one minute.

Furnaces and temperature measurements

The two muffle furnaces used were SOLO (Kasemar & Sperisen SA SMO 3265 Biel-Bienne Switzerland) and Carbolite CF (24 Bamford Sheffield, England).

In order to achieve accurate temperatures the furnaces' built-in temperature measuring instruments were by-passed with a calibrated instrument called a "Eurotron Microcal 1 multiple function indicator/calibrator" (Eurotron Italiana s.r.l., Sesto S Giovanni, Italy), using a thermocouple type K, which gave an accuracy of about 5°C of the reported temperatures. The thermocouple was placed so that it did not touch any of the enclosing surfaces and the temperature range during the test period was not more than 40°C. The test was performed twice.

RESULTS

Clinical Data

The overall results are shown in Fig. 3. From a total of 58 patients 37 (64%) were edentulous. Thirty three (57%) of the patients had dentures and 15 of the dentures were correctly marked. Further, 21 patients had their own teeth and six of those had some type of partial denture, two of which were marked. Thus, of the

39 denture wearers, only 17 could be identified by means of ID-markings on their dentures.

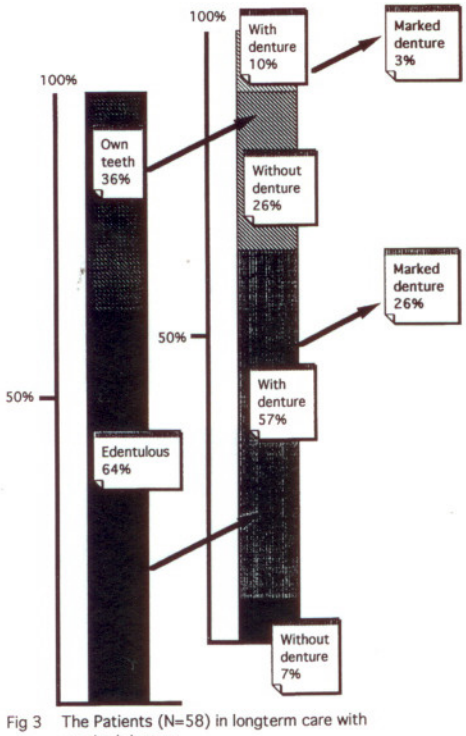

Fig 3 The Patients (N=58) in longterm care with marked denture.

Experimental data

None of the metal bands had readable markings at 1200 and 1300°C (Fig. 4).

At 1100°C the ID-band and the Jasch were readable (Table 2) (Fig. 5).

Table 2 Results of readability test

Specimen	No.	Target temp.	Measured temp. interval	Readable
ID	2	1100	1041 -1124	YES
Jasch	2	1100	1041 -1124	YES
Remanit	2	1100	1041 -1124	NO
ID	2	1200	1196 - 1241	NO
Jasch	2	1200	1196 - 1241	NO
Remanit	2	1200	1196 - 1241	NO
ID	2	1300	1280 - 1315	NO
Jasch	2	1300	1292 - 1322	NO
Remanit	2	1300	1302 - 1331	NO

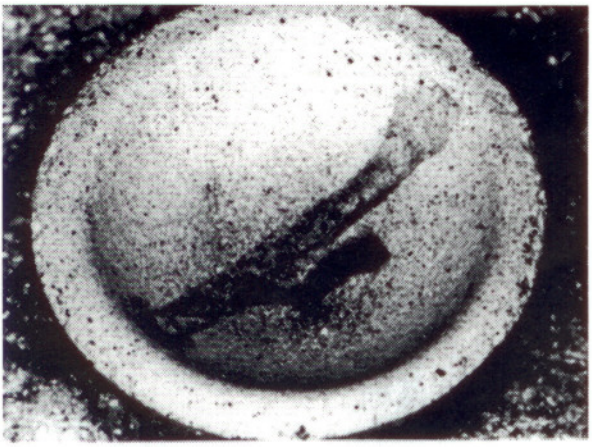

Fig. 4
Destructed non-readable steel band (Remanit) after 1200°C test.

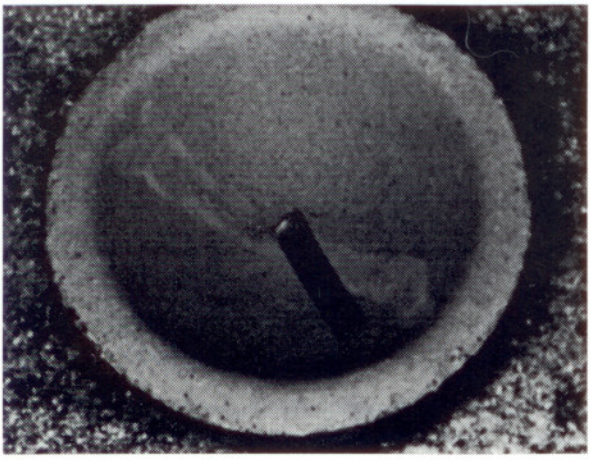

Fig. 5
Readable steel band (ID-band) after 1100°C test.

DISCUSSION

In a study of forensic odontology cases in Sweden during a 10-year period (1980-1989)[10] it was demonstrated that out of 167 cases with complete or partial dentures only 32 (19%) were marked with the personal identification number.

In a literature survey of air disasters, Haines[11] found that among 380 victims 25% (97) had dentures and only 10% (17) of those were marked with the victims' names. This shows that the dentists could have overlooked or did not consider it important to order marking of dentures by their technicians. In the Swedish study[10] the dentures could have been made prior to the marking recommendations as stated. In our material the patients with partial or complete dentures had correct markings in 17 out of 39 cases (43%). The reasons for the higher number of

marked dentures in this study could be that our group had easier access to dental service and/or that our observations were done in 1991.

In our temperature test we found that none of the tested bands resisted temperatures above 1100°C. In the investigations and reconstructions after the fire on the Scandinavian Star in 1990 by the Norwegian State Committee[12] it was found that the temperature probably did not reach 1000°C. This statement was based in simulations performed with ship's equipment similar to that on the Scandinavian Star. In spite of this however, the exact temperature in a fire is difficult to estimate. The recommendation from the Swedish National Social and Health Board (SOFS(M) 1980: 91)[13] on the specific type of metal band to be used for denture marking may now perhaps be regarded as too rigorous regarding temperature resistance. The latest recommendation from the Swedish National Social and Health Board (1986)[5] does not state any temperature requirements as mentioned earlier.

It is well known that if a denture is present in the mouth of the deceased the soft tissues of the face and the tongue will protect it from exposure to high temperatures. In these cases the acrylic base with the identification band often remains intact (the ignition temperature for methylmethacrylate[14] is about 300°C).

In Sweden from 1975 to 1981 the number of individuals with complete dentures has decreased from 52% to 39% in the age range 65 to 74 years (NHV-Rapport 1986: 6)[15]. However, in the elderly population over 80 years-of-age in Sweden, especially in institutional care, the number of denture wearers is still high. Furthermore, in a recent review article[16] it was stated that more than half of the elderly above 65 years in Sweden have removeable dentures. These figures can be compared to data from Finland[15] where the majority of the 65 to 74 year-olds had lost all their teeth and 80% of these persons used complete dentures in both jaws. In Denmark[15] 59% of the 65 to 81 year-olds were edentulous in both jaws. In Norway[15] 47% of the population over 65 is edentulous. Thus, even though oral health has improved considerably, and the frequencies vary in different counties there are still many denture wearers in the elderly population and it is important that their dentures can be identifiable. An appropriate marking method for dentures is thus desirable and should be implemented.

The conclusions of this study are therefore that the standards of identification marking bands have to be brought into line with the ID-bands and the Jasch-bands. The results of this study further indicate that the Remanit band, which is a metal band for orthodontic use, is not suitable for marking purposes. Moreover, it is advisable to recommend to patients that unmarked dentures be marked in the proper way with a suitable steel band. This will help the owner of a lost denture to recover it, and save much work for the forensic odontologist.

ACKNOWLEDGEMENTS

This study was supported by grants from the Swedish National Board of Health and Welfare and the Swedish Society for Forensic Odontology.

REFERENCES

1. Humble BH. Identification by means of teeth. Brit. Dent J 1933; 54: 528-35.
2. Simpson K. Dental evidence in the reconstruction of crime. Brit. Dent J 1951; 9: 235-236.
3. Thomas CJ, Kohler WW. A case of non-identification by denture. J Forensic Odontostomatol 1983; 1: 65-71.
4. Johanson G. Denture making (in Swedish). Sv Tandl Forb Tidn 1963; 6: 1-3.
5. Swedish National Board of Health and Welfare. SOFS (M); 1986: 25.
6. Jerman AC. Denture identification. J Amer Dental Assoc 1970; 80: 1358-9.
7. Harvey W. Dentures and identity and the marking of dentures. In: Dental identification and forensic odontology. London: Henry Kimpton Publishers, 1976: 57-66.
8. Whittaker DK, MacDonald DG. Markers and names in dentures. In: A colour atlas of forensic dentistry. London: Wolfe Medical Publishers, 1989: 67-71.
9. Ekman, B, Johanson G. Are dentures marked (in Swedish). Sv Tandl Forb Tidn 1977; 21: 1213-4.
10. Teivens A, Mornstad H. Ten years of forensic odoontology. J Forensic Odontostomatol 1992; 10: 50-7.
11. Haines D. Identification in mass disasters from dental prostheses. Int J Forensic Dentistry 1973; 1: 11-5.
12. "Scandinavian Star" disaster Report from the Norwegian state (in Norwegian). 1991; 1B 492-579.
13. Swedish National Board of Health and Welfare. SOFS (M); 1980: 91.
14. David C. Thermal degradation of polymers. In: Bamford CM, Tipper CMH. Comprehensive chemical kimtics, degradation of polymers. Elsevier Sci Publ Co Amsterdam, OxFord, New York, 1975; 14: 53-7.
15. Rise J, Holst D. Dental care in the elderly (in Swedish). The Nordic School of Public Health. Stockholm: Tandlakaforlaget, 1988; 6.
16. Ainamo A, Osterberg T. Changing demographic and oral disease patterns and treatment needs in the Scandinavian populations of old people. Int Dent J 1992; 42: 311-22.

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ACCURACY AMONG DENTISTS EXPERIENCED IN FORENSIC ODONTOLOGY IN ESTABLISHING IDENTITY

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ABSTRACT

The aim of this study was to investigate the accuracy of 17 forensic odontologists identifying individuals from two sets of radiographs, one regarded as ante- and the other as postmortem. Each case was observed twice and only one pair out of 31 did not match. The observers were asked to comment about each case, classifying it as easy, moderate or difficult.

The results show that one observer was totally correct in the first analysis while four observers made no errors the second time. In the first evaluation 14 observers made between one and seven errors and two observers made 11 errors each. In the second evaluation 12 observers made between one and seven errors and one observer made 13 errors. At the first evaluation, the observers judged 18 of the cases as easy, eight as medium and five as difficult. At the second evaluation, the observers pronounced 13 of the cases as easy, 13 as medium and five as difficult. The corresponding values for the authors were 6, 12 and 13. Most of the mistakes were made on the cases with no restorations and the incorrect answers were found mostly among the difficult cases. In practical forensic work however additional dental chart information is usually available to the forensic odontologist.

Key words: Identification, forensic odontology, radiography.

INTRODUCTION

Radiography is becoming more and more important in forensic odontology. There are several advantages of radiographs over chartnotes[1,2] because the radiographs are actual images of the dental status and cannot be misrepresented. Furthermore, the chartings often register only the therapy that has been performed by a particular dentist and not all previous restorations that are present.

It is not impossible that findings of similarity can occur between records from different persons, especially if there are only a few dental characteristics available for comparison between ante- and the postmortem records. The radiographs can therefore provide characteristic details which would be matching points for the ante- and postmortem radiographs such as type, extent and position of restorations, roots (number and form), pulps/root canals and alveolar bone morphology. Thus, when antemortem radiographs are available they could be compared with the postmortem radiographs and can be used as legal evidence of an individual's identity in court.

According to Stevens[3], radiographs of only a fragment of a jaw containing a few teeth, or even one distinctive tooth may be sufficient to establish a positive identity. Further, according to the same author each case has to be considered upon its own merits. Therefore, it is not possible to state precisely what number or combinations of similarities are necessary to make a positive identification. In this regard the matching points found on radiographs are especially important. Johanson and Mornstad[4] also state that one ante- and one postmortem radiograph from the correponding area of the victim is usually enough for establishing identity.

In the earlier studies by our group[5-7], differences in accuracy were found among different specialists when they were asked to combine "ante- and postmortem" radiographs of dentate (with and without restorations) and edentulous cases. In those studies it was shown that the performances of the radiologists were superior to those of the other specialists. It should be remembered that practical forensic work is quite different from experimental studies.

Clearly, further studies are needed specifically to test the performances of the forensic odontologists. The aim of this study was therefore to investigate the accuracy in establishing identity by means of radiographs among dentists with special interest and education in forensic odontology. We also wanted to study the different types of mistakes made and if the same mistakes were repeated in a second evaluation. Further, it was of interest to know the observers' opinions about the difficulty of the cases.

MATERIAL AND METHODS

The radiographs

The images used in this study were bitewing radiographs taken on patients referred to the Public Dental Service. Radiographs from some forensic cases were also included in the study. The radiographs were obtained (paralleling technique) with varying dental X-ray machines. The radiographic parameters were 60-65 kV and FSD was 20-28 cm. One bitewing radiograph from a given person was regarded as the "antemortem" radiograph while each one from the second set

served as the "postmortem" radiograph. There were 31 pairs of radiographs and the observers were asked to combine the ante- and postmortem radiographs. One pair out of 31 did not match. The time interval between the ante- and the postmortem radiographs was variable with a range of one to several years. All radiographs were coded and mounted in plastic frames.

The antemortem radiographs were coded with letters and the postmortem radiographs with numbers, while for the second evaluation the codes were changed. Different categories of dental conditions were represented. Fifteen cases had no therapy while 13 cases exhibited simple therapy that had been added to or changed between the ante- and postmortem radiographs. Three cases had complicated therapy such as crowns, bridgework, rootfillings or extractions. Two authors (GE and HB) made an evaluation of the degree of difficulty of the cases and six cases were considered as easy, 12 as moderate and 13 as difficult.

The observers

The 17 observers were briefed beforehand and informed in writing about the nature of the study. All examiners had extensive clinical experience and had participated in several continuing education courses in forensic odontology. They formulated their own criteria for determination of identity based on their previous experience in the forensic field. They analyzed the radiographs independently in their own clinics.

The obervers were also asked to evaluate the degree of difficulty of each case as easy, moderate or difficult. This classification was done independently and without any priming. The procedure was repeated after one year and all reports were made on standardized forms designed by two of the authors (GE, HB) (see below).

Evaluation form

Please combine the 31 antemortem (numbers) and the 31 postmortem (letters) and indicate for each pair of radiographs the degree of difficulty (easy, moderate or difficult).

AM radiograph PM radiograph E M D

1 .....
2 .....
3 .....
4 .....
5 .....
6 .....
/
/
29 .....
30 .....
31 .....

Statistical analysis

Statistical analysis (chi^2-test) was performed according to a method described by Bailey[8].

RESULTS

First evaluation

One of the observers combined all 31 radiographs correctly, while two obervers made 11 errors each and the remaining 14 made between one and seven incorrect combinations of radiographs (Table 1). All observers were able to solve 13 of the 31 cases.

Second evaluation

Four of the 17 observers combined all 31 pairs of radiographs correctly. One of the observers made 13 errors and the remaining 12 made between one and seven errors (Table 1). All observers were able to solve 11 of the 31 cases.

Comparison of the two evaluations

Eight cases were correctly solved by all observers in both evaluations. Six of those were considered as easy, two as moderate in the first evaluation while in the second evaluation five cases were considered as easy and three cases were judged as moderate. No pairs of radiographs had been solved incorrectly by all observers in both evaluations. Totally, errors were made on the same cases 24 times in both the first and the second evaluation. However, on 60 occasions the errors were not made on the same cases. Three pairs of radiographs had the highest number of errors in both evaluations, two of them being "no therapy" cases. The third pair was the case in which the ante- and postmortem radiographs did not match. The proportion of correct answers for the pair that did not match was 18%.

The observers

The observer who made no errors in the first evaluation made two mistakes in the second evaluation. One of the cases that this observer did not solve correctly is shown in Figure 1. The four observers who did not make any mistakes in the second evaluation each made 1, 1, 3 and 5 errors respectively in the first evaluation. The observers who made 11 errors in the first evaluation made 13 errors in the second (Table 1).

The judgement of the degree of difficulty of the cases

The judgements of the degree of difficulty of the cases made by the observers at both evaluations were quite different from that made by the authors (Table 2). In no case did the observers consider a case to be more difficult than the authors (Fig. 2). In general, the observers judged the cases the same as the authors or less difficult.

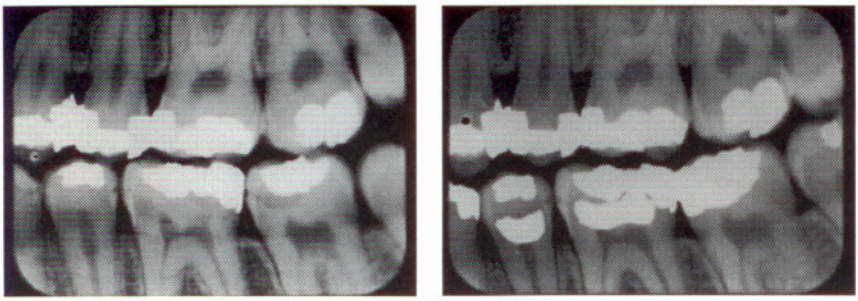

Fig. 1 - Ante-mortem (a) and post-mortem (b) dental radiographs of a case judged to be easy by both the observers and the authors. One observer made an error on this case in the second evaluation.

Table 1

Number of mistakes made by the 17 observers in the first (I) and in the second (II) evaluation.

Observer	I	II
1	1	0
2	1	2
3	4	3
4	7	1
5	5	0
6	1	0
7	5	1
8	0	2
9	4	5
10	1	6
11	1	1
12	11	13
13	2	3
14	1	5
15	3	0
16	1	5
17	11	7
	59	54

Table 2

The observers' and the authors' judgements of the degree of difficulty of the cases in the first (I) and in the second II evaluation.

		Observers	
	Authors	I	II
Easy	6	18	13
Moderate	12	8	13
Difficult	13	5	5
Total	31	31	31

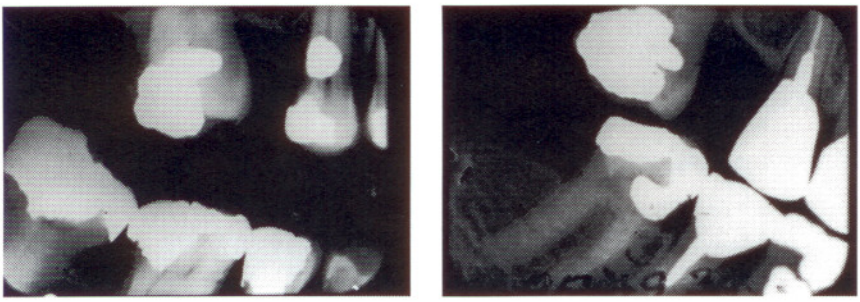

Fig. 2 - Ante-mortem (a) and post-mortem (b) radiographs of a case judged to be moderate, even though several dental characteristics have changed due to additional therapy as well as extraction of 47.

Table 3

The observers' judgements of the incorrect answers in the first (I) and in the second evaluation (II).

Evaluation	I	II
Easy	9	2
Moderate	23	20
Difficult	27	32
Total	59	54

Table 4

The observers' judgements of the correct answers in the first (I) and in the second evaluation (II).

Evaluation	I	II
Easy	225	193
Moderate	159	184
Difficult	84	96
Total	468	473

The judgements of the incorrect answers are shown in Table 3. The results from the two evaluations were similar and the observers thought that most of the cases were difficult. The judgement of the correct answers are demonstrated in Table 4. The total number of correct answers in the first evaluation and in second evaluation was 468 and 473 respectively and as shown in Table 4, the number of easy cases was reduced and an increase especially in the number of cases judged as moderate was noted.

Comparing the judgements, 13 pairs of radiographs were judged alike by the observers and the authors in both evaluations. In seven cases the observers considered the cases as easy and the authors as moderate. In five cases the observers thought that the radiographs were moderate and the authors judged them to be difficult. In one case, the observers thought that the radiographs were easy and the authors decided that they were difficult while in the remaining five cases there was a difference between our judgement and both evaluations. There were significant differences ($p=0.013$) among the first, the second judgement made by the observers and the judgement made by the authors.

DISCUSSION

An investigation with a design like this is of course not realistic in the sense that the observers did not have the opportunity of using chart notes or access to multiple radiographs. Often during practical work there is also the opportunity to collaborate with a colleague when uncertain. In this study, we chose to use only radiographs, mainly bitewing which are the most common radiographs in Sweden. Bitewing radiographs have disadvantages because they do not provide information about the roots and the surrounding bone. However, the common dental restorations are well displayed as seen in Figs. 1 and 2 and we therefore continued to work only with radiographs as before[5,6] where differences in observation ability were shown between dental specialists when they evaluated radiographs from different types of cases.

By using only radiographs the observers were forced to study and interpret the radiographic information with special care. There is also a legal consideration in the use of radiographs because they constitute permanent records that can be used in court to prove or exclude an identity.

There was very little difference between the number of mistakes in the first and the second evaluation. However, it should be noted that the majority of errors were not made on the same cases in the first and in the second evaluation. One explanation for this discrepancy could be that the second evaluation was made one year after the first and the fact that some of the observers could have known that one pair of radiographs did not match did not seem to affect the results.

The eight radiographs which seemed to be the easiest for the observers to solve correctly in both evaluations had either no restorations or simple restorations. Of those pairs of radiographs on which the observers had most errors in both evaluations, one had complicated therapy and was "the case that did not match". The other two pairs of radiographs had no therapy and were very much alike. In a real forensic situation it is essential to have several radiographs from the same area obtained at different angles in order to display as many details as possible for comparison between the ante- and the postmortem radiographs. For example, if only one antemortem radiograph is available, the forensic odontologist will take several postmortem radiographs to achieve similarity in projection between the ante- and postmortem radiographs. Further, as in cases of fire the postmortem material can be very limited and it is of crucial importance to find comparable areas on the radiographic images.

As dental health improves we might face more and more patients with no therapy. Additionally, in the future when amalgam may gradually be replaced by tooth coloured restorations, without radiographic contrast, the restorations could be difficult to observe on the radiographs. Moreover, it could be impossible to distinguish the different materials from one another. It is therefore essential to have several radiographs in each case and it is of course desirable to get a second

opinion before making the final confirmation of an identity. The results from this study seem to support the view of many forensic odontologists that forensic work is recommended to be performed by two persons who collaborate i.e. one doing the examination and the second checking and making notes.[9,10]

The conclusions from this study are as follows:

1. Most of the mistakes were made on cases with no therapy.
2. In both evaluations the observers judged the radiographs as easier than the authors did.
3. In most cases the observers did not make mistakes on the same pairs of radiographs in both evaluations. In these cases however they did not have the same opinion about the degree of difficulty in both evaluations.
4. The incorrect answers were found mostly among the cases judged by the observers as difficult.

The overall conclusion of this study is that person identification by dental characteristics should only be performed by experienced and fully qualified experts.

ACKNOWLEDGEMENT

We would like to thank the 17 colleagues who participated in this study. Without their contribution this study would not have been possible.

REFERENCES

1. Luntz LL. X-ray techniques in dental identification. In Luntz LL And Luntz P. Eds. Handbook of dental identification. Techniques in forensic dentistry. Philadelphia and Toronto: JB Lippincott, 1973:91.
2. Whittaker DK, MacDonald DG. A color atlas of forensic dentistry. London: Wolfe Medical Publishers, 1989.
3. Stevens PJ. Fatal aircraft accidents. Their medical and pathological investigation. Bristol: John Wright & Sons Ltd. 1970:140.
4. Johanson G, Mornstad H. Rattsodontologi, Kompendium (Textbook for teaching forensic odontology to Swedish dental students). 1986.
5. Borrman H, Grondahl H-G. Accuracy in establishing identity by means of intraoral radiographs. J Forensic Odonto-Stomatol 1990; 8: 31-6.
6. Borrman H, Grondahl H-G. Accuracy in establishing identity in edentulous individuals by means of intraoral radiographs. J Forensic Odonto-Stomatol 1992; 10: 1-6.
7. Rasmusson L, Borrman H. Accuracy in dental registrations in forensic odontology among dental students. J Forensic Odonto-Stomatol 1992; 10: 43-49.
8. Bailey NTJ. Statistical methods in biology. Hodder and Stoughton: London 1980. p 52.
9. Averill DC, ed. Manual of forensic odontology. 2nd ed. Colorado Springs American Society of Forensic Science. 1991.
10. Clark D. Forensic odontology. London: A Livingstone Ltd, ch. 7, 1992.

IDENTIFICATION OF AN AMERICAN HIKER

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ABSTRACT

The skeletonized remains of an American hitch-hiker were recovered from a forest near Knysna in the Cape. There were no recognizable features except the presence of dental restorations. The use of the "fax" to transmit dental records while being a speedy means of communication does have its limitations. Electrical faults on the telephone line can cause the document to become illegible and subsequent duplication of this document aggravates the problem. An appeal is made to standardize the notation of teeth by using the FDI code and to adopt a 2 digit code for restoration morphology.

Keywords: Identification, skeleton, dental coding.

INTRODUCTION

Skeletonized remains are difficult to identify as most of the recognizable features are lost. In most cases the bones reveal only the age, sex and in some cases the racial characteristics of the deceased. In these events it requires a great deal of investigative work to attempt to identify the body especially when there has been no restorative dentistry performed or the teeth are missing. In certain countries, especially those of the third world, most dental problems are dealt with on a "relief of pain and the treatment of sepsis" basis and scanty if any dental records of treatment exist. When it comes to identification of these remains therefore, the resourcefulness of the forensic dentist is tested to the limit.

In some cases where restorative dentistry has been performed it is often difficult to interpret the abbreviations and "hieroglyphics" written by the dentist on the treatment record cards. This may be aggravated by records which are received by

facsimile (fax), when an electrical fault on the telephone line will create illegibility of a large portion of the document which is being transmitted. If this document is then photocopied, the results are often even more illegible.

This is a case report in which the skeletonized remains of an American citizen were eventually identified by means of a dental record comparison but the delay in identification was due to illegibility of reproduced records.

CASE REPORT

On 24 October 1991 a 24 year-old economics student from America Mr. E.P. was on a walking tour along the Outeniqua trail near Knysna, South Africa. He was joined that evening by a married couple at an overnight hut. During the course of the evening two other male hikers arrived at the shelter. One of the new arrivals was approximately 30 years old, dressed in black and wore a black balaclava on his head. The younger of the two, aged about 16 years, was described as effeminate and both wore gold ear-rings in their left ears. The men did not sleep in the hut with the others because they said that they preferred to sleep in the open. In the morning they had disappeared and food and some of the equipment belonging to the married couple was missing. During the course of that evening and early the following morning, the married couple advised E.P. that it was unwise to walk along the trail alone but he did not share their concern and set off early the next morning. The married couple followed the same trail but the husband was unhappy about their safety and he and his wife abandoned their walk and headed for Knysna where they reported the incident to the police. In his statement to the police the husband said he had felt uneasy about the appearance of the two men and added that they "appeared like SAS troops and were up to no good". When they had discovered that some of their possessions were missing, his misgivings about the criminal intentions of these men was confirmed and he and his wife decided to abandon their walk and report to the police. They expressed their concern for E.P.'s safety and a search was arranged but he was not found.

On the 10 December 1991 a "bad smell" was noticed by a forest dweller and he led police to a decomposed and partially skeletonized body of an adult male in Millwood Forest about nine kilometres from the overnight hut. The body was lying in a gorge about 35 metres off the hiking trail. The hands of the corpse had been tied above the head and the body partly hidden by bushes. A wallet containing two photographs as well as a pair of blue socks were found in the vicinity. The body was removed to the mortuary at Paarl and an autopsy was performed the following day by the authors.

POSTMORTEM EXAMINATION

Examination of the remains was conducted during which the skull and pelvis were found to be that of a male. Interesting peculiarities in the deceased were that there were only 11 thoracic vertebrae and the 5th lumbar vertebra showed a non-union between the vertebral body on the one side and the arch and processes on the opposite side.

The right femur length was 44.2 cm with a femoral head diameter of 47 mm. Using tables 45 and 48 in Krogman's[1] book "The human skeleton in Forensic Medicine", the height of the decesed was calculated as being bweteen 1,63 - 1,66 meters. The skull showed an irregular defect of 85 x 60 mm with some of the pieces of fractured bone from the defect lying inside the skull cavity. The upper aspect consisted of a slot fracture extending cranially, suggestive of being caused by an axe-like instrument with a fissure fracture extending over the midline and ending in the opposite parietal bone (Fig. 1).

Fig. 1 - The postero-lateral aspect of the skull showing the shape and size of the fracture of the parieto-temporal area.

No soft tissue was present around the neck or skull, and the soft tissue of the anterior chest and abdominal wall was absent. Rib 11 on the left, embedded in decomposed matter, showed a fracture of the outer table, and an intact inner layer, indicating a compression factor. As the major objective was the identification of the deceased and because there were no normal distinguishable features except the 10 small occlusal restorations in the posterior teeth of the upper and lower jaws, the oral autopsy was the only method of establishing the identity of E.P.

ORAL AUTOPSY

MAXILLA (Tooth notation using the FDI coding)

The maxilla had lost teeth 11 and 12 postmortem (Fig. 2).

Restorations present in the teeth were as follows:

Tooth 16
- occlusal amalgam in mesial fissure
- palatal amalgam (pit)

Tooth 17
- occlusal amalgam in mesial fissure

Tooth 26
- occlusal amalgam in mesial fissure
- palatal amalgam (pit)

Tooth 27
- No restorations, occlusal and palatal caries.

Teeth 18 and 28 were absent.

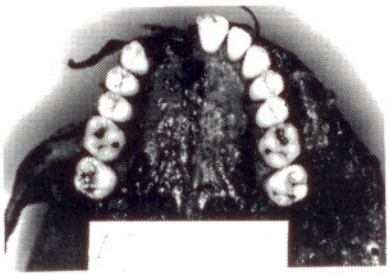

Fig. 2 - Occlusal aspect of the maxilla showing the small amalgam restorations in the molar teeth.

MANDIBLE

The mandible had lost tooth 41 postmortem (Fig. 3).

Tooth 36
- occlusal amalgam
- buccal amalgam (pit)

Tooth 37
- occlusal amalgam

Tooth 46
- occlusal amalgam
- buccal amalgam (pit)

Teeth 38 and 48 were absent.

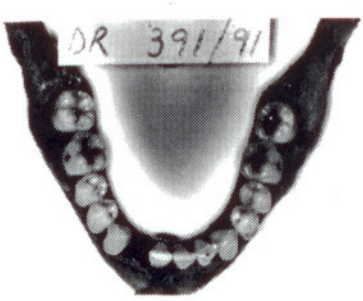

Fig. 3 - Occlusal aspect of the mandible showing the small amalgam restorations in the posterior teeth.

RADIOGRAPHY

Postmortem periapical as well as "bite wing" radiographs were taken of the teeth. These confirmed that the wisdom teeth 18, 28, 38 and 48 were missing (Fig. 4).

The distal root of tooth 47 showed an area of external resorption on the distal aspect of the root adjacent to the apex of the tooth (Fig. 5).

A postmortem dental record was compiled using the data from the jaws and the radiographs (Fig. 8).

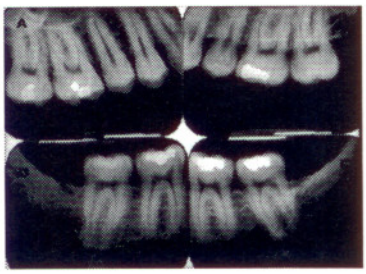

Fig. 4 - Postmortem periapical radiographs of the wisdom teeth areas (18, 28, 38 and 48) showing that these teeth are absent. a = right maxilla, b = left maxilla, c = left mandibula, d = right mandibula.

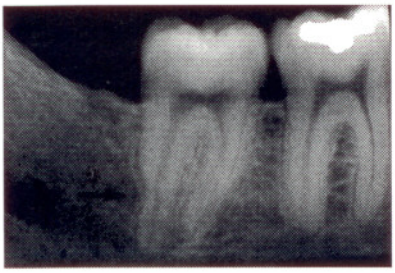

Fig. 5 - An enlargement of the right molar periapical radiograph showing the external resorption of the distal root of the 47 tooth (arrowed).

ANTEMORTEM DENTAL RECORD

The antemortem dental record was obtained from E.P.'s dentist in California, USA, which consisted initially of a hand written dental record. This document was transmitted by facsimile machine (fax) to the American Consulate in Cape Town, photocopied, and then supplied to VMP as an antemortem record. This document was illegible. Subsequently, when the antemortem dental radiographs (Figs. 6 & 7), which were sent by E.P.'s mother arrived by courier service at the American Consulate, the original faxed dental record was requested.

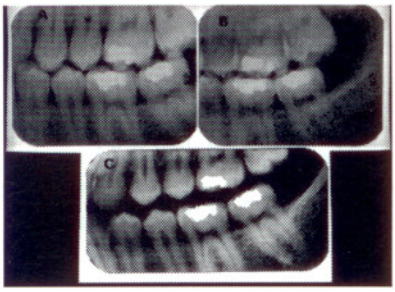

Fig. 6 - "Bite wing" radiographs of the left posterior teeth showing the morphology of the restorations in the molar teeth. A and B are antemortem and C postmortem radiographs.

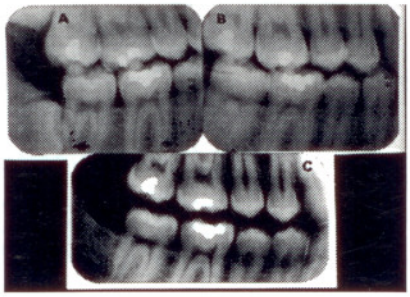

Fig. 7 - "Bite wing" radiographs of the right posterior teeth showing the morphology of the restorations in the molar teeth. Note that the wisdom teeth 18 and 48 are still present at this stage. The impacted 48 has caused external resorption of the 47 distal root (arrowed). A and B are antemortem and C postmortem radiographs.

This was barely legible but a vast improvement on the photocopied version. An antemortem dental record could now be compiled including information from the antemortem "bite wing" roentgenographs. The charting of the teeth from the American dentist was by the Cunningham's (Universal) notation[2] which was translated into the FDI notation on the antemortem dental record (Fig. 9).

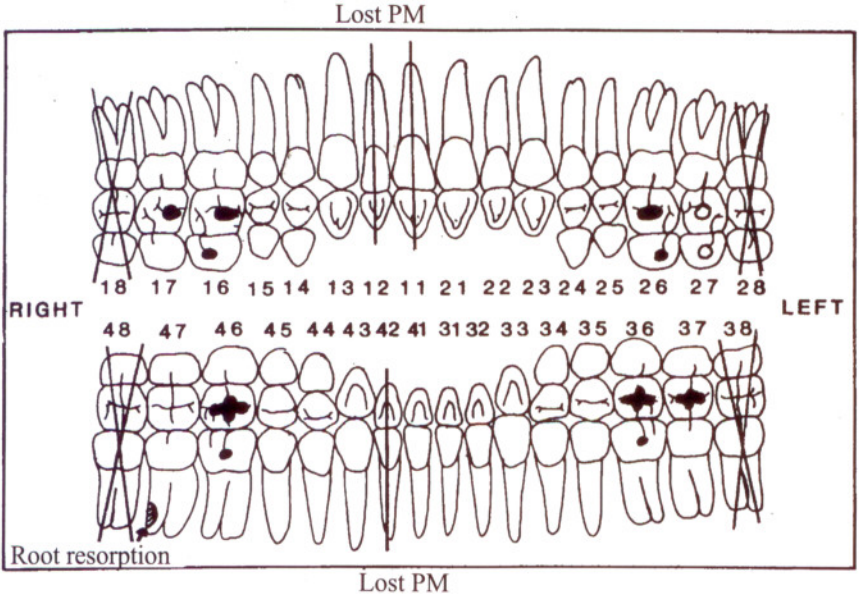

Fig. 8 - The postmortem dental charting of the teeth of Dr 391/91 from the jaws and antemortem radiographs.

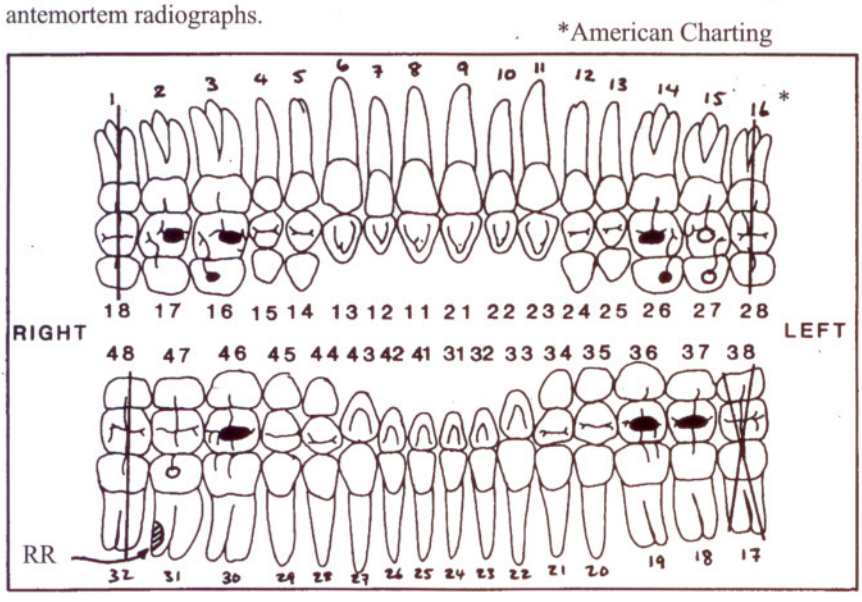

Fig. 9 - The antemortem dental charting of EP translated from the written records and the antemortem radiographs.

RESULTS

Comparison between the ante- and postmortem dental records showed that there were 12 concordant points (Table 1). The one surface amalgam restorations recorded on the written dental record, as well as observed on the antemortem radiographs, corresponded to those seen in the postmortem radiographs (Figs. 6 & 7). Teeth 18, 28, 38 and 48 were absent on postmortem examination (Fig. 4) and the dental records reflected that these had been extracted. A unique feature in the 47 region of the antemortem radiograph showed the 48 to be present, unerupted (Fig. 7) and impacted and causing external resorption of the distal root of the 47. This scallop-shaped area could be clearly seen on the postmortem radiographs (Figs. 4 & 5).

DISCUSSION

The utilization of dental records for identification purposes is a well established method where fingerprints are not available. In the cases of charring or skeletonized remains it is often the only means of identification. The age, race and sex of an individual can be determined with relative accuracy from the bones, but identification is reliant on antemortem medical or dental records.

When medical records are used for identification they usually consist of radiographs of the skeleton or accounts of surgical procedures[3]. Dental records however have the same accuracy as fingerprints in identifying individuals particularly as teeth and dental restorations are highly resistant to postmortem deterioration. The only factor which is of paramount importance in any identification procedure is accurate antemortem data. When a forensic dentist receives an original written dental record he can often decipher most of the codings used by his colleagues. Problems of interperpretation do arise because they are often hand written and often incomprehensible abbreviations used.

When antemortem dental records are requested the newest tendency is to use "fax" transmission. This is of course very useful and quick, but if there is some interference in the telephone line parts of the document can become illegible. If the "faxed" document is then photocopied the result can be so poor that it is useless.

After the Helderberg disaster near Mauritius, Ligthelm[4] stated that the use of the "fax" aided their identification procedures by giving them rapid access to dental records of the victims of the crash. He did however mention that the interpretation of data from the written record cards was at times impossible due to abbreviations and codings made by the dental practitioners of other countries. There has recently been an appeal by the International Organization for Forensic Odonto-Stomatology for dentists to use the FDI notation.

Phillips[5] in his study on the uniqueness of amalgam restorations devised a 2 digit code for single and multisurface restorations. It would facilitate the interpretation of dental records if an international coding system for single and multisurfaced restorations could be adopted. This would not only assist in the interpretation of dental records but also allow computerization of not only teeth but restorations as well.

The skeletonized remains of E.P. were eventually identified (12 concordant features), but the delay and subsequent anguish caused by illegible antemortem dental records could have been avoided if the original records were supplied to the forensic dentist.

TABLE 1 - POSTMORTEM AND ANTEMORTEM CONCORDANT POINTS

FDI	**POSTMORTEM RECORD (DR 391/91)**	FDI	**ANTEMORTEM RECORD (EP)**
16	Occlusal amalgam restoration. Palatal amalgam restoration.	16	Occlusal amalgam restoration. Palatal amalgam restoration.
17	Occlusal amalgam restoration.	17	Occlusal amalgam restoration.
18	Absent.	18	Extracted.
26	Occlusal Amalgam restoration. Palatal amalgam restoration.	26	Occlusal amalgam restoration.
27	Occlusal caries. Palatal caries.	27	Occlusal caries. Palatal caries.
28	Absent.	28	Extracted.
36	Occlusal amalgam restoration. Buccal amalgam restoration.	36	Occlusal amalgam restoration.
37	Occlusal amalgam restoration.	37	Occlusal amalgam restoration.
38	Absent.	38	Absent.
46	Occlusal amalgam restoration.	46	Occlusal amalgam restoration.
47	Resorption of apical 1/3 distal root.	47	Resorption of apical 1/3 distal root.
48	Absent.	48	Extracted.

REFERENCES

1. Krogman, WM, Iscan, MY. The human skeleton in forensic medicine. 2nd edn. Illinois: Charles. C. Thomas, 1986: 189-267, 302-51.
2. Clark DH. Dental record interpretation. In: Clark DH, ed. Practical forensic odontology. Oxford: Wright, 1992: 101-4.
3. Stevens PJ. Identification of the bodies of the dead. In: Fatal civil aircraft accidents, their medical and pathological investigation. Bristol: John Wright and Sons, 1970: 148-51.
4. Ligthelm AJ. Helderbergvliegtuigramp - forensiese - odontologiese ondersoek. IADT 1990 Abstract 102: 64.
5. Phillips VM. The uniqueness of amalgam restorations for identification. J Forensic Odontostomatol 1983; 1: 33-8.

FORENSIC ODONTOLOGY IN WAR GRAVES EXHUMATION IN THE UKRAINE

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INTRODUCTION

In June 1991 the Australian Government sent an exhumation team (comprising an anthropologist, a forensic pathologist and forensic odontologist) to exhume the human remains in alleged mass graves in the Ukrainian Republic of the Soviet Union. The Australian investigators had been told of a massacre of mainly Jewish Soviet citizens who had been taken from their village to a site two kilometres away where they were shot and buried in a mass grave. Further information from witnesses revealed that one of the Ukrainian guards had returned to the village following the initial massacre and collected about twenty children of mixed Jewish parentage who ranged in age from six months to 12 years and who were subsequently killed.

A second grave site also in the Ukraine, was alleged to hold over one hundred persons, mainly adults. This site was enclosed in a Soviet army base.

METHOD

First Grave Site

Only the approximate location of the grave site was known. The actual limits of the grave were found by using a backhoe to cut a one metre deep trench across the alleged site and examining the difference in soil texture and colour. The light, deeper layers of soil when mixed with the darker upper layers gave a distinctive colour difference that indicated clearly the exact limits of the grave.

The actual uncovering of the grave was carried out by Soviet army conscripts who were instructed to dig manually until they uncovered the first evidence of human remains. Bulldozers were then used to remove the overburden to within 40 cms of the level where bodies were first located. The tedious and painstaking task of removing the remaining 40 cms of clay then began, using spades to remove the earth in 5 mm slices. When the human remains were encountered the exhumation team exposed each skeleton by careful removal of the earth from around the bones without disturbing them (Fig. 1).

Fig. 1 - Development of skeletal remains of four year old child.

When the remains of the children had been fully uncovered they were photographed as they lay, while a theodolite was used to record positions both vertically and horizontally. The skeletons were then lifted and taken to a Soviet army tent for more detailed examination where injuries and dental information were recorded. Dental examinations of the skeletal remains of 18 children were carried out.

Second Grave Site

There were several reports that this site had been mined by the German army to prevent exhumation of the remains. Prior to excavation the site was searched by the Soviet army personnel with a mine detector and repeated at intervals of 60 cms as the grave site was uncovered.

The location of this second grave site was only approximately known as there were no civilian eyewitnesses who survived. The information on the position of

the site came from Ukrainians who, some months after the event, saw a large earth mound which they presumed to be the grave. This location was again found with the use of trenches cut through the suspected site of the grave as the archaeologist looked for changes in soil texture and colour as before. The grave was alleged to hold mainly females, children and old men and women, as the men and teenage boys had been previously rounded up and sent to labour camps in Germany.

When the skeletons were uncovered they were found to be in rows, the majority of skulls had a bullet entry hole at the base of the skull.

RESULTS

First Grave Site (Children)

The Australian exhumation team had been charged with examining evidence relating to the murder of a number of half-Jewish children. This act was supposed to have succeeded a previous massacre of over one hundred adults who had allegedly been buried approximately 40 cms below the children. The adult remains were only sampled in five separate areas and an approximation of the total number of victims was extrapolated. The exact number of adults and details of their injuries was not required for our investigation.

Eighteen juvenile remains were found approximately 30 cms above the adult skeletal remains. Those of one very young child consisted of only teeth and therefore the cause of death was difficult to establish.

The remaining seventeen skeletal remains examined showed the following patterns of injury:

1. Seven showed bullet wounds either entry or exit or both to head and in one case to an innominate bone.

   In addition there was a further case which showed a partial entry wound showing internal bevelling to a portion of occupit.

2. Ten showed fragmentation of skulls consistent with blunt force injury and no evidence of bullet injury.

3. All seventeen remains showed fracturing of various bones, most commonly the skull and mandible but also greenstick fractures of long bones and fracturing of scapula.

After recording the injuries to the jaw bones they were pieced together using a cyanoacrylic ester glue (Loctite 420*) commonly known as "superglue". The glue has an exothermic reaction with bone and gives off a pungent gas. When

gluing, a minimal amount of glue should be used and the area where the procedures are being carried out should be well ventilated.

Following the repositioning of fragments a dental charting was carried out using the Federation Dentaire Internationale (FDI) notation on the Interpol pink post-mortem dental forms.

The jaws, fragments of jaws and occlusal surfaces of the teeth were then photographed using single lens reflex camera with a ring flash.

A portable dental X-ray unit**, specially made for the Australian armed forces for field use was taken to the Soviet Union and proved very effective, even when being run with Soviet army field generators which tended to produce considerable voltage fluctuations. The film used was Kodak*** periapical and occlusal film which was developed with standard chemistry in a Procomat**** automatic dental X-ray film processing unit.

The radiographs of jaws were utilised to estimate the ages of the children, but as there were no tables available for age estimation of Russian children from either the Soviet officials or the forensic pathologists the American Schour and Massler tables[1] in conjunction with others[2-5] served the purpose.

Table 1
THE AGE ESTIMATIONS

Body No.	Estimated Age	Body No.	Estimated Age
1.	3 years ±6 months	10.	3.5 years ±9 months
2.	6 years ±9 months	11.	6 months ± 2 months
3.	1 year ± 3 months	12.	10 years ±9 months
4.	2 years ±6 months	13.	2 years ±6 months
5.	7 years ±9 months	14.	3 years ±6 months
6.	2.5 years ± 6 months	15.	5 years ±6 months
7.	6 years ±6 months	16.*	5.5 years ± 9 months
8.	2 years ±6 months	16a.*	6 years ±9 months
9.	7 years ±9 months	17.	1 year ± 3 months
*Considered from the same body.		18.	2 years ±6 months

*Loctite Corporation, Dublin Ireland.
**Medical Application Pty. Ltd., 56 Buffalo Road ,Gladesville, Sydney.
***Kodak, Australia.
****Siemens, Germany.

Second Grave Site (Adults)

This grave held approximately 104 individuals. Ageing adults by dental means is not precise but on observation of the local Ukrainian dentitions, the authors considered they were much more worn than an equivalent Australian population. Local health authorities were approached for permission to attend a dental polyclinic, where seventy five dentists worked, and a survey was carried out relating to decayed (D), missing (M), filled (F), teeth (T), total DMFT, CIPTN and attrition.

Pearson correlations were carried out and the attrition/age correlation of 0.81 was found to be the highest of all the parameters examined (Table 2). Because the sample was reasonably small (only 80 individuals) two standard deviations covered a range of ±16 years. This survey did however give an indication of age when assessing the dentitions.

Table 2
DENTAL AGEING STUDY CARRIED OUT IN UKRAINE DENTAL POLYCLINIC

VARIABLE	PEARSON CORRELATION
Decayed Teeth (D)	r = -0.057
Missing Teeth (M)	r = +0.458**
Filled Teeth (F)	r = +0.092
TOTAL DMFT	r = +0.307*
Periodontal Disease (CIPTN)	r = +0.348**
Attrition Premolar	r = +0.722**
Attrition Molar	r = +0.808**
TOTAL ATTRITION	r = +0.8112**

Two standard deviations +16.16 years relating to Total Attrition
* p (0.05) ** p (0.01)

The bodies were examined at the grave site and an opinion on the cause of death was given by the pathologists. Thereafter independent observation of the skulls by the two pathologists and the dentist led to agreement on the age of the individuals (within a decade) in all but three of the 104 bodies examined. In the three cases of disagreement, the results were averaged.

DISCUSSION

At the first site, where the main evidence to be examined was the remains of eighteen children, our assessment was made difficult by the fact that the skeletons were mainly heaped on top of one another. The bones of different individuals were intermingled which made reconstruction of individual skeletons extremely time consuming.

The roots of most molar teeth are mechanically locked into bone when the periodontal membrane breaks down following death. On the other hand the anterior teeth and most premolars are easily dislodged from the skull and great care has to be taken to replace and glue them into the correct body and the correct socket. With the very young children the bones were so fragile that in the case of body number 11 no cranial and postcranial bones were found, only a near complete deciduous dentition which was aged at approximately six months using the Shour and Massler tables.

Many of the older children had been shot, or had had their skulls crushed, presumably with a heavy object (such as a rifle butt). Having many skull fragments in close proximity also made reconstruction of the cranium difficult.

An unexpected phenomenon occurred when excavating for the children's skeletons about 40 cms above the remains of over 100 adults. The earth would collapse under foot into a body space of one of the adults lying below the children, and it was distressing to experience this violation of a fellow human's burial site.

At the second grave site the victims were allegedly told to lie down naked in rows where they were shot usually in the base of the skull. These skeletons were, therefore, able to be reconstructed with less chance of confusing the skeletal remains.

The Russian authorities were at all times most helpful. They provided members of the Soviet army and their heavy equipment to uncover the grave site. The Soviet air force made available a heavy lift helicopter when our group wanted to film the site from the air.

To assist us further the KGB opened the relevant files which were found to be extremely comprehensive and included the statements of witnesses taken soon after the German forces were driven from the Ukraine. The KGB informed the Australian government in 1948 that there were over 1000 immigrants/refugees in Australia who were implicated in war crimes, including the names and in many cases the aliases and Australian addresses of these "refugees". At that time Australia had a conservative government, and as this was the period of the Berlin airlift and the "iron curtain" it was not until nearly fifty years later that investigations were initiated into the mass extermination of Ukrainian Jews by naturalised Australian citizens.

CONCLUSION

What are the benefits of holding war crime trials fifty years after the event?

Initially when you are down in a grave site and observing how old men, women and children were killed, one is strongly of the opinion that there should be no statute of limitation on murder. However, in real life, events are never black or white. The young Ukrainian guards conscripted by the Nazis were often of German descent whose ancestors had moved to the Ukraine during the reign of Catherine the Great

(to avoid religious persecution in Germany). These men were offered the choice of either joining the Ukrainian guard or going to labour camp in Germany. Who can blame them for being tempted to take the soft option? Having little experience of life, being young seventeen year-olds and given a gun and a sense of power, many were too naive to know whether or not an "order" was illegal.

The disadvantages of war crime trials may be that they are expensive to run and sometimes ethnically divisive in a community. The advantages we believe are two-fold, firstly, that by reporting in the press the story of these mass murders of civilian populations, it is shown to the world how fragile democracy is, and how people can be manipulated by political factions of either left or right. Also, to the lengths leaders will go to retain a position of absolute power, even if it means killing members of their own communities.

Hopefully by relating these events and similar events that have occurred in more recent times democratic nations will be shaken from their political complacency. If democracy is to survive we think that it is important that people take an active interest at the "grass roots" level as advocated by the American philosopher Chomsky[6].

The second benefit of these trials is more conjectural and embodies the deterrent element, through both the reporting of the murder trials and of the prosecution of alleged perpetrators. Unfortunately deterrence cannot easily be measured because if the deterrent effect works, the act is not committed and therefore cannot be measured.

REFERENCES

1. Schour I, Massler M. The development of the human dentition. J Am Dent Assoc 1941; 28:1153-60

2. Fanning EA. A longitudinal study of tooth formation and root resorption. NZ Dent J 1961; 57:202-17.

3. Demirjian A, Goldstein H, Tanner JM. A new system of dental age assessment. Hum Biol 1973; 45:211-27.

4. Demirjian A, Goldstein H. New systems for dental maturity based on seven and four teeth. Ann Hum Biol 1976; 3:411-21.

5. Demirjian A. Human Growth; Dentition Falkner F, Tanner JM eds. 2nd edn London: Plenum Press 1986:269-98.

6. Chomsky HN. Manufacturing Consent. Panphern Press, Random House, Melbourne 1991.

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POINTS OF CONTACT BETWEEN QUALITY ISSUES AND FORENSIC ASPECTS

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The lively and sometimes highly emotional and controversial discussion on quality in the medical and dental professions is new in this form. What is not new, however, is the actual problem complex.

Doctors and dentists have always endeavoured to provide their patients with high quality treatment promising success in the light of contemporary expertise. On the other hand, legal disputes between patient and doctor with respect to the quality of treatment have always entailed the invariably consulted expert being asked by the judge whether the treatment was in accordance with the state of the art.

Regardless, then, of whether a maximum for medical treatment was to be established or a borderline set between proper and false treatment, there has always been a need to ascertain or define the respective state of the art.

As this is subject to constant change due to further development and increasing knowledge, the definition of the state of the art has to be continuously updated. This process is thus just as dynamic as the further development of the subject itself.

It has obviously become impossible for the individual to keep abreast of the vast developments and immense increase in know-how throughout the field of dentistry and to have a complete command of them, especially with the number of specialities constantly on the increase.

As progress is meaningless, however, unless it is ultimately of benefit to the patient, we are expected to keep ourselves posted at least to the extent of being able to advise patients on currently available diagnostic and therapeutic methods, even though we might not be able to carry out the specific measures ourselves and would have to refer the patient elsewhere.

The entire spectrum of each dentist's individual activity must be measurable against the state of the art in dental terms. That is an integral part of the duty to take care, inherent in the therapist-patient contract.[2]

To meet this demand, doctors and dentists - according to German law - are under obligation to keep themselves informed of the medical state of the art to the very limits of what can reasonably be expected, as these professions, unlike most others, are responsible for life and health as objects of legal protection.[4] It is, of course, virtually impossible to master everything constituting the highly developed dental science confronting us today. For this reason it is essential for us to bracket out areas in which we are not fully skilled, if we are not to be accused of "over-reaching ourselves".[3,5] The trend to specialization is manifest in all areas.

Many cases of unacceptable dental treatment are certainly not due to a lack of good intention on the part of colleagues but rather to a simple lack of know-how or skill. This cannot, however, exonerate them from legal liability. It is not the good intention but the actual quality of our work that is decisive.

How, though, is the individual doctor or dentist to discover what the state of the art is and whether his work is in line with current standards of therapy? And how is the expert to define, in the event of a legal dispute, the criteria on which he bases his appraisals when forming his opinion on the treatment in litigation without exposing himself to accusations of being subjective and arbitrary?

It is precisely there that efforts being made within the framework of the quality discussion are assigned the function of working out continuously in the individual spheres of dentistry, according to the respective state of the art and level of know-how, what dentistry is capable of achieving in general if the available know-how and good, proper workmanship are applied, and on what the patient may justifiably depend.[1]

It stands to reason that - in contrast to a cognitive science - an action-based, empirical science such as dentistry cannot be subjected to any universally absolute, timelessly applicable principles; the diversity of dental work precludes its definitive subsumption under a network of rules. This by no means implies, however, that we lack any form of orientation. There are indeed concepts which enjoy broadly-based support and, naturally within temporal limits, can lay claim to the character of maxims.

In this context I refer to the compilation published in 1988 by the German Dental Association of all statements issued by it in recent years on the generally recognized scientific status of each method of treatment.[6]

These statements have, as the preface claims, been warmly welcomed by the vast majority of dentists, have often contributed to substantiating verdicts by committees of experts, courts or similar institutions, and are of significance as an instruction and guideline for the dentist, to whom they represent confirmation of and security for his actions.

Especially with respect to forensic science too, in the sphere of scepticism-prone legislation on liability in the medical profession, it may contribute to substantiation, and the evidence put forward may be placed on a better presented and therefore more objective footing.

Yet it is not only when dentist and patient are already entangled in a lawsuit that objective quality criteria play an important role: they may also help to avert litigation in the preliminary stages. This statement is based on an investigation which the veritable boom in lawsuits between dentists and patients induced us to carry out.[7] The complaint is frequently heard among colleagues that litigation is provoked chiefly by opionated or contentious patients with unrealistic demands and excessive expectations. Is that true? If not, what are the actual causes of the debatable development of what was once, at least by implication, a confidential relationship, and are there any targeted approaches to their prevention?

With this issue in mind, we examined 30 lawsuits concluded with legal force over the past 10 years, for which we had provided expert opinions on prosthetic work. One striking aspect was that the following points acted as triggers for litigation in each and every case:

failure to remedy defects,
repeated failure of attempted corrections,
protracted temporization tactics,
unwillingness to discuss the matter, or suggestions that symptoms are psychosomatic,
patients feeling let down due to lack of or inadequate information,
refusal to continue giving treatment, or even an explicit recommendation to the patient to institute legal proceedings.

The disputes were thus kindled not so much by a fault per se as by the way in which the complaint, put forward by the patient, was dealt with; for instance, when primary symptoms persisted in spite of treatment, or when symptoms had recurred or even become worse after treatment. Many colleagues are clearly unprepared, or inadequately prepared, for this situation. It is at this point, however, that the decision is made whether to take the case to court. We see here an unfortunate dilemma in the reality of the modern dental practice: Under the

pressure of so-called economic efficiency, any possible or indeed inevitable complaints by patients on conclusion of treatment have naturally been more or less disregarded in the job scheduling process and thus have the effect of virtually sabotaging the smooth running of the practice.

If the necessary time and a clear cut, rational diagnostic and therapeutic concept are not available to deal with such situations, this often gives rise to a vicious circle characterized by feverish activity and disorganized polypragmatism.[8]

Diagnoses born of sheer desperation, a flow of empty promises, and references to so-called acclimatization problems are seen by the patient as excuses and temporization tactics. Repeated but untargeted and consequently unsuccessful attempts at improvement undermine confidence in the dentist's competence and often do nothing but make matters worse. The declaration eventually made in a volatile atmosphere that the work is quite all right but that the patient should see a psychiatrist or a solicitor often signposts the way to a lawsuit.

To avoid coming into conflict with his patient and to keep the peace in his practice, the dentist needs a well thought out concept to deal with such situations. It is admittedly not easy for him to subject his own work to objective, impartial evaluation - in other words to act as a judge of his own work, as it were.

Yet it is in this very process that objectively defined standards or criteria may be of inestimable value. Just as the expert does in the event of a dispute, the dentist concerned should examine his work critically before legal proceedings are instituted, to see if it complies with the state of the art. If it fails to do so, he still has an opportunity of putting things right and averting a judicial escalation. If, on the other hand, his work does meet objective quality requirements, he need have no misgivings about litigation.

All things considered, it is both meaningful and important to describe and define quality characteristics of dental treatment as reflected in the state of the art. Wherever difficulties are encountered in this process, the research requirement should be pinpointed. Quality specification is a dynamic process that has to take its bearings from the development of this speciality. Bearing all factors in mind, there can be no doubt that it involves a high level of expertise, which accounts for the specification and interpretation of quality having to remain within the profession. Medical ethos commits us to strive to provide quality for the benefit of our patients. From the forensic aspect, these endeavours may contribute to objectification and substantiation. My wish on behalf of us all, on the other hand, is that legal disputes with our patients may be avoided.

REFERENCES

1. Ankermann E. Behandlungsstandard und - spielraum in der Zahnmedizin aus haftungsrechtlicher Sicht. Dtsch Zahnartzl Z 1991: 46: 253-6.

2. Bundesgerichsshof. Neue Juristische Wochenschrift 1975; 28: 305-7.

3. Bundesgerichsshof. Neue Juristische Wochenschrift 1984; 37: 655-7.

4. Bundesgerichtshof. Versicherungsrecht 1977; 28: 546-8

5. Deutsch E. Die Anfangeroperation: Aufklarung, Organisation, Haftung und Beweislastumkehr. Neue Juristiche Wochenschrift 1984; 37: 650-1

6. Deutsche Gesellschaft fur Zahn-, Mund- und Kieferheilkunde: Stellungnahmen. Carl Hanser Verlag, Munchen - Wien 1988.

7. Figgener L. Der Patient in der gerichtlichen Auseinandersetzung - ein Problempatient? Dtsch Zahnartzl Z 1992; 47: 180-2.

8. Marxkors R. Verhalten beim Ausbleiben des Erfolges. Zahnartzl Welt 1982; 91: 44-6.