

THE USE OF DENTAL RADIOGRAPHS FOR IDENTIFICATION OF CHILDREN WITH UNRESTORED DENTITIONS

S Fridell, J Ahlqvist

Oral and Maxillofacial Radiology, Dept of Odontology, Umeå University, Sweden

ABSTRACT

The success of dental identification is often dependent on the extent of previous dental care and the location of detailed dental records. However, several factors limit available comparable data among children. There are often no clinical indications for dental radiography before the age of five and many children and adolescents have no restorative care. This reduces the amount of individualizing information suitable for comparative identification.

The aim of this study was to investigate matching of dental x-rays from children without fillings at different ages, and to see if radiographic expertise facilitated radiographic comparison. Five general dental practitioners (GDP) and five oral and maxillofacial radiologists (OMR) attempted to match bitewing examinations from 30 children.

The results showed that dentists are likely to match bitewing radiographs in these conditions. This likelihood is further enhanced when oral and maxillofacial radiologists compare images. This suggests that manual comparison of bitewings from children allow sufficient concordant visible points for identification to occur.

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INTRODUCTION

On the 26th of December 2004 one of the largest disasters in history happened when a tsunami occurred in Southeast Asia. Hundreds of thousands lost their lives and many thousands more were affected by loss of family members, relatives, houses and employment.¹

In Thailand the tsunami hit tourist areas and the people who lost their lives came from many different countries. Identification teams from 19 countries were sent to the area to identify the remains. The

teams included police, criminal investigators, forensic pathologists, DNA experts, fingerprint technicians, and forensic odontologists.

In the identification work, postmortem data were collected from the bodies of those found. The police recorded various findings e.g. clothing, tattoos and fingerprints. The forensic pathologist performed a physical examination of the body including notation of scars, missing organs and other physical characteristics that might provide material to facilitate identification. A DNA sample was also harvested. The forensic odontologist examined the teeth and jaws and recorded the dental status by clinical and radiographic examination.

Antemortem data were collected from the missing person's dentist, family and others who had information about the missing person. All information about the missing persons and the bodies found were recorded on INTERPOL Disaster Victim Identification forms. Using computer software programs, antemortem and postmortem information was sorted, and likely matches were postulated. Manual comparisons were then undertaken to confirm or refute a putative match.²

Dental records, fingerprints and DNA alone can each serve as a basis for identification. In cases with partial information within these different disciplines, combined information can be used. Earlier studies, as well as experience from the tsunami disaster, show that dental identification is the method that predominates in disaster victim identification work.³⁻⁵ This is due to the fact that a vastly larger number of people have antemortem dental records compared to the number of people who have antemortem fingerprints or DNA profile recorded.

However, the success of dental identification is partially dependent on the extent of previous dental intervention as recorded on the dental record.^{4, 6-8}

This was clearly seen with the identification of children who lost their lives in the tsunami disaster.⁵

There are several factors that can limit the available comparable data among children. There are often no clinical indications for dental radiographs before the age of five and many children and adolescents have had no restorative care.⁹⁻¹⁰ Another problem is that normal maturational changes occur with children such as loss of deciduous teeth and the development and eruption of permanent teeth. The latter process can, however, be used in reconstructive identification by establishment of the age at death.¹¹

The lack of restorative therapy among many children means that there is limited information for comparison. Even if no fillings exist and treatment need is low, bitewing examinations are almost always a part of the dental record if the child has reached the age of five to six years.^{9,10} These images contain radiographic information that could be used in an attempt to match x-rays of the same person taken some years later, including root and pulp structure. If extraoral images are available, the shape and size of the frontal sinus is regarded as unique for each individual and has been used for identification.¹² By looking at anatomical structures and by undertaking postmortem age stratification, a possible match might not be conclusive, but could be the basis for a combined investigation based on comparison of clothing and personal effects, fingerprints and/or DNA-analysis.

The aim of this study was to investigate manual matching of radiographic examinations from children without fillings in different age groups. In order to see if radiographic expertise facilitates radiographic comparison the matching was performed by both general dental practitioners and oral and maxillofacial radiologists.

MATERIALS AND METHODS

Bitewing examinations in the archives of the public dental clinic at the Dental school in Umeå, Sweden were used. Examinations from three different age groups were collected. From every age group the first ten children who had at least two bitewing examinations with a 1-3 year interval between examinations and who had no fillings were selected, i.e. a total of 30 children. The children were 6-7, 9-10 and 12-13 years old at their first examination and 0.8-3.2 years older at their second examination. Examinations with the longest time interval between

Table 1: Ages of children examined and elapsed time between the bitewing examinations

	Minimum	Mean Value	Maximum
Age at first examination (year)	6.1	9.8	13.7
Time between examinations (year)			
6-7 year	0.8	2.0	3.2
9-10 year	0.9	1.4	2.0
12-13 year	1.2	1.5	2.1
All ages	0.8	1.6	3.2

were seen in the youngest age group with a mean value of 2.0 years. In the group 9-10 years, the mean value was 1.4 years and in the group 12-13 years the mean value was 1.5 years (Table 1).

To mimic the difficulty in finding missing persons among a large number of victims another 20 bitewing examinations from children without fillings and with ages corresponding to the ages at the second examination were selected.

There were seven in the youngest age group, six in the oldest age group and seven in the group in between.

The bitewings from the earlier examinations, simulating antemortem data from missing persons, were marked with letters. The bitewings from the latter examinations and the examinations that had no match simulated postmortem data. These were marked with numbers. The "antemortem material" also included information about sex, examination date, and age at "disappearance". The "postmortem material" included information about sex.

All bitewing examinations were duplicated. One set was sent to the public dental clinic in Vimmerby, Sweden and the other to Oral and Maxillofacial radiology at the department of Odontology, Umeå University. An instruction and an answer form followed the examinations. In the answer form the examiner was asked to combine the number of an examination with the letter of an earlier examination from the same person and grade the confidence of the match as one of three levels; "without doubt", "probably" and "possible". In the confidence level "without doubt" only one proposal could be made. In the other two, "probable" and "possible", more than one proposal was allowed.

Table 2: Total result of matching and results in reference to age and gender of the children, elapsed time between bitewing examinations and examination groups

Category	Amount correct/total	% correct	P-value
Total	265/300	88.3%	
Age at first examination			
6-7 year	80/100	80.0%	
9-10 year	91/100	91.0%	
12-13 year	94/100	94.0%	0.005 ²
Gender			
Boys	144/160	90.0%	
Girls	121/140	86.4%	0.371 ¹
Time between examinations			
<1.5 years	142/150	94.7%	
>1.5 years	123/150	82.0%	0.001 ¹
Examiner			
GDP	117/150	78.0%	
OMR	148/150	98.7%	<0.001 ¹

¹ Fisher's exact test
² Person Chi-square test

Ten examiners compared the images individually, five general practitioners and five oral and maxillofacial radiologist. The number of correct matches were analysed with respect to time between bitewing examinations, age and gender of the children and examiner group. The results were compared using Fishers exact test when two parameters were compared e.g. general practitioners vs. oral and maxillofacial radiologists. If three parameters were compared the Pearson chi-square test was used. The level of significance was set at 5%.

RESULTS

A match was considered correct regardless of the confidence level of the match, i.e. if an examiner gave three answers under the heading "possible" and one of these was correct, this was considered a correct match. The reason for this is that when the possible matches are reduced to a small number the probability of achieving a positive identification based on the dental findings in combination with information from other disciplines (fingerprints, DNA) must be considered high.

The total number of correct matches was 88.3%. The average of general practitioners was 78.0% and for oral and maxillofacial radiologists 98.7% ($p < 0.001$). The time between examinations influenced the possibility of making a correct match.

Table 3: Proportion correct matches in reference to age groups and examination groups

Age at first examination/ examiner	Amount correct/ total	% correct	P-value ¹
6-7 year			
General dentist	32/50	64%	
OMR	48/50	96%	<0.001
9-10 year			
General dentist	41/50	82%	
OMR	50/50	100%	0.003
12-15 year			
General dentist	44/50	88%	
OMS	50/50	100%	0.027

¹ Fisher's exact test

If the time between bitewing examinations was <1.5 years the average correct match was 94.7% and if it was ≥ 1.5 years the correct match was reduced to 82.0% ($p = 0.001$).

There was a statistically significant difference in the possibility of correctly matching images from children in different age groups. In the youngest age group, 6-7 years, (age at the first examination) 80.0% of the children were correctly matched. The corresponding figure was 91.0% in the 9-10 year group and 94.0% in the group 12-13 years of age ($p = 0.005$). The difference between the two examiner groups was also statistically significant. The general dentists made correct matches in 78.0% of the cases and the oral and maxillofacial radiologists in 98.7% (Table 2).

There was also a difference in success rate in the different age groups between the general practitioners and oral and maxillofacial radiologists. The largest difference was seen in the age group 6-7 years where the general practitioners on average correctly matched 64.0% of the cases and the oral and maxillofacial radiologists on average correctly matched 96.0% of the cases ($p < 0.001$). The difference in correctly matched cases was less pronounced, but still statistically significant, in the middle group ($p = 0.003$) and the group 12-13 years of age ($p = 0.027$). The oral and maxillofacial radiologists had a success rate of 100 % in these two groups (Table 3).

If the time between examinations was longer than 1.5 years the general practitioners suggested more than one number ("body found") to a letter ("missing

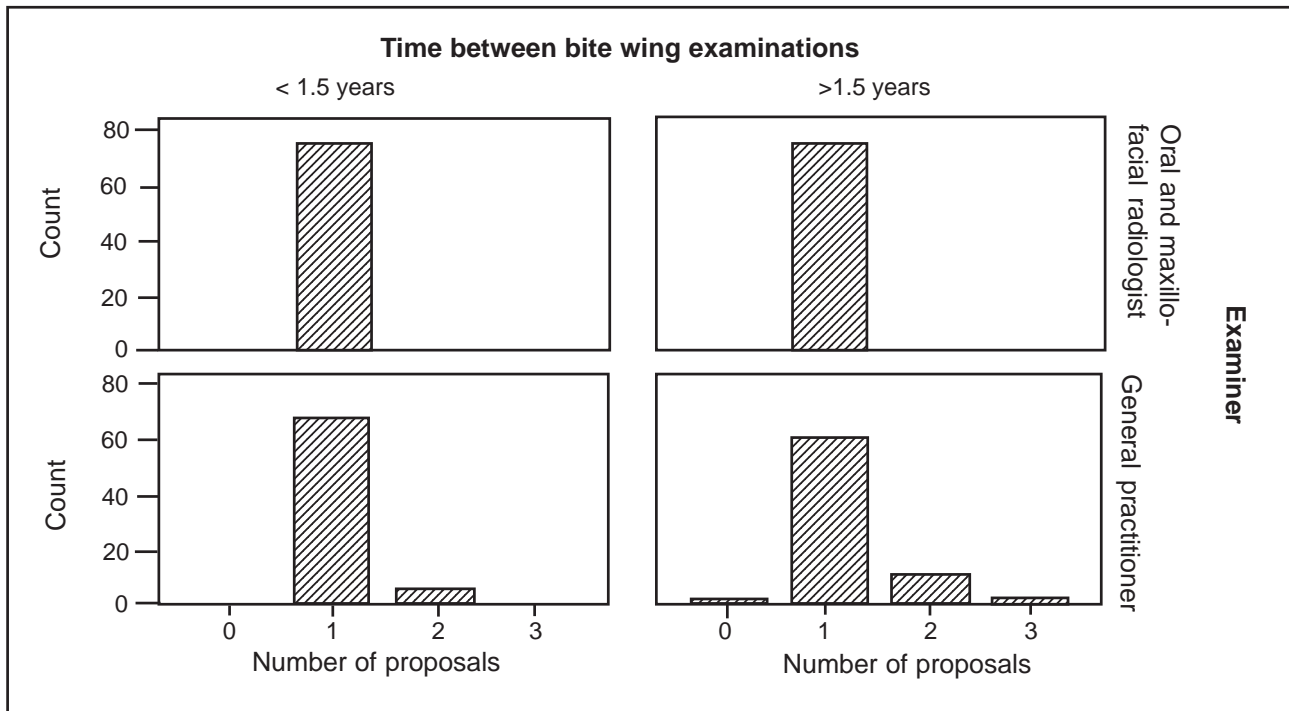


Fig.1: Number of proposed matchings with reference to time between bitewing examinations, and examination groups

person”) more often than if the time was under 1.5 years. The oral and maxillofacial radiologists did not suggest more than one probable and/or possible match at all (Fig.1).

The answers of the oral and maxillofacial radiologists were more often found under the headings “without doubt” and “probably” compared to the general practitioners.

DISCUSSION

This study shows that it is possible to match bitewing examinations of children without fillings who have a 1-3 year interval between examinations. Ten dentists matched bitewing examinations to see how effective the method is. The examiners were general practitioners (five) and oral and maxillofacial radiologists (five). The results show that oral and maxillofacial radiologists have an advantage over general practitioners in matching x-ray images when the radiographic signs are limited to anatomy. Besides a higher score in correct matching, their answers were more often found under the heading “without doubt” and “probably” compared to the general practitioners answers, indicating that the oral and maxillofacial radiologists were more confident in their decisions.

None of the oral and maxillofacial radiologists used the possibility of correlating more than one “found body” to a “missing person” and the matches were almost 100% correct. It is most likely that their greater radiological experience in comparison to general practitioners was an advantage when analysing the radiographs.

The results show that it is more difficult to match images from younger children. This, combined with the fact that dental records from younger children often contain less information that can be used for dental identification than that seen in older children, teenagers and adults, can be one explanation for the relatively large proportion of Swedish children who are still missing after the tsunami disaster. Another explanation could of course be a complete lack of comparable data.

In this study the time that passed between examinations was longer in the youngest age group. From about 6 years and onward the dentition undergoes dramatic change. This is a probable reason for the greater difficulty matching the images in the youngest age group seen mainly in the results of the general practitioners.

The problem with changing anatomy has been discussed by Kirk, Wood and Goldstein.¹² In a retrospective study of 39 cases of identification using frontal sinuses comparisons they concluded that the method was valid for persons older than 20 years. The technique has, however, not been evaluated for young people where the sinuses undergo large changes. They predicted difficulties using the method in persons younger than 20 years.

In conclusion, this study shows that dentists are likely to match bitewing examinations from children without fillings. It also shows that this likelihood is further enhanced when oral and maxillofacial radiologists compare the images. This suggests the possibility that manual comparison of bitewings from children may lead to matches between radiographic data from missing and deceased persons. These matches can, in cases that are not conclusive from a dental point of view, be the basis for a combined investigation based on dental status, fingerprints and/or DNA-analysis.

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Address for correspondence

Jan Ahlqvist
 Department of Odontologi
 Umeå University
 SE-901 85 Umeå
 SWEDEN
 Tel: +46 706176172
 Email: jan.ahlqvist@odont.umu.se