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Contents

The Mesial Root of the Third Mandibular Molar

A Possible Indicator of Age

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The mandibular third molar can be of value in age determining. Johansson[1] reported the case of an unidentified Swedish fisherman whose partly decomposed body had, as its only means of identification, a tattoo on his upper arm. However, a roentgenological examination of the mandible was used to estimate his age by way of the only teeth present, the mandibular third molars.

The characteristic tattoo gave the final positive identity, but 'the contribution of the age determination on the teeth was that the search, from the beginning, could be narrowed to a certain age group of the missing persons'.

This paper reports the findings of a follow-up on the study done by Nortjé[2] in which the stage of development of the third mandibular molar roots was plotted against chronological age. Although this preliminary study yielded good results, it was suggested that a further study, using direct measurement of the mesial root length of the 48 as a possible indicator of age, should be done.

Materials and Method

Four hundred and seven routine panoramic radiographs of Coloured patients taken at the Faculty of Dentistry, University of Stellenbosch, were studied. Ages varied from 15 to 21 years (45% males and 55% females). Direct measurement of the mesial root length of the 48 was made by use of calipers and magnifying lens (Fig. 1). The length measured (given to nearest 0,5 mm) was from the amelo-cemental junction to the tip of the root where calcification could be observed. The subject's demographic data were noted as well as the presence or absence of all 4 third molars and of adjacent molars (46, 36, 47, 37). The stage of development of the roots of the 48 was recorded. Nortjé used 8 stages but found that fewer discrepancies through misclassification would be made if 5 stages were used, viz.:

Stage 1: The root is visible with about 5 mm already formed and the cleft present.

Stage 2: The root has reached one third of the final length.

Stage 3: The root has reached two thirds of the final length.

Stage 4: The root is virtually fully developed, only the apex is not closed; the root canal walls are convergent.

Stage 5: The apex is fully formed and it is possible to see the contour of the periodontal membrane and the root canal walls are convergent.

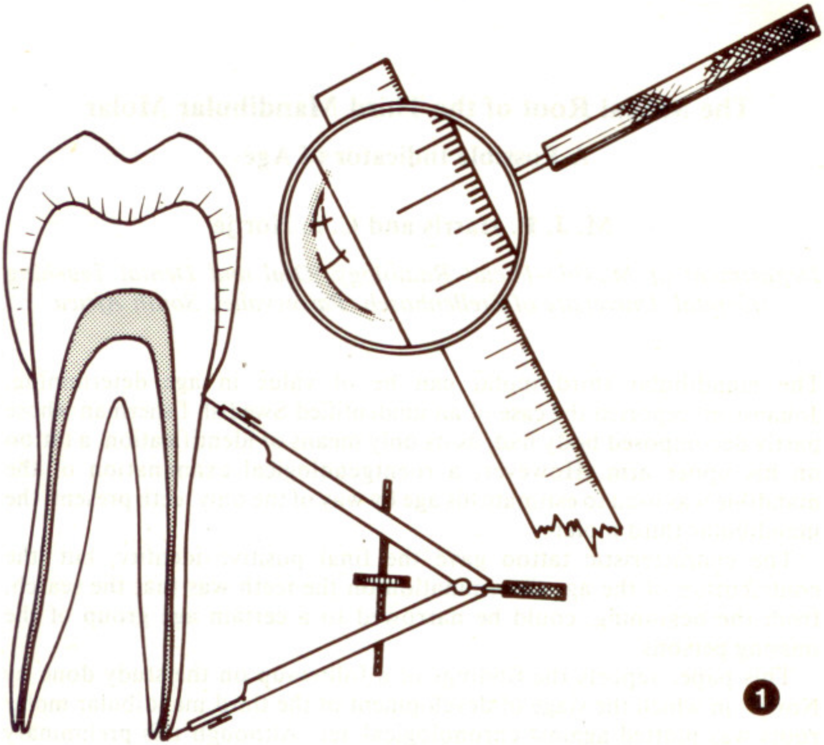

Fig. 1. Caliper and magnifying lens used for measurement of the mesial root length.

The nomenclature for stages 1 and 2 as suggested by Nortjé was varied slightly to read as follows: 'The root had reached one third of the final length (stage 1), and by changing one third to half (stage 2). Any curvature of the roots was taken into account by choosing an arbitrary point in the curve. The parts divided by this point were measured individually along a straight line. The lengths of the 2 parts were then added. This method overcame the effects of a marked curve of the roots. If any visible difference in lengths between the right and the left third molars was observed, the length of the 38 was also noted.

To check the reliability of measurements made by the observer, 2 independent observers also made these measurements in 45 cases. All measurements were made on pantomographs taken on a General Electric panelipse machine.

Results

The correlation between the measurements made by the author and the 2 independent observers was significant at the 95% level. The mean ages and lengths with the standard deviations within the 5 stages are shown in Fig. 2. Analysis of the frequencies of the absence of the molars revealed that 52,5% of the first molars and 27% of the second molars were absent. The

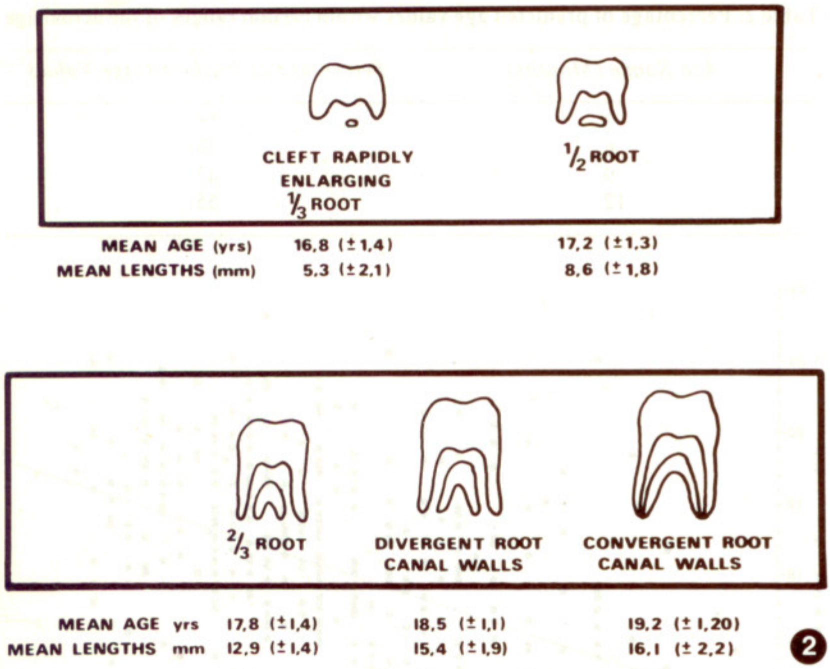

Fig. 2. The 5 stages of mandibular third molar root development with the corresponding mean ages and mean lengths.

effect that these absences would have on the root development of the third molar was then investigated. The result indicated a significant difference between the mean lengths of the groups with and without the first and second molars (Table 1).

Table 1: Mean lengths of 48 root in relation to absence or presence of adjacent molars

Tooth	*Length (mm)*
46 present	11,9
47 present	11,9
46 absent	13,0
47 absent	13,9

The percentage of predicted age values within certain age ranges of the actual age are given in Table 2. Only 18% of the predicted age values lie within a 3-month range of the actual age; 30% within a 6-month age range of the actual age; 42% within a 9-month age range of the actual age and 55% within a 12-month range of the actual age.

The graph in Fig. 3 represents a positive linear correlation between age in years and length of root in mm. No difference between males and females was observed.

Table 2: Percentage of predicted age values within certain ranges of the actual age

Age Range (Months)	*Percentage of Predicted Age Values*
3	18
6	30
9	42
12	55

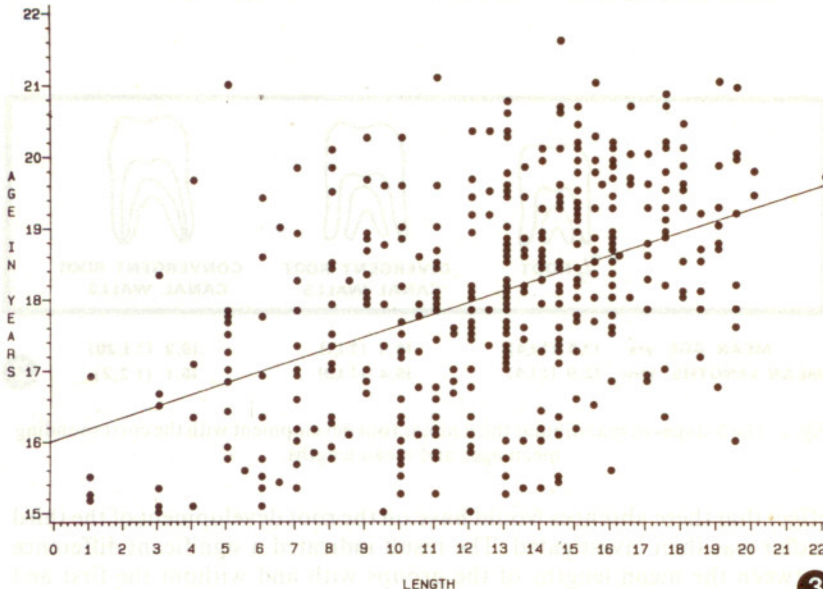

Fig. 3. The third mandibular molar. Graphic representation of the correlation between age and length of root.

Discussion

Analysis of molar root development data for Coloured patients, using the direct measurement method, compares very favourably with the study by Nortjé[2] in which he merely made use of visual interpretation. Furthermore, a strong correlation of the mean age values within each stage root of development exists between the values obtained in this investigation and those of Johansson[1] and Nortjé.[2] The discrepancies due to misclassification of stages of development of the molar as reported in the previous study have, to a large extent, been eliminated by using the 5 stages described above. A further problem that could arise is that of interobserver error of measurement. We investigated this possibility and found a significant correlation between measurements made by the 3 observers.

Engström[3] investigated the relationship between the mandibular third molar, chronological age and skeletal maturation and found strong correlations between these variables.

Our study was limited to the correlation between mandibular third molar development (by way of direct measurement of root length as well as stages) and chronological age with the correlation co-efficient $r = 0,452$, $p < 0,001$ for the first method. A future study could include skeletal maturity as a variable.

Engström also found that the lower third molar developed slightly earlier in males than in females, although the difference in age at the various lower third molar developmental stages was not statistically significant at the $p < 0,05$ level. This finding correlates with our findings.

This study on Coloured patients revealed a very high percentage of absent first and second molars. We also found a significant difference in third molar root lengths, possibly due to the absence of these molars (Table I), which may accelerate root development and early eruption of the third molar tooth. Finally, a further investigation, where the first and second molars are present, should be undertaken to determine whether this significant difference in molar root length is due to the absence of these molar teeth.

Conclusion

This investigation revealed that, with the direct measurement method, the chronological age of a subject could be ascertained within 31 months with 95% confidence and within 40 months at a 99% confidence level, and compares very favourably with the study by Nortjé[2] in which he merely made use of visual interpretation. Obviously the use of the third mandibular molar for age determination has certain shortcomings and limitations which must be borne in mind when predicting age, but for forensic purposes it could be a good predictor of age between 15 and 21 years of age.

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Probabilities of Dental Characteristics

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Summary

Probability theory has applications in the field of dental identification, including forensic odontology, since the uniqueness of a particular dental profile can be estimated, with an associated degree of certainty. This article reviews the literature dealing with the probabilistic aspects of dental identification, and expands the underlying mathematical theory.

If prior knowledge is available to provide the frequency with which certain dental characteristics occur in the general population, a mathematical model can be established from which the probability of occurrence of a specific dental configuration can be obtained. An example is given, which compares data from three Cape Peninsula populations.

Introduction

The probabilistic aspects of dental identification are relevant in forensic odontology, for example when bite marks of a suspect are identified, or in the identification of victims of a mass air disaster. In both cases the identity of an individual is established on the basis of the "uniqueness" of the particular dental profile of that individual. From the statistical viewpoint, however, the question must be posed as to the degree of certainty with which any specific identification can be made. This article reviews some applications in the literature and discusses and expands on some of the probabilistic concepts which have been put forward. Empirical estimates are derived of the probability of people having similar sets of dental characteristics, based on surveys carried out in the Cape Peninsula, and finally a mathematical model is proposed which appears to have considerable merit for dealing with this situation.

Dental Identification of Criminals

Surprisingly perhaps, there is very little in the dental literature dealing with the probabilistic aspects of dental identification. Evidence based on bite marks has, however, led to conviction of suspects in court on various occasions. For example, Dahlberg[1] describes how an individual left the imprints of his teeth in a piece of cheese during a night robbery of a grocery store. This person had taken three bites in the cheese, leaving unmistakeable marks of several characteristics of his teeth. Once the local local police had found a suspect with comparable dentition characteristics, consultation followed with forensic personnel in Chicago who then produced estimates of the probability that the suspect was the person who had made the tooth marks in the cheese. It was estimated that the probability of an individual having a mesio-incisal defect on the mandibular left canine, such as was shown on the cheese, was 1 in 100. Similarly, the possibility of the maxillary incisors being missing was 1 in 10. Probabilities were allocated to other characteristics, and a combined probability of 1 in 2 000 000 was computed. Faced with these figures, his attorney advised the suspect to plead guilty, which he did.

Vale *et al.*[2] show how a comparison was made between bite marks observed on the nose of a female homicide victim and the configuration of the dental structures of a male suspect. In a discussion of the probability considerations, the five most distinctive tooth marks were considered. It was assumed that each tooth represented could be forward of normal alignment, in normal alignment, or set back from normal alignment. Also each tooth could be rotated to the right or left, or show no rotation. Thus each tooth would have a total of $3 \times 3 = 9$ possible positions, and the total number of possible arrangements or combinations of the five teeth could be calculated to be 59 049. It was argued therefore, that the probability of the particular arrangement of these teeth occurring by chance would be 1 in 59 049. The likelihood of a coincidental concordance was further investigated by a study of 710 randomly assorted models of adult dentitions which were matched against the bite mark at two local universities. Not one of the 710 cases matched the bite mark. The dental investigation and subsequent dental testimony were prime factors leading to the defendant's conviction of manslaughter.

The basic reasoning in each of the above cases is that the dental characteristics of the suspect which appeared to match the bite mark, are one of a large number of possible configurations of characteristics and it is therefore improbable that a close match between the bite mark and the suspect's teeth would be obtained purely by chance. A more meaningful approach to the problem would be possible if prior knowledge was available of the frequency with which certain dental characteristics occur in the general population.

MacFarlane *et al.*[3], in discussing the identification of a suspect from a bite mark, point out that where there is a close correspondence of features, especially unusual or particularly distinctive features, positive identification can be made. They go on to state however, that if particular emphasis is to be placed on various characteristic features of the teeth, then it is pertinent to ask how common such characteristics are in the general population. The authors then report on a survey of a sample of 200 patients who attended the outpatient clinic at Glasgow dental hospital. Models were made of the 6 upper and 6 lower incisor teeth, since these frequently give the most useful bite marks. Various characteristics were then noted, such as the relation of the individual teeth to the arch form and to rotation. The authors give useful information on the occurrence of certain tooth characteristics in the sample studied, and the upper 95% confidence limit of these characteristics in relation to the Glasgow population. The method which they use to work out a combined probability for a specific set of characteristics is, however, woefully inadequate since this is done by simply multiplying together the upper 95% confident limits.

A paper later appeared by Aitken & MacDonald[4] in which a very elegant mathematical treatment of the results obtained by MacFarlane *et al.* was carried out using the Kernel method. Aitken & MacDonald examined 28 features for each patient. 12 of these features related to tooth status, which was assessed for each of the 6 upper and 6 lower anterior teeth. The presence or absence of individual natural or artificial teeth and details of shape and any fractures were noted for these teeth. The relation of each of the 8 individual incisor teeth to the arch, was assessed in 7 categories and noted in the following 8 features. Similarly the rotation of each of these 8 teeth was assessed in 9 categories and noted in the last 8 features. Using the Kernel method, the authors were able to calculate the probability of a particular dental characteristic, given that certain other dental characteristics had been observed. For example, the probability that the third lower incisor would be found in a position behind the arch given that the first, second and fourth were in their natural positions, was computed to be .051. They illustrate how the method can be used to calculate the upper confidence limit of a probability associated with the particular dental characteristics noted for a suspect in a court case. In general if such a probability is very small, i.e. if the particular configuration of dental characteristics of the suspect occurs only very rarely in the population, then identification can be made with a high degree of certainty.

Further statistical techniques which have forensic applications have been derived by Evett.[5] Evett provides quantitative interpretation of scientific forensic evidence in cases where material is transferred during commission of a crime, using an approach based on Bayesian inference.

Dental Identification in Mass Disasters

As Kogon *et al.*[6] have pointed out, history has recorded numerous events in which literally thousands of lives have been lost due to natural disaster. Explosions, fires and floods consistently take their toll of hundreds of people every year. In spite of the inherent safety of our transport system, accidents do occur which may result in the death of many people at one time. For legal, moral and personal reasons a positive identification of victims of a mass disaster is often demanded. Whenever a large amount of soft tissue has been destroyed by fire, trauma or decomposition, dental identification becomes important since the hard dental tissues of the human body are most resistant to destructuring. Furthermore, when dental treatment has been carried out, the dentition becomes individually characteristic. Kogon *et al.* provide a computerised method for the comparison of the dental characteristics of the victims with those of dental records. The problem of assessing the degree of certainty of dental identification is not, however, dealt with.

Keiser-Nielsen[7] underlines the fact that the dental expert cannot base his identification of an unknown body on the relative frequency of occurrence of any single dental feature and points out that an evaluation must be made of the combination of features involved. Looking only at the number of teeth which are missing or filled, he calculates the number of ways in which a specific configuration (i.e. the given number of teeth missing and the given number filled) can occur and makes deductions concerning the probability of a particular person having a configuration which is the same as that listed in some dental record.

The ideas put forward by Keiser-Nielsen appear to warrant closer investigation, and the reasoning can be extended to take account of teeth which are decayed but not filled. Under the assumption that we are dealing with a maximum of thirty-two teeth let

N equal the number of normal teeth,
M equal the number of missing teeth,
D equal the number of decayed teeth, and
F equal the number of filled teeth.

Dental records may then be compiled for each member of the population, in which the status of each tooth is indicated as belonging to one of the four above categories, i.e. normal, missing, decayed or filled. If a person has thirty-two normal teeth then there is clearly one way in which this could occur. If, however, it is stipulated that he has thirty-one normal teeth and one missing tooth, this could occur in thirty-two different ways, since any of the thirty-two teeth might be missing. Similarly if he has any two teeth missing this could occur in

$\frac{32}{1} \times \frac{31}{1}$ different ways.

In general it is possible to show mathematically, that the number of ways in which m teeth can be missing out of 32 normal teeth is given by

$$\binom{32}{M} = \frac{32!}{(32\text{-}M)!\,M!}$$

(where 32! is the product of all the integer numbers from 1 to 32). When we take account not only of missing teeth, but also of teeth which may be normal, decayed or filled, it can be shown that the mathematical expression for the total number of combinations C, for given values of N, M, D and F is given by

$$C = \binom{32}{M}\binom{32\text{-}M}{D}\binom{32\text{-}M\text{-}D}{F}$$

This may be written as

$$\frac{32!}{M!\,D!\,F!\,N!} \qquad \text{———————— (1)}$$

taking note of the fact that the number of normal teeth N equals

$$32 - M - D - F$$

If we further wish to consider the total number of combinations for all possible values of N, D, F and N this would be given by

$$\Sigma \frac{32!}{M!\,D!\,F!\,N!}$$

which equals to 4^{32} or $1{,}8 \times 10^{19}$.

It is therefore clear that if we merely consider the four possible states of a tooth, there is a vast number of possible combinations. If a specific individual is found with a given number and specific configuration of normal, decayed, missing and filled teeth, some indication as to the likelihood of finding another individual with identical dental features can be obtained by evaluating equation (1) above for various values of M, D, F and N. This is given in Table I.

From the table it can be seen that at the two ends of the spectrum, i.e. where we are dealing with a nearly normal or an almost edentulous mouth, the total number of possible combinations is not large. However, as the number of missing and decayed teeth increases, so the number of possible combinations increases, and hence the likelihood *if given an individual with a specific configuration,* of finding another individual with exactly the same configuration appears to become very small.

There are, however, two drawbacks to the above reasoning. Firstly, it assumes that the dental characteristics are uniformly distributed, i.e. any event, such as a missing tooth, is just as likely as any other. Secondly it assumes that the events relating to a particular tooth are completely independent of those relating to any other tooth. This is unlikely to be true in practice. Furthermore as we have pointed out above, the usefulness of this type of information in the actual identification of an individual will depend very much on the overall dental state of the population from which he or she is drawn.

Empirical Evaluation

In order to get an empirical evaluation of the likelihood of two or more people having an identical configuration of decayed, missing and filled teeth, information on three populations was studied. The first consisted of Coloured high school children drawn from schools in the Cape Peninsula, aged 15 to 19 years. A computer program was written to firstly group together those persons who have the same frequency of decayed, normal, missing or filled teeth and then within these sub-groups, to search for perfect matches in respect of tooth position. Out of the total sample of 178, two identical pairs were found and one identical triplet, involving a total of 7 individuals. Thus in this particular population, we could expect doubt as to identity to arise in the case of some 4% of the population.

The second sample related to 255 cases, drawn from the Rylands area including those from a reform school. Of the cases 46 were found to be edentulous and could therefore not be differentiated on the basis of the information studied. Of the remaining 209 all showed unique patterns, thus no matches occurred. Therefore all cases could be uniquely identified on the basis of dental records.

The third data set related to a survey of Cape Coloured families taken from various socio-economic strata. Here it was decided to look only at persons over the age of 20 years.

Out of a total of 810 such persons 11 identical pairs were found, three identical triplets and one identical quadruplet. Thus doubt would exist in the identification of 35 persons out of 810 or approximately 4,3%. Clearly it might be possible to uniquely identify some or all of these individuals if further dental characteristics were taken into account.

Refinement of Approach

As stated above, one drawback of the combinatorial approach suggested by Keiser-Nielsen and given in an expanded form above, is that all events in respect of each tooth position are regarded as equally likely. It is possible to refine the approach by taking account of the probability of each event in relation to each tooth position, thus for example, an estimate would be calculated of the probability that the first lower incisor is either normal, missing, decayed or filled. A similar set of probability estimates must be available for every other tooth or tooth position. We have attempted to estimate these probabilities from the three data sets mentioned above. The probability of a specific tooth configuration can now be calculated.

If the teeth are numbered from 1 to 32 and the probability of tooth i being e.g. missing denoted by $p(i_M)$, then under the assumption that the different teeth are independent, the probability for the configuration 1_N, 2_D, 3_F, . . .,32_H (i.e. the first tooth healthy, the second decayed) is equal to:

$$p(1_N)p(2_D)p(3_F)\ldots p(32_N)$$

This involves a total of 32 x 4 = 128 probabilities, e.g. $p(13_D)$, which can be estimated from a sample and may be denoted by e.g. $\hat{p}(13_D)$. These estimates will also have the characteristic that

$$\hat{p}(i_N) + \hat{p}(i_D) + \hat{p}(i_F) + \hat{p}(i_M) = 1$$

for each of the 32 teeth.

These 128 probabilities were estimated separately in each of the three samples mentioned above. We will now examine some examples. The probability of the configuration

$1_N\ 2_N\ 3_M\ 4_M\ 5_N\ 6_N\ 7_N\ 8_M\ 9_M\ 10_M\ 11_M\ 12_M\ 13_D\ 14_D\ 15_D\ 16_D$
$17_N\ 18_N\ 19_N\ 20_N\ 21_N\ 22_N\ 23_N\ 24_N\ 25_N\ 26_N\ 27_N\ 28_N\ 29_N\ 30_M\ 31_M\ 32_M$

was in (i) the sample of Coloured high school children equal to:

$1{,}77 \times 10^{-16}$

(ii) the sample from the Rylands area (including the reform school)
$2{,}46 \times 10^{-15}$

(iii) the sample of adult members from Cape Coloured Families
$1{,}60 \times 10^{-18}$

It will be seen that these estimates differ greatly amongst each other, so severely that for example (i) it is 0,07 times the estimate in sample (ii) and 110,17 times the estimate in sample (iii). It is therefore necessary to be sure from which population the estimate is obtained.

Conclusion

1. The expansion of the approach put forward by Keiser-Nielsen indicates that at either end of the range where, on the one hand we have a mouth of almost entirely normal teeth or, at the other end, an almost completely edentulous mouth, there are few possible configurations and we are unlikely to be able to identify people with any degree of certainty. In the central part of the range, however, where the individual may have an assortment of normal, decayed, missing or filled teeth, a specific configuration is likely to be rare and should lead to positive identification in most cases.

2. The calculation of actual probabilities based on the samples has shown that the assumption of equal probabilities for normal, decayed, missing or filled teeth is unrealistic, and may therefore, be dangerous.

3. If the entire population is studied, the probability can be estimated for each tooth of a specific condition occurring; however, the populations which we have studied, differed considerably in respect of the estimated probabilities. When faced with the problem of identifying either an individual (on the basis of bite marks), or a group of people (as in a mass air disaster) it is important to know the type of population from which those involved, have come.

Acknowledgement

We would like to thank Prof. W. van Wyk, for providing the data used in example (i) and (ii) and Prof. N. Louw for providing the data used in examples (iii). Thanks are also due to Mrs. Miriam Goldenfarb for programming the various computations, and to our colleagues who contributed various suggestions on the approach to the problem.

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Child Abuse and A Bite Mark
A Case Report

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A one-year-old boy was brought to a pediatrician by his foster mother for a routine physical examination. During the examination the child was found to have a vividly discoloured bite mark on his abdomen and, as he later testified in court, the physician was 'incensed' at what he considered was a 'recent vicious injury'. He photographed the mark with 35 mm colour transparency film (Fig. 1) and measured the overall mark width, the central ecchymotic area and the lengths of the lineal marks which could have been caused by the incisal edges of upper front teeth. He also compared the dimensions of the mark with that of the dental arches of an adult female present at that time and concluded that the mark was caused by a recent adult human bite.

Fig. 1. The bite mark. The teeth marks are indicated and the centrally situated dark area is due to ecchymosis.

The physician then alerted the Children's Protective Service of the County Department of Social Services. A police academy trained investigator of the Children's Protective Service narrowed the number of possible perpetrators to 3, and obtained written releases for their dental examinations. The dental examinations were taped; and witnessed by a police detective. They included visual examinations, photographs, impressions, and bite marks into warmed base plate wax.

Comparison of the results of the dental examinations with the slide of the bitemark indicated that, within the limits of dental probability, only one of the 3 suspects could have made the mark. This person was charged with Cruelty to Children by the County Prosecutor and arrested by the police. The defendant was tried in the Juvenile Division of Probate Court, and the District Court and, because of sufficient evidence, it was referred to the Circuit Court. Upon acceptance of a *nolle prosequi* motion, the case was not tried or adjudicated in Circuit Court, but dismissed.

The decision not to prosecute further was based upon 3 considerations:

i. The County Prosecutor felt that the probability of a first-offender grandmother receiving a severe sentence from a jury for a bite mark which some might view as a love bite was rather remote, especially considering that in Michigan the maximum possible sentence could be only 4 years.

ii. The child had been repeatedly abused by his natural parents to an extent that he required hospitalization. Sentencing the grandmother would not correct that situation.

iii. The plea bargaining included the unconditional release of the child for adoption, thus removing him from all 3 prior sources of abuse.

In view of these considerations, it was felt that the most important aspect of the case, which was the future well-being of the child, would be better served by complete separation from his abusers than by a quite possibly light sentence to but one of his three abusers.

Discussion

An unusual feature of this case was that the only photograph or other hard evidence of the bite mark was a less-than-ideal 35 mm colour transparency of the baby's abdomen, taken from several feet away without the inclusion of a dimension indicator. (Two police laboratories attempted to enhance the slide, with little success). The evidence used in Court was an outline tracing made by projecting the slide to an enlargement which coincided with the dimensions of the actual bite mark on the child's abdomen, as observed and measured by the pediatrician at the time of his examination. The projection of the slide and the tracing of the marks were witnessed by 2 police officers and 2 dentists.

Details of the marks corresponded with those of maxillary anterior teeth of average size, configuration and alignment in an adult upper dental arch of average size and contour. The marks made by the incisal edges of the maxillary centrals were 7 to 8 mm and the laterals 5 to 6 mm. There was a large ecchymotic central area and the marks corresponding to the mandibular anterior teeth were irregular, with indications of significant diastemata. The overall width of the mark was approximately 50 mm.

Upon dental examination of the 3 suspects, the mother had peg or miniaturized lateral incisors and a normal lower dentition. The father exhibited an upper central incisor in quite obvious labioversion and normal lower dentition. The third suspect, the paternal grandmother, had a complete upper denture and had lost 2 lower incisors, resulting in significant diastema effect and incisal irregularity.

The thrust of the dental Court testimony was that neither the mother nor the father could, within reasonable dental probability, have made the bitemark.

Conclusion

It is felt that 3 aspects of this case are unusual:

i.The alertness, concern and cooperation of the physician and the Children's Protective Service Agent.

Without a photograph and the actual measurements, both of which were done by the physician, the dental evaluation of the mark would have been nearly impossible. Without the narrowing of the field of possible suspects by the agent to only 3 persons, the case may not have come to court at all.

ii. As far as is known this was the first Michigan criminal case in which a bite mark was the crucial or the only evidence presented.

iii. The bite mark was made by using a complete denture. There seem to be few such cases in the literature.

A Case of Non-Identification in Which Marine Biology Played a Role

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Abstract

A case is presented involving the discovery by divers, of a human skull and a long bone next to a sunken yacht in 19 metres of water, two kilometres off a Durban beach. The skull with three teeth present was thought to be that of a surfer who had disappeared in the same area two years previously. The long bone was identified as that of a dog. As barnacles were present on the skull and teeth the opinion of a Marine Biologist was obtained. By comparing the dental records of the missing surfer with those of the skull it was concluded that the skull did not belong to the missing surfer.

Key words: Identification, Barnacles, Marine Biologist.

Case Report

The Department of Dentistry of the University of Durban-Westville has been involved in Forensic Odontology cases over the past 18 months. All investigations are conducted in conjunction with the Chief Pathologist and his Staff of the Department of Health and Welfare, Durban.

A skull of which the mandible and left temporal bone were missing and a long bone were found on the sea bed at a depth of approximately 19 metres. The site was two kilometres off-shore between African beach and Limestone reef in the Indian Ocean off Durban. The skull and bone were discovered next to the wreck of the sunken yacht, "Dulcimer", by five trainee divers from the Durban Undersea Club. The "Dulcimer" sank in mysterious circumstances off Durban's Addington beach in August 1983. Two runaway Transvaal schoolboys had taken her from her Point Yacht Club moorings in what they later said was an attempt to leave the country. They abandoned "Dulcimer" when she apparently was caught up in the shark nets and tethered her to a net buoy off Durban's African beach. They returned to shore in the yacht's dinghy. An attempt by a Naval craft to tow the "Dulcimer" back to port failed when she started taking in water and subsequently sank.

Findings

The skull (Fig. 1) had three teeth present, i.e. the left and right maxillary first molars and the right canine. The sockets of teeth which appeared to have been lost post-mortem were those of the right maxillary second molar, both premolars and both incisors. The left maxilla showed incisors, canine and premolars missing as well as the second molar. No fillings were seen in the teeth present. The cusps and fossae of the molars showed a slight degree of attrition. The sharp edges of the bony sockets showed no evidence of periodontal disease. Marked staining of the enamel on the palatal aspects of the teeth with a black pigment suggested the victim was a heavy smoker. Small barnacles, the largest measuring 4 mm in diameter, were found attached to the base of the skull and the enamel surfaces of the teeth (Fig. 1 and 2).

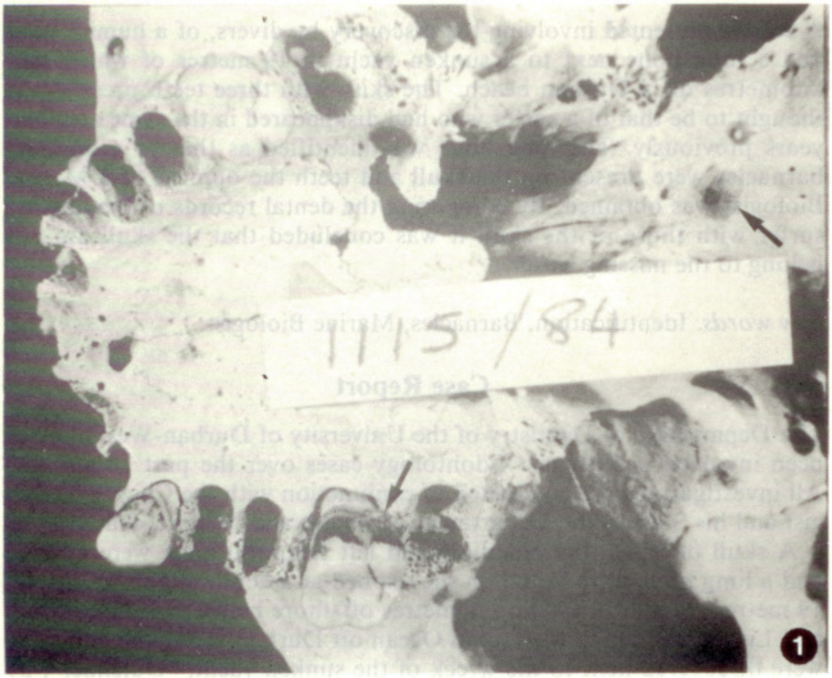

Fig. 1. The base of the skull and maxilla showing the small barnacles attached to the palatal aspect of the right molar and basilar bone (arrows).

The skull was sent to an anatomist at the Natal Medical School. He reported that the features were in keeping with that of an adult male caucasoid over the age of 21 years. The long bone was that of a dog.

The missing persons list in Durban was consulted. A report by the Police and a subsequent newspaper report indicated that, two years previously a young male surfer had disappeared off the Durban beach area. It was felt that the skull could be that of the missing surfer. His dental records were obtained from a Pietermaritzburg Dentist. They covered a period from 1969-07-04 to 1980-04-25. The initial treatment having been carried out when he was 7 years old. The dental record

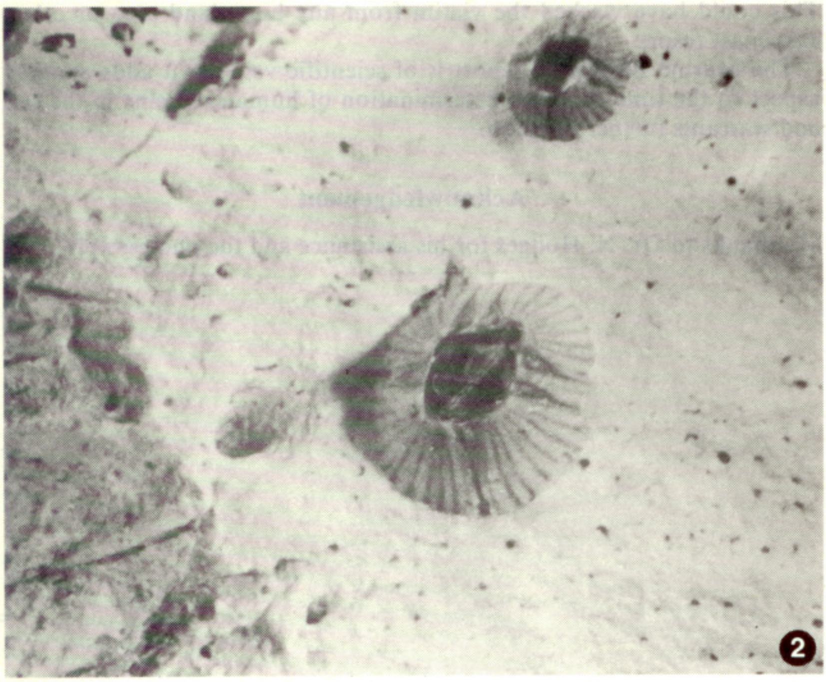

Fig. 2. A close up view of the barnacles attached to the bone.

showed that the surfer had occlusal amalgam restorations in his upper first molars and that he had his maxillary first premolars extracted for orthodontic reasons. These features did not concur with those of the skull.

An estimation of the length of time the skull had been in the sea was required as this would lead to an approximate time of death of the victim. The skull was submitted to a Marine Biologist in Durban for his opinion. He reported that the crustaceans present on the skull were commonly known as acorn barnacles. Their scientific name being *Balanus venustus.* These are fast growing barnacles and filter feeders. Because of this they would not survive or grow if the skull was buried under the seasand. It was estimated that the barnacles had been growing for 3-5 months, and therefore the skull had been in the sea for at least this period of time.

Discussion

The skull was definitely not that of the missing surfer, but it posed questions as to its origin because during the period January and February 1984 the cyclones Demoina and Imboa struck the Natal coast causing rivers to flood, strong underwater currents and heavy sea swells.

This could have washed the victim from any hinterland area or other east coast resort.

The Marine Biologist's report is of scientific value as it adds another aspect to the time of death determination of human remains in the sea and warrants further research.

Acknowledgement

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