

Can dental arch size be used to determine the age of the perpetrator of a bite injury?

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Abstract

A question commonly asked by Investigators is whether or not a bite mark injury can be ascribed to a child or to an adult on the basis of its apparent size. We review the literature in relation to this question, and demonstrate that there is a wide variation in arch sizes in both males and females in both adult and juvenile cohorts. Because some of these ranges overlap, there is great danger in reaching some conclusions without further information to aid the decision-making process. We conclude that arch measurement alone is not a sufficient characteristic on which to base an opinion.



Gender	Age	Males			Females		
		Mean	SD	Range	Mean	SD	Range
Intercanine width							
F	5	28.4	1.98	25.6-32.3	22.2	1.11	20.0-25.5
M		30.5	1.87	26.8-32.8	23.7	2.14	20.0-26.4
F	7	29.9	2.09	25.6-33.9	24.6	1.93	20.3-27.9
M		32.0	1.48	28.4-36.2	26.2	2.18	21.5-28.9
F	10	31.2	1.65	28.0-34.8	25.9	1.51	21.3-28.0
M		33.7	2.02	29.8-36.8	27.8	1.82	22.0-29.5
F	13	32.0	1.50	28.5-35.3	25.6	1.42	22.2-28.2
M		34.2	2.05	30.1-37.6	27.3	1.99	22.3-29.2
F	16	32.3	1.53	29.0-35.3	25.4	1.70	22.1-28.4
M		34.5	1.77	30.4-37.8	26.8	1.79	23.5-29.1
F	31	32.3	1.48	29.1-34.5	25.3	2.01	21.0-28.0
M		34.4	2.02	30.1-37.5	26.1	1.38	22.5-28.5

Introduction

When investigating bite marks, the forensic investigator will analyse the bite mark as they would any other piece of physical evidence. They will look at 'Class' and 'Individual' characteristics of the bite mark. In the present context, arch size would be designated as an Individual characteristic.

The "ideal" bite mark results from contact between the substrate and all six incisor and canine teeth of each arch, and sometimes with additional teeth as well. In practice, this is not always the case, and sometimes partial arches are recorded. We are reluctant to consider analysis of "partial" bite marks except in exceptional circumstances when the quality of the injury and/or its imaging provides a compelling case.

Bite Mark Analysis

A full bite mark examination comprises two stages.

The first is *bite mark analysis*, in which an alleged injury or images of an alleged injury thought to be a bite mark is examined to determine if it is indeed a human bite mark, and if sufficient information is present to permit a valid comparison between it and possible suspect dentitions. At the analysis stage, the quality of the available evidence relating to the alleged injury is carefully assessed.

If the analyst believes that there is enough information to move forward, the second phase, *bite mark comparison* is undertaken. This is the stage where the alleged injury is compared with the suspect dentition or dentitions (or representations of this), and conclusions are reached.

¹ Barsley RE, Lancaster DM. Measurement of arch widths in a human population: relation of anticipated bite marks. *Journal of forensic sciences*. 1987;32(4):975-82.

² Thilander B. Dentoalveolar development in subjects with normal occlusion. A longitudinal study between the ages of 5 and 31 years. *European journal of orthodontics*. 2009;31(2):109-20.

³ Bernstein ML. Chapter 5 - The Nature of Bitemarks. In: Dorion RBJE, editor. *Bitemark Evidence - A Color Atlas and Text*. Boca Raton, London, New York: CRC Press; 2011.

Literature

Arch widths in bite marks generally fall in a specific size range. The work most commonly referred to in terms of arch widths in the forensic odontology literature is Barsley et al.¹ who found that the mean intercanine arch width measurement of the adult (14-87 years) maxillary dental arch was 35.9 mm and the mandibular arch was 28.1 mm from a population of combined whites and blacks attending a dental school. These authors noted that blacks had a larger mean intercanine width in both arches than whites. The corresponding intercanine width measurements for white males were maxillary: 36.0 mm, mandibular: 27.8 mm, and for white females, maxillary: 34.4 mm and 26.8 mm. There were problems with this study, however. These included that the intercanine width was measured from the labio-distal aspect of worn canines instead of from the centre of the worn area, and that if canines were missing, the measurements were taken from the next most distal tooth unless no posterior tooth was present, in which case it was taken from the next most anterior tooth in the arch. The mean widths are therefore likely to have been overestimated.

The more recent study by Thilander² examined a large sample of Swedish caucasoids with normal occlusion. Intercanine width dimensions are shown in Table 1. Bernstein³ maintains that bite marks arising from children are typically smaller than those of adults and feature smaller, rounded, bowl-like arches. He maintains that the mean maxillary intercanine width measures 28-29 mm from ages 3-6 years and the mean mandibular intercanine distance is approximately 22.6 mm. These mean measurements are broadly concordant with Thilander's² results.

Conclusion

A review of the literature allows us to conclude that arch measurement alone is not a sufficient characteristic on which to base an opinion. Overlapping of arch width amongst various cohorts (gender, age and ethnicity) indicates the The results of the study by Thilander² clearly demonstrate the overlap

Limitations such as correct imaging of the bite, history, a comparison bite of the suspect, and context....

If an injury features arch widths that fall substantially outside the ranges given by Thilander² without an adequate explanation, we believe that further analysis of the injury as a bite mark should cease at this point.