A Fixed Dental Appliance as a Supplementary Aid in Bite Mark Analysis.

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A Fixed Dental Appliance as a Supplementary Aid in Bite Mark Analysis

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Abstract

No study has been undertaken which has proved that each individual human dentition produces bite wounds that are so distinctive that no other person could possibly be implicated in their commission.

This case illustrates how a fixed orthodontic retainer in a person suspected of having bitten a victim left a diagnostic imprint that narrowed the range of possible suspects significantly, increasing the evidential value of the bite mark comparison and preventing his exclusion as the causative individual.

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Introduction

During the commission of a violent act, a female person was alleged to have been bitten several times in various sites by a male assailant.

De-identified casts of the teeth of both the victim and the alleged perpetrator were obtained and made available to us for analysis, together with a number of photographic prints of the alleged bite injury (Figure 1).

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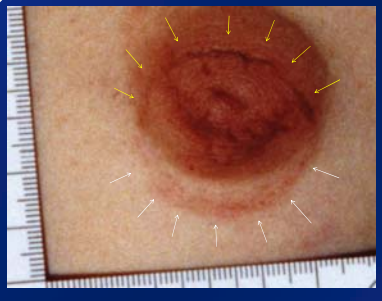

Figure 1.

This image shows one of the injury sites present on the alleged victim.

It shows two separate groups of injuries displaying class characteristics consistent with those commonly observed in bite marks of human origin.

The features of the lower wound suggest that the arc towards the top of the image (yellow arrows) was probably made by upper teeth, and that in the lower part of the image (white arrows) was likely to have been made by lower teeth.

This is a good example of a multiple-bite type injury. One portion of a second bite mark may be noted inside the oval-shape left by the first injury.

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Analysis

Analysis of the components of this injury was undertaken by our standard procedure. This involves the following steps:

a)Making a "simulated wound" by biting the teeth of a dental study cast into a substrate (dental wax) and comparing the features of the mark produced with those present in the supplied image of the alleged victim.
b)Comparing the simulated wound with that on the supplied image, paying great attention to correct scaling of the compared images. This allows us to determine if there is a pattern-match (Figure 2).
c)Using the simulated wound comparison to place the teeth from the dental model by a similar procedure to that in step (b) (Figure 3);
d)Performing laser contour analysis of the teeth of the dental cast and using them to analyse the three-dimensional relationships between the features of the dentition and those of the wound on the supplied image.
e)Determining the degree of similarity between the features of the teeth on the dental cast, the simulated wound and the image of the wound supplied by police, and attempting to exclude the person from whom the dental study cast was taken on this basis.

The process is illustrated for the lower teeth of one supplied dental study cast.

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(a) Simulated wound in position at 100% opacity

(b) Simulated wound in position at 30% opacity

(c) Simulated wound in position at 10% opacity

(d) Simulated wound in position at 0% opacity

The simulated wound is used to establish if there is a pattern match between the features of the wound observed in the photographs and those in the simulated item. If a pattern match is detected, then the simulation can be used to determine the positions of the teeth from the corresponding dental cast (Figure 3).

Note the feature arrowed in the image at the highest opacity also appears in the other three images.

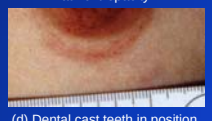
Figure 2.

5

(a) Dental cast teeth in position at 100% opacity

(b) Dental cast teeth in position at 50% opacity

(c) Dental cast teeth in position at 20% opacity



(d) Dental cast teeth in position at 0% opacity

The simulated wound is used to determine the positions of the teeth from the corresponding dental cast.

Note that the feature indicated with the arrow in Figure 2 is also present on the dental cast (arrow).

It can now be seen to be a wire retainer fixed to the teeth to maintain the results of orthodontic tooth movement.

Figure 3.

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(a) Laser contours in position at 20% opacity

(b) Original wound photograph

Enlargement of the region of interest demonstrates that the presence of the orthodontic retaining wire (arrow, 5a) on the dental cast and laser contours correlates extremely well with a feature of the wound that can be observed in the photograph (arrow, 5b). Additionally, the analysis demonstrates excellent correlation of the features of the teeth and simulated wound with the

Figure 5.

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(a) Laser contours on teeth of cast at100% opacity

(b) Laser contours in position at 50% opacity

(c) Laser contours in position at 20% opacity

(d) Laser contours in position at 0% opacity

At this time, the teeth of the dental cast can be passed through a plane of laser light, and at regular intervals a line can be drawn with a computer program (Adobe Photoshop (® Adobe Systems Inc) around the upper margin of the line cast by the beam. This produces a contour map of the teeth as shown, which permits examination of the three-dimensional aspects of the biting process in the context of the wound. Note that the shape of the retaining wire can be recognized in the wound photograph (Figure 5).

Figure 4.

8

Conclusions

In a similar manner to tool mark analysis, this type of analysis cannot be used to implicate a given individual as the causative agent in a bite, since there is no scientific basis for claiming that every set of teeth results in a bite mark that is recognizably different from that produced by every other dentition. There are also many uncontrolled variables in a bite, including the fact that surfaces are curved, the victim may pull away from the assailant causing unpredictable effects, and that human tissues do not make a perfect recording medium.

We therefore attempt, where possible, to eliminate individuals as potential causes of a given wound, and the strongest finding we would normally return after an analysis is that a given individual cannot be excluded. Presentation of the visual evidence before a court is easy for a jury to understand, but no unexplained discrepancies in the explanation should exist, if the evidence is to be regarded as sound.

In the present case, an unusual feature observed in the wound can be correlated with an orthodontic retaining wire on one of the dental casts submitted for analysis, which also meets the criteria for non-exclusion by comparison of both the upper and lower teeth and simulated wounds. This provides an additional degree of weight to the outcome of the analysis. It should always be remembered that the circumstances of the case will limit the pool of potential suspects.