

## CASE REPORT

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### The Use of Human Skin in the Fabrication of a Bite Mark Template: Two Case Reports

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**ABSTRACT:** Comparison of a suspected biter's dental arches with the patterned injury of a bite mark is especially difficult when the bite occurs in an anatomic location with a small radius of curvature or with complex or compound curves. The authors present two case reports in which human skin was used as a template for the reproduction of a bite. In one case the victim's skin was used; in the other, the skin of an anatomically similar person was used. The use of inked dental casts, photography, and transparent overlays significantly reduced the errors common to analysis of bite marks in these highly curved areas.

**KEYWORDS:** odontology, bite marks, human identification

The analysis of bite marks on highly curved surfaces is among the most difficult tasks encountered in forensic dentistry. Various forms of dental wax have been the standard for use by the forensic dentist in the analysis of bite marks [1]. Recently Styrofoam has been suggested as a more stable medium for the production of bite mark templates [2]. Each method consists of the dentist impressing study models of, or the suspected biter's dentition, into the chosen medium for several millimetres in order to register accurately the incisal and occlusal patterns generated by the teeth. A template to be used in the comparison is then prepared. Acetate overlay tracings, photography, and various radiographic techniques have been used to produce the template, which is then compared with the patterned injury, usually by observing the bite injury as depicted in a photograph viewed through the overlay.

These methods can introduce errors due to differences in the physical properties of skin and wax or Styrofoam. Dental waxes and Styrofoam are nonelastic materials and are most often used in a flat configuration. Skin is elastic and the areas involved in bite

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mark injury are almost always curved to some degree [3]. During the act of biting, the skin is stretched and compressed by the teeth as it is dragged and pushed between the dental arches. The skin may come in contact with the mesial, distal, facial, labial, occlusal, or incisal edges of the teeth, or any combination of these surfaces. The skin is literally forced through the labyrinth of tooth surfaces so that the areas of contact between the skin and the teeth give rise to the patterned injury. The forensic odontologist must consider this in the bite mark analysis.

The following procedure can be used to demonstrate the differences between a template made in wax or Styrofoam and one made using skin. The dental models of the biter are pressed into dental wax or Styrofoam to an appropriate depth, and a transparent overlay is produced. To use skin as the medium, the incisal and occlusal surfaces of the teeth on the model are "inked" by rolling or depressing the model onto a standard office ink pad. Figure 1 illustrates an inked model. The inked models are then placed on the skin of the victim or an anatomically suitable volunteer in the same orientation as the original bite. The ink is transferred to the skin (in a manner similar to the use of a rubber stamp), and a simulated bite mark is obtained. A properly composed photograph [4] is then taken of the inked bite mark, and a transparency is traced from a one-to-one print. Direct comparison of the two transparencies obtained by the differing methods will demonstrate that they do not correlate well, even though they were obtained from the same dental model.

In an actual case, the forensic dentist can use the skin of the victim if available. When this is not possible, a volunteer of like age, sex, anatomic size and shape, muscle tone, skin texture, body fat, and other physical characteristics can be substituted. The forensic odontologist can also account for the effects of posture, gravity, and skin stretching when recreating the bite in ink on a living model.

## Case Reports

### *Case One*

A four-year-old white female child was brought to the hospital emergency room unconscious and in distress. She was placed on life support in the intensive care unit. The investigation revealed that someone had attempted to suffocate her with a pillow but failed, leaving her with severe, permanent brain damage. There were only two suspects—her mother and her stepfather. An injury on her left arm, just above the elbow, was determined to be a human bite mark. However, it was felt that the injury was not of sufficient quality or definition to allow a positive match to be made. The odontologist



FIG. 1—A dental model with the incisal edges inked and ready for printing on the skin.

was able to secure a life-size photograph of the injured area by measuring the size of the patterns on the hospital gown and the IV tubing.

The district attorney requested that the odontologist attempt to rule out one of the suspects and state that the bite could not have been made by one of the suspects. At this point a court order was obtained requiring the stepfather to submit to a dental examination to obtain photographs and study models. The mother voluntarily agreed to a dental examination. The stepfather was approximately 6 ft, 2 in. (1.88 m) tall and the mother only 5 ft (1.52 m) tall. Initially, it was thought that one of them could be excluded merely on the basis of the intercanine arch width distances. In this case that distance was 33 mm in the maxillary arch for each subject. Figure 2 shows that the stepfather was missing tooth No. 7, and tooth No. 6 had drifted toward the midline. Wax templates of each dentition were made. Figure 3 illustrates the poor correlation of the overlays with the bite mark. The police investigators remained certain that only these two people had had the opportunity to inflict the injury.

A decision to fashion a new bite template using skin was made. The victim's poor medical condition made her an unsuitable model; therefore a stand-in was needed. The four-year-old son of one of the authors was anatomically similar to the victim. It was felt that there was no significant difference between the elbows of young males to those of females. Study models of each subject were inked and positioned on the arm of the volunteer to simulate the original bite injury. Postural positioning was considered during this simulated bite. Photographs of the inked bite mark were used to fashion acetate templates, as shown in Fig. 4.

Comparison of the templates with the bite mark photograph revealed a surprising result. The mother was clearly ruled out as a possible biter. The unusual formation of the stepfather's dentition was more readily apparent during comparison of the template with the bite mark. The odontologist was able to report that it was "highly probable" that the stepfather had inflicted the bite injury. Figure 5 depicts the stepfather's overlay and a life-size photograph of the bite mark.

#### *Case Two*

A 38-year-old white female was assaulted and raped. A bite mark was discovered partially on the right cheek, extending under the angle of the mandible. The injury pattern was diffuse and not well defined, as shown in Fig. 6. Three suspects were located by the authorities during the investigation; however, the victim was not able to identify her attacker visually.

Court orders were obtained requiring each suspect to undergo a dental examination,



FIG. 2—The stepfather's wax dental bite showing the missing tooth No. 7 and the resultant mesial drifting of tooth No. 6.

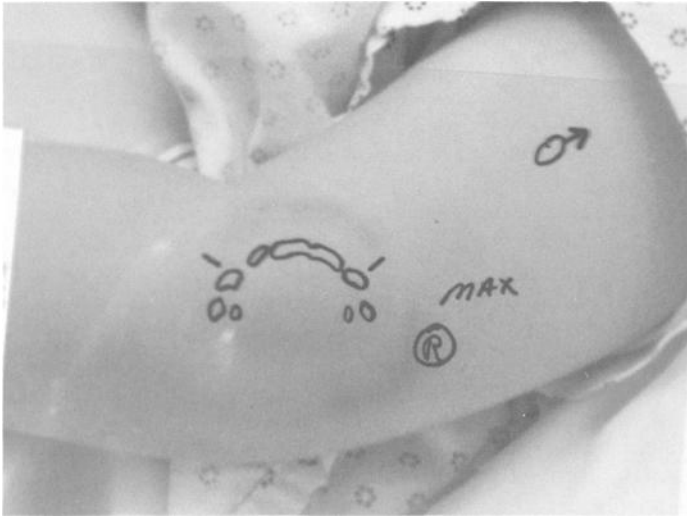


FIG. 3—The stepfather's wax bite overlay positioned on top of the bite mark, with no apparent correlation.

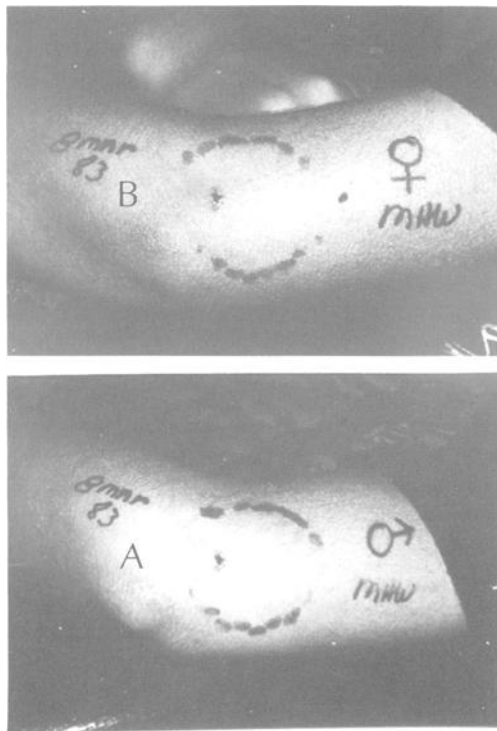


FIG. 4—The inked bite of the stepfather (A) and the mother (B) on the volunteer's arm.



FIG. 5—The stepfather's inked bite overlay positioned on top of the bite mark, showing excellent correlation.

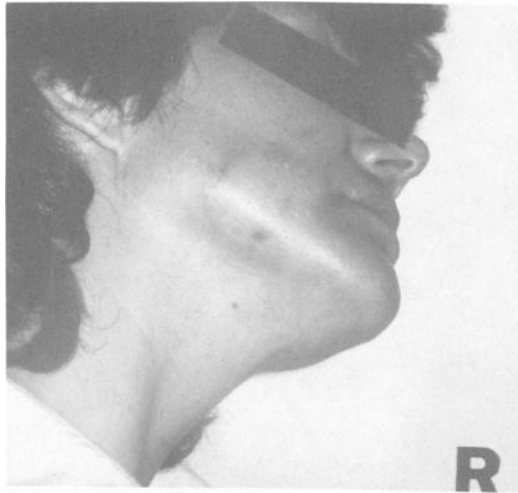


FIG. 6—Bite mark on the cheek and jaw area of the victim. Note the complex curvature of the area involved.

including models and photographs. Wax bites were produced from the models and the resulting acetate overlays showed little or no correlation to the injury. A decision to use skin to fashion the templates was made in order to attempt to rule in or rule out one or more of the suspects. The victim herself volunteered to allow the inked bites to be simulated on her skin. The study models of each suspect were inked and placed on the skin of the victim with great care. Landmarks on the skin, which were visible in the injury photograph, were used to position the models as exactly as possible. The suspects were known as A, B, and C. Photographs of the inked patterns were taken in each case (Figs. 7, 8, and 9).

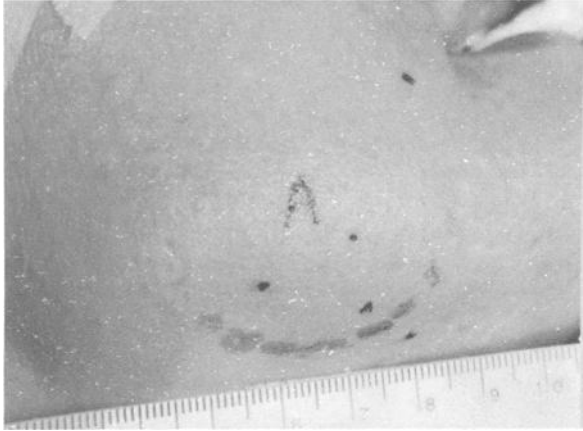


FIG. 7—*Inked bite pattern of Suspect A.*

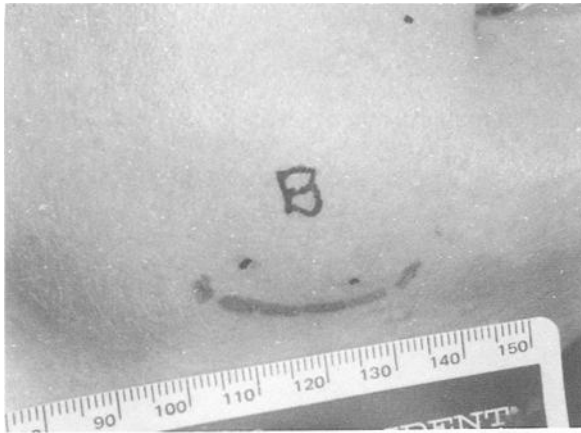


FIG. 8—*Inked bite pattern of Suspect B.*

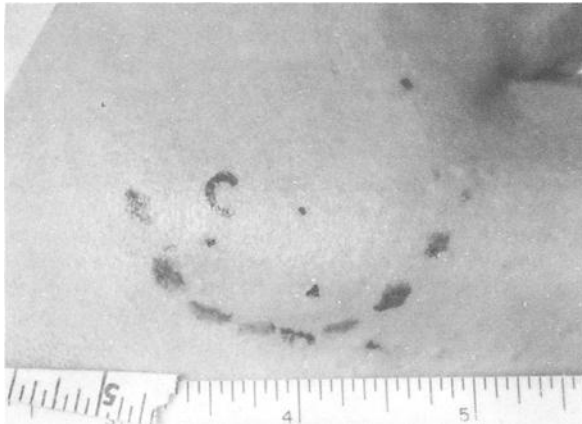


FIG. 9—*Inked bite pattern of Suspect C.*

Acetate overlays were traced from one-to-one photographs and compared with the actual injury photograph. Based on the comparison and analysis, Suspects A and B were excluded and Suspect C was determined to be a match. Figures 10a and 10b show the bite mark, the wax-produced template, and the skin-produced template for Suspect C. Figure 11 shows the effect produced in the bite mark by various degrees of jaw opening by the victim during the simulated bite.

### Discussion

The analysis of bite marks on human skin is most difficult when the skin involved has a small radius of curvature [5]. If a complex or compound curve is present, a successful analysis may well be impossible using the methods previously available to forensic odontologists. A celebrated case of the 1970s centered on a bite mark found on the inner thigh of a deceased teenager [6]. Seven well-respected forensic odontologists split four to three in analyzing this bite on a curved skin surface. More than 1300 pages were required to record their combined testimony. The possible distortion of the bite mark due to skin elasticity was the primary area of disagreement in the expert opinions offered by the prosecution and the defense. Although a simulated bite technique was discussed by one expert in this case, the appellate court reported no evidence that such a technique was demonstrated for the trial court.

The authors of this paper have previously advanced the opinion that the dynamic interplay of the dentition and the skin is the critical occurrence in the formation of the patterned injury that is the bite mark. Understanding and visualizing the manner in which the bite occurred is central to successful bite mark analysis. Bite recreation or simulation allows the forensic odontologist to observe this interplay. The method described in these

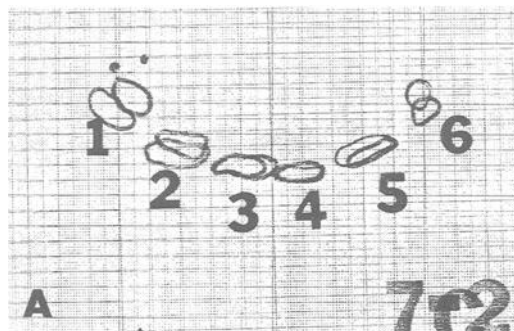


FIG. 10a—Suspect C's wax bite overlay on the bite mark photograph.

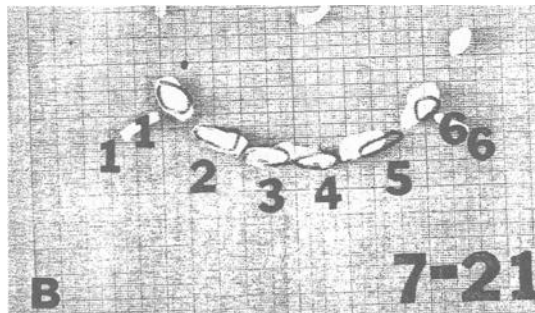


FIG. 10b—Suspect C's inked bite overlay on the bite mark photograph.

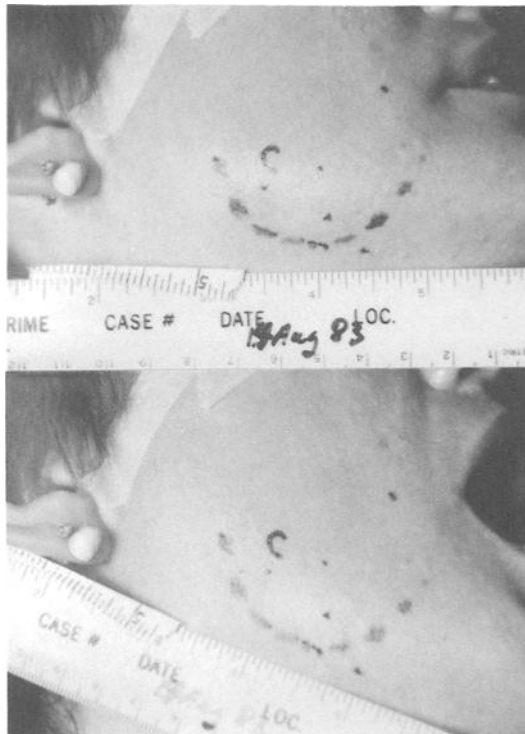


FIG. 11—Suspect C's inked bite on the victim's skin, showing the differences in appearance caused by progressively wider mandibular opening by the victim in this case.

cases provides the dentist with demonstrative visual evidence for courtroom presentation which is simple to explain and convincing to a juror.

### Conclusions

The correlation of the elasticity and compressibility of the substrate in which the bite mark is left is critical to the successful duplication of the wound pattern for comparison purposes. If a substrate is chosen that differs in elasticity and compressibility, error may be incorporated into the analysis and lead to an incorrect finding. Although investigators claim to use wax or Styrofoam bites for preliminary comparison only, another medium is rarely chosen to complete the analysis. An analysis that begins with an improper assumption may well lead to an incorrect conclusion.

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