

TECHNICAL NOTE

Byron W. Benson,¹ D.D.S., M.S.;
James A. Cottone,² D.M.D., M.S.; Thomas J. Bomberg,³ D.D.S.;
and Norman D. Sperber,⁴ D.D.S.

Bite Mark Impressions: A Review of Techniques and Materials

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ABSTRACT: Many techniques are described in the literature for use in making impressions of bite mark indentations. A representative technique is presented in detail. Several types of dental materials common to many impression techniques are reviewed with regard to their accuracy, ease of use, and dimensional stability over time. Adherence of materials and a model pouring technique are also discussed.

KEYWORDS: odontology, bite marks, impressions, dental impression materials, forensic dentistry

The use of imprints or marks made by the human dentition on skin or inanimate objects for identification has been well accepted by the scientific, law enforcement, and legal communities [1-9]. Properly preserved and analyzed, bite mark evidence can link the assailant to the victim of a crime. Bite marks are most commonly found on the victim, who may be either alive or deceased. On occasion, the victim may also inflict a bite on the assailant or even on himself [10-13]. Bite marks inflicted on human skin are especially transient in nature, therefore preservation of the evidence is a necessity [1, 11, 14]. One of the methods of preserving this evidence is that of making an impression of the indentations and the subsequent creation of a model of the bitten area. This paper describes a representative impression technique, along with variations in both technique and materials. The relative accuracy of materials will also be addressed.

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¹Assistant professor, Department of Oral Diagnosis and Radiology, Baylor College of Dentistry, Dallas, TX.

²Professor and head, Section on Forensic Odontology, Department of Dental Diagnostic Science, University of Texas Health Science Center, San Antonio, TX.

³Professor, Department of Applied Dentistry, University of Colorado Health Science Center, School of Dentistry, Denver, CO.

⁴Chief forensic dentist, San Diego and Imperial Counties, San Diego, CA.

Discussion

Before any impression procedure, photography and swabbing of the area are performed to record the appearance of the wound and determine the ABO blood group of the biter. Detailed descriptions of these procedures are available elsewhere [1, 10, 12, 15-19].

Some recommend that impressions of the bitten area be made with the body part in the same position as when the injury occurred [16, 19]. Others recommend that the bitten area be oriented horizontally in an attempt to control more easily the flow of impression material away from the bite. Practically applied, it is not difficult to dam adequately the flow of impression material in most orientations. If the skin surface is hairy, the hair should be clipped, so that it will not be incorporated into the impression material. Shaving the area is to be avoided, as the scab material which may overlay an older bite may be removed [20].

An impression technique for recording bite marks has been described which uses a vinyl polysiloxane impression paste (Exaflex).⁵ The impression material is reinforced with semi-rigid, thermoplastic orthopedic tape, Hexcelite⁶ [20, 21]. When Exaflex is used, equal lengths of impression paste are expressed from compressible tubes onto a pad and mixed with a spatula or tongue blade until the color is homogeneous. The mixed impression material is then gently flowed into the indentations with a spatula or syringe, care being taken to avoid inclusion of air bubbles. The material should extend well beyond the entire bite mark with a generous border. When dealing with a refrigerated body, a prolonged setting time is anticipated, since the impression material polymerizes more slowly at cool temperatures. The material is allowed to set completely. The orthopedic tape is cut to the approximate size of the bitten area and warmed in hot water or any other available hot liquid, rendering it plastic. The warmed, flexible tape is gently placed and adapted over the set impression material. As the tape cools, it regains its rigidity, lending support to the flexible impression layer. To lock the tape in place, a second portion of impression material is mixed and layered over the tape. The vinyl polysiloxane used in this impression technique readily penetrates the tape mesh and bonds to the already polymerized material of the same type, thus allowing a dependable adhesion of layers [22]. Second and third pieces of orthopedic tape with intermediate layers of impression material are added for increased rigidity. Before the set of the final impression material layer, a self-adhering label is placed on the surface of the material. Information regarding the date, location of the bite mark, subject's name or body number, and initials of the person making the impression is recorded. The orientation of the bite mark with regard to other body structures is also recorded on the label. Following the set of the last layer, the reinforced impression mass is removed from the bite mark area [20, 21].

At least two impressions should be made. Dental stone may be poured into the impression to create a model for analysis, or the first impression may be preserved in an unpoured state for submission in court [1, 11, 14]. When a model is desired for courtroom submission, it should be made from the first impression. Subsequent impressions may be made in the same manner as the first, and models made from them in the fashion described later in this paper.

Alternate methods of recording bite mark indentations abound. Variations occur not only in the method in which materials are used, but also in the types of materials available for use (Table 1). The literature cites the use of plaster of Paris as an impression medium; however, its usefulness is limited by its inability to record fine detail or be removed from undercuts [14, 18, 23]. The heat generated upon setting may also be uncomfortable to the living subject. Reversible hydrocolloid (agar) and irreversible hydrocolloid (alginate) have also been used, but are not desirable due to dehydration and subsequent distortion of impressions stored in the unpoured state for any length of time [14, 21, 23, 24]. Reversible hydrocolloid also requires additional equipment. Most accurate and stable are the elastomeric impression mate-

⁵G.C. International Corporation, Scottsdale, AZ.

⁶Kirshner Medical, Dublin, CA.

TABLE 1—Representative products for making bite-mark impressions.

VINYL POLYSILOXANE IMPRESSION MATERIALS	DENTAL VIBRATORS
(All contain palladium or similar agent to modify hydrogen gas production)	Vibrator No. 1 (Buffalo Dental, Syosset, NY)
Cinch-vinyl (Parkell, Farmingdale, NY)	Vibrator No. 78-1 (Handler, Westfield, NJ)
Exaflex (G.C. Intern'l. Scotsdale, AZ)	PLASTER/DENTAL STONE (ADA TYPES I AND II)
Mirror-3 (Kerr, Romulus, MI)	Plaster of Paris (generic)
Reprosil (Caulk, Milford, DE)	Coecal (Coe, Chicago, IL)
(new formulation)	
ORTHOPEDIC TAPE	DIE STONE (ADA TYPE IV)
Hexcelite (Kirshner, Dublin, CA)	Die Rock (Whip-Mix, Louisville, KY)
	Velmix Stone (Kerr, Romulus, MI)
PLASTER BANDAGE	
Specialist Plaster Bandage (Johnson & Johnson, E. Windsor, NY)	

rials, which are classified into four groups: polysulfides, condensation (conventional) silicones, polyethers, and addition silicones (vinylpolysiloxanes)⁷ [5,24,25-27]. The elastic recovery of the elastomeric materials ranges from 97.9 to 99.5% when a model is made within the manufacturer's time specification [25,26,28]. Thus, any one of the elastomers will render an accurate impression when it is mixed according to the manufacturer's specifications and when models are made at the recommended time, usually immediately [28]. One must be concerned with the longer term stability of the materials, however, especially those who advocate that the first impression be left in an unpoured state for presentation in court [11,14]. Delays may also occur when making models from impressions when the procedures are carried out in the field. Polysulfides and polyethers exhibit the greatest distortion, 0.60%, at 24 h⁷ [15]. Vinyl polysiloxanes appear to be the most stable with only 0.05% distortion at 24 h, making this class of impression material the one of choice for forensic science purposes⁷ [15,24,27,28]. If a vinyl polysiloxane is desired, a brand should be selected that contains palladium or other agents that modify hydrogen production in the setting material. Vinyl polysiloxanes without these additional agents release hydrogen, even after setting, and voids or bubbles may be produced in the model if an adequate amount of time has not elapsed before pouring⁷ [29].

As a result of the flexible nature of impression materials, a more rigid external backing or internal reinforcement is required to stabilize the impression during removal and subsequent handling. Plaster of Paris and dental stone have been recommended by some for this use [18,21,30]. The powder and water are mixed together in the proper proportions and flowed not only over the impression material layer, but beyond the periphery of the impression onto the skin. Luntz describes a technique using multiple layers of wet plaster bandage as a backing material [17]. After hardening, a marking pen may be used to label the impression complex before removing the entire mass from the bitten area.

Methyl methacrylate, an autocuring acrylic tray material,⁸ has been advocated as a convenient and rigid backing material [19,31]. The acrylic material, which is supplied as a powder and liquid, is mixed to a dough-like consistency and applied over the impression layer. The tray material should extend beyond the border of the impression by at least 0.5 cm. The thickness should not exceed 0.5 cm because of excessive heat generated by the exothermic setting reaction of this material. The heat may be limited by placing a cold towel over the

⁷B. K. Norling, "Elastomeric Impression Materials," lecture notes, Dental School, University of Texas Health Science Center at San Antonio, TX, 1983.

⁸Hygon, Hygenic Dental Manufacturing Company, Akron, OH.

area while the material sets. Multiple layers are used to obtain the desired thickness [19,31]. Some recommend that a thicker layer of tray material be used if the surface area is large or the undercuts deep [31]. The use of acrylic tray material is limited by its initial shrinkage, however. A 6 to 7% shrinkage in the first 24 h after initial polymerization is exhibited. The greater the mass of material used, the greater will be the expected distortion [28,32,33]. The use of this material as reinforcement in a forensic science setting might add distortion to the flexible impression material. When this acrylic material is used to make custom trays for prosthetic dental purposes, the trays are allowed to set for 24 h before use for impressions to minimize tray material distortion.

The technique described initially in this paper is unique in that orthopedic tape, Hexcelite, is used as an internal reinforcement [20,21]. This orthopedic tape is a mesh that is rendered plastic when heated, regaining its rigidity upon cooling. The tape is easy to use, requiring only scissors to shape it to size and a cup of hot liquid for softening. Upon cooling and regaining its rigidity, the dimensional distortion has been stated to be less than 2%.⁹

The stability of reinforcing orthopedic tape is dependent upon the use of an impression material that will not only mechanically lock into the mesh, but also adhere to itself in multiple layers. When plaster of Paris, dental stone, or tray acrylic is used as a backing, adhesion of the impression material to the reinforcing layer is inadequate without mechanical assistance. The adhesive liquid normally used with cured acrylic cannot be used while the acrylic is polymerizing. Mechanical retention in the form of undercuts or locks must be obtained. One technique recommends the creation of "hills" or "peaks" in the most superficial impression layer with the operator's fingers while the material is still soft [19]. This technique should be used judiciously to avoid disturbing the initial layers of impression material. Other techniques incorporate staples on end or paper clips into the soft superficial impression layer. A subsequent layer of plaster of Paris, dental stone, or tray acrylic will then lock onto the imbedded retentive features, allowing the entire unit to be removed as one. There are some practical problems with stone and plaster backing when used on traumatized victims. The setting time required for the material is inconsistent with the management of a squirming baby, an intensive-care patient, or an emotionally and physically traumatized sexual-assault victim.

The impression of the bite mark is a negative replication of the indentations of the teeth. Models are created by pouring the impression with improved dental stone (ADA Type IV stone, die stone) to create a positive replication of the indentations. In mixing die stone, strict adherence to the manufacturer's powder-water ratio is required to prevent excessive expansion [1]. A flexible rubber bowl and spatula or tongue blade are used to mix the stone material. A small dental electric vibrator is easily portable and useful in mixing and pouring stone into the impression [17]. Gentle vibration of the viscous mixture in the bowl works air bubbles to the surface, so that they are not incorporated. With the impression oriented at a 45° angle, the hand holding it is placed on the vibrator and stone added at one edge of the impression. This allows the stone material to flow into the indentations without trapping air. Overvibration is to be avoided, since this may create new bubbles with resultant voids in the model. The poured impression is allowed to remain completely undisturbed for the manufacturer's recommended time. The model is separated from the impression with finger pressure only. If vinyl polysiloxane or polyether were used as an impression material, multiple models may be made from the same impression with minimal loss of accuracy [25,27,28].

Summary

The accurate preservation of bite mark indentations is vital to analysis of the evidence. Impression techniques record the three-dimensional aspects of the bite mark in a manner

⁹W. Martin, Kirshner Medical, personal communication, 1986.

that is easy for a jury of lay people to comprehend [10]. A representative impression technique has been described. Variations of both technique and materials have been discussed, along with their relative merits. An increased awareness of the materials and techniques available for forensic science use will enable the forensic odontologist or involved dentist to select and justify properly in court an accurate and reliable method of preserving evidence in bite mark cases.

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Address requests for reprints or additional information to
Byron W. Benson
Department of Oral Diagnosis and Radiology
Baylor College of Dentistry
3302 Gaston Ave.
Dallas, TX 75246