TECHNICAL NOTE

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Use of Glue Gun in Forensic Anthropology and Pathologic Bone Reconstruction Cases

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ABSTRACT: Fragmented "wet" bone material can be rapidly reconstructed with a minimum amount of specimen preparation using hot melt adhesives and commercially available electric glue guns. The reconstruction of fragmented bone aids in the analysis and interpretation of extensive trauma cases.

KEYWORDS: physical anthropology, pathology and biology, musculoskeletal system, fragmented skeletal material, glue gun, hot melt adhesive

Cases with extensive damage to bone—usually the skull—or decomposing cases with skeletal trauma are fairly frequent occurrences in a busy medical examiner's office. The determination of the type of trauma as well as understanding the nature of the injuries frequently depends on interpreting the fracture lines in blunt force or gunshot wounds. Recombining the bone fragments to demonstrate the defects caused by the trauma may be essential to determining the direction of a gunshot or the number of blows. Occasionally, a pattern can be identified only by reconstructing the skull. When the body is badly decomposed or otherwise artifacted (that is, fragmented), reconstruction of the skull or other bones is necessary to assess the nature and scope of perimortem trauma.

Traditionally, reconstruction is performed by first cleaning the skeletal material using one of several techniques [*1*]. Where necessary, the tissue is manually removed, and the bone is cleaned and defatted. The bone is then partially dried and reconstructed using a solvent-based cement. In cases in which it is not possible to remove the bone from the body, as in massive head trauma autopsies, the bones can be held by drilling paired holes in adjacent bone fragments and wiring the pieces together. Both cementing and wiring yield results but are fairly labor-intensive and time-consuming.

Another method, using commercially available hot melt glue guns, offers a number of advantages since it can be used at autopsy, on decomposed bone, and immediately after defleshing.

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Hot melt glues are a group of thermoplastic adhesives formulated without solvents and available with a range of physical properties, including melting points from 250 to 450°F (121.1 to 232.2°C) [2]. Because they are thermoplastic, they cool quickly and immediately exhibit their adhesive qualities without requiring either chemical reaction or solvent evaporation to occur. They are widely used in industry to seal cardboard boxes and put labels on cans for example.

Method

The bone material of a decomposed skull fragmented by one or more gunshots was cleaned of soft tissue using a hypochlorite method. The bones were rinsed with clear water and then immediately reconstructed using the hot melt glue. The glue, applied at a temperature higher than that of boiling water, dried the bone surface. While the glue was hot and plastic, adjacent pieces of bone were fitted and pressed into appropriate anatomic relations. Holding the two pieces in position for a few moments allowed the glue to cool, harden, and fix the pieces.

Bone surfaces free of blood or connective tissue and having a minimum of liquid water present appear to be the only requirements. Slight drying of the mating surfaces enhances the adhesive features, although some physical support is provided by the mechanical presence of a "lip" formed at the glue joint. With drier surfaces the glue cools more slowly, allowing more time for positioning and adjusting the pieces as well as improving one's ability to press the pieces together more closely to produce a very small joint. The drier the bone, the less glue required to hold the fragment. The bigger the fragment, the more glue required for a solid joint.

Since pressure on the gun controls the amount of glue, the pieces can be "tacked" together until one desires to make the relations "permanent." This can be helpful, since some pieces may have to be put into place before others, and the bone fragments can be easily removed if they are only loosely held. Since fragments are placed one after another, glue is added only to connect adjacent bone segments and never to fill a defect or gunshot wound.

Application of the technique to fresh bone not cleaned with hypochlorite requires only that the bone surface be as dry as possible. This method can be advantageous since the time required for cleaning is eliminated. If the bone is largely "bleached" from decomposition, photographs can be taken immediately. Additional glue can be added to the inside or outside of the bone along the fracture lines to increase the strength of the joint. Since a fine line can be applied with the gun and the glue is a translucent amber color, the glue line has not been a distraction in analysis or photographs. Excess glue exuding from a fracture line can be easily trimmed while warm but becomes more difficult to cut when completely cool. The resulting specimen can be studied, X-rayed, photographed, and measured in the usual fashion as well as defatted or bleached for long-term storage.

In autopsies, the bone surface should be defleshed and made as dry as possible. Gently scraping the cortical bone surface free of blood and wiping with cloth or paper is usually sufficient to dry the medullary surface when prior inspection shows that there is only a fracture line. No standing fluids should be present on the joining surfaces. The remaining moisture of the marrow will not totally prevent the joining of the bones.

These adhesives adhere poorly to a wet surface. However, this method may be used to "tack" wet fragments together for photography and analysis. On wet bone, removal of the glue requires only pulling on the bead. On decomposed but not dried skulls, the bead can generally be pulled from the fracture edge without damage to the bone. As the bone becomes drier during the gluing process, the adhesive, rather than the mechanical, properties become more evident, and the blue may have to be removed by a combination of mechanical and chemical solvent means. These glues are not generally solvent resistant, so polar solvents will be effective.

We have used this technique for over a year and have never had to remove the glue (Figs. 1 through 3). Once the skull is reassembled and documented, it is usually returned to evidence or removed for burial. In those situations where more bone has been found or some other need to add to the skull assembly has arisen, there has been no difficulty in gently bending the joint while the glue is warm and inserting a new fragment. When cold, the joint can be opened with the hot tip of the applicator gun or with a "plastic cutting tip" such as is used on an electric soldering gun. Potentially, any narrow object that can be heated to approximately

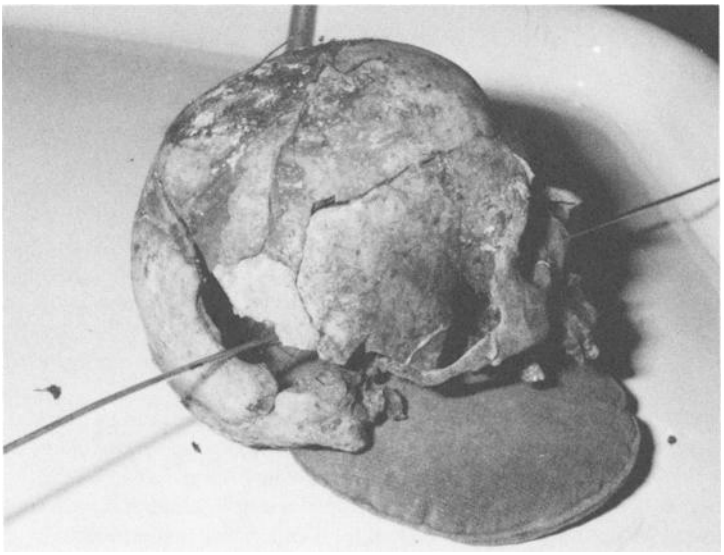

FIG. 1—*Reconstructed skull from approximately 40 bone fragments showing gunshot and pathway.*

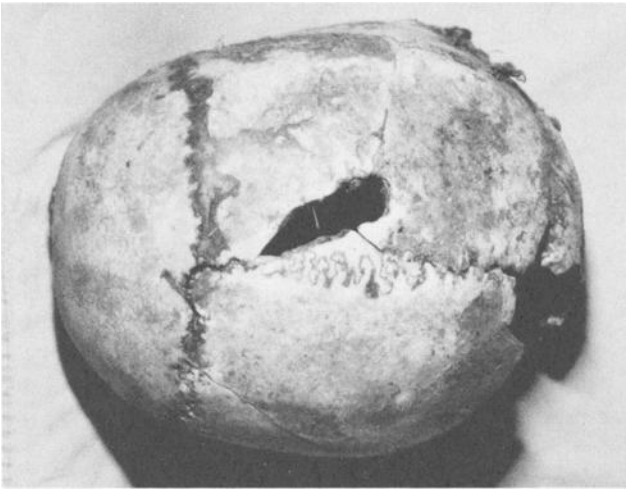

FIG. 2—*Reconstructed skull showing entry wound.*

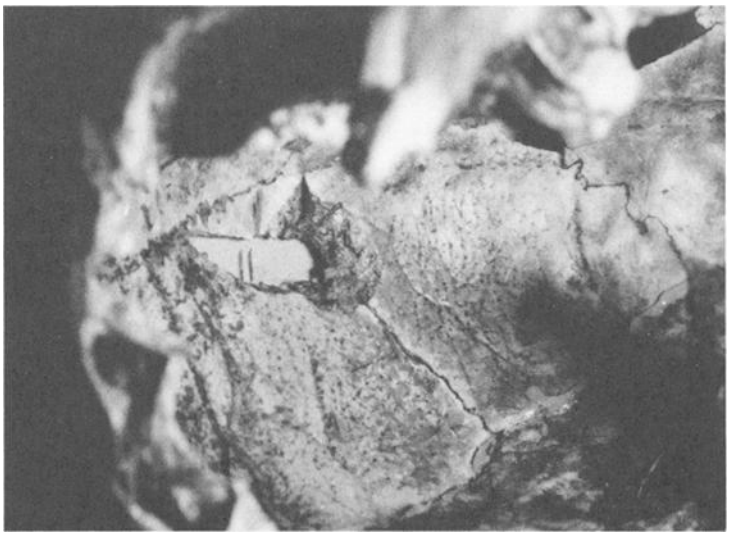

FIG. 3—*Internal view of Fig. 2 showing internal coning in three reassembled bone fragments.*

300°F (148.8°C) will work to sever the joint. To reglue, the hot applicator tip is used to remelt both sides of the joint, and the bones are reapproximated.

In many cases the glue can be pulled off the bone fragment after heating resistant areas. Although no damage or change to the surface of the bone was observed, all our experience is with forensic science specimens. Whether this method would be acceptable for museum or archeological specimens has not been evaluated, nor has there been any study of the long-term effects of hot melt glue on bone. Although the materials generally do not contain solvents, the chemical components may not be inert. Fortunately, there are many different hot melt adhesives to select from, both in color and composition, so there is an increased chance that one or more could be of value in other scientific fields.

References

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[2] *Forest Service Agricultural Handbook No. 516, Adhesives in Building Construction*, U.S. Department of Agriculture, Feb. 1978.

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