

Technical Note: A New Technique for the Fabrication of a Shoulder Prosthesis

R.L. Engelmeier, D.M.D., M.S.

INTRODUCTION

Perhaps the greatest difference between prosthetics and other specialties involved with the treatment of cancer patients is the fact that prosthetic practitioners deal almost completely with rehabilitation and very little with the treatment of the patient's disease. Rehabilitation refers to the restoration of the patient to a useful life through therapy and/or education. Those involved in rehabilitation take a different approach and often see and address problems overlooked by other specialists. The surgeon's treatment is aimed at eradicating the patient's disease and usually ends when the surgical procedure is over. Prosthetic treatment however, is often involved with intense follow-up of these patients for the duration of their lives. In other words, prosthetic efforts are aimed not at saving the patient's life, but at increasing the quality of that life.

Everyone has seen amputees, who, for one reason or another, have not restored their missing extremity with a prosthesis. Even though the loss of the limb was apparent, it could for the most part be hidden under clothing to the point where it was socially more acceptable. In the case of a four-quarter amputee, however, where both the arm and shoulder mechanism are amputated, it is not possible to hide this defect under clothing. The patient is left with only a rib cage on the side of the amputation, and none of his clothing fits anymore (Figures 1 & 2). This makes his clothing look as though it is falling off that side.

In an effort to enable these patients to adequately support their clothing with a prosthesis, which is easy for them to handle as well as being easy and inexpensive to fabricate, the following technique was developed.

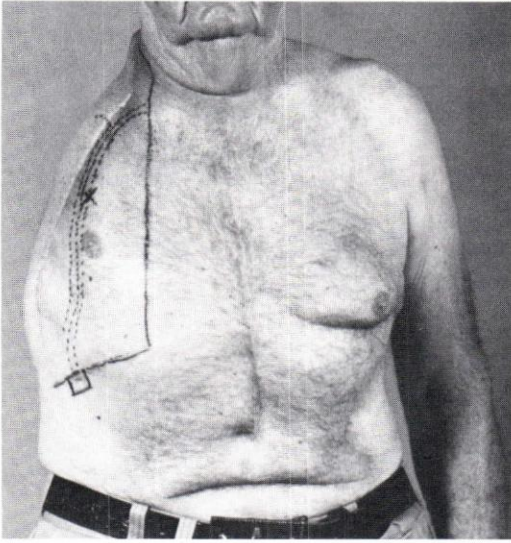


Figure 1. An anterior view of patient, showing extent of surgery performed.

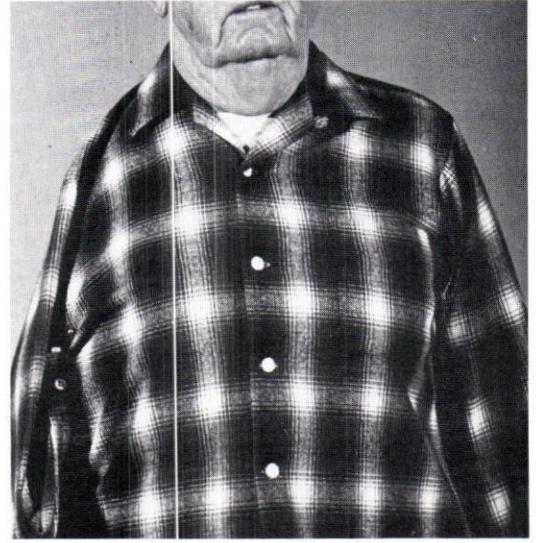


Figure 2. Anterior view of patient, demonstrating inability to disguise disability without a prosthesis.

MEASUREMENTS AND MODIFICATION

Before making any impressions, appropriate guidelines are drawn on the patient with an indelible ink pencil. These will transfer to the negative impression and will act as reference lines (i.e.; midline, clavicle, and the level of the opposite axilla) during the sculpture phase (Figure 3). Then, body impressions, of irreversible hydrocolloid,¹ gauze, and accelerated dental plaster,² are made of the shoulder to be treated and the remaining normal shoulder. The impressions should be kept as thin and light as possible so as not to distort the skin any more than necessary. The patient should be sitting upright during this procedure, and the impressions should extend from the front midline to the back midline and from just above the clavicles to just below the axilla.

The sculpture is then developed from base plate wax³ on the positive model. The wax sculpture is hollow rather than solid to save materials and make it easy to remove the sculpture from the model to try it on the patient (to check fit, extension and contours) (Figure 4). After the trial fitting and any modifications to the wax-up, the margins are luted to the cast and finished

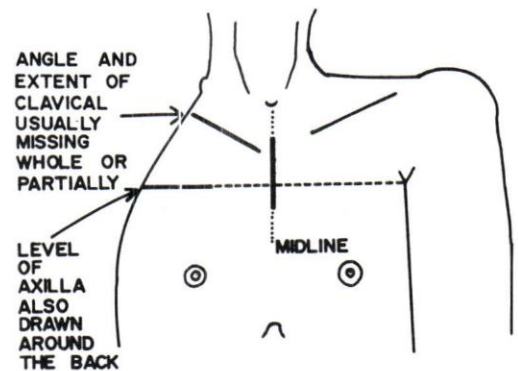


Figure 3. Diagram illustrating the areas to be outlined prior to making the negative impression.

down. The exposed plaster of the positive model is painted with separating medium.⁴ Cardboard (e.g., a manila folder) and paper tape can be used to box the model so that the top half of the mold can be poured over the wax-up. After the top half of the mold has set, the wax-up is eliminated in boiling water and both sides of the mold are painted with a tin foil substitute⁴ (Figure 5).

Figure 4. (right) The hollow base plate wax sculpture ready for trial fitting.

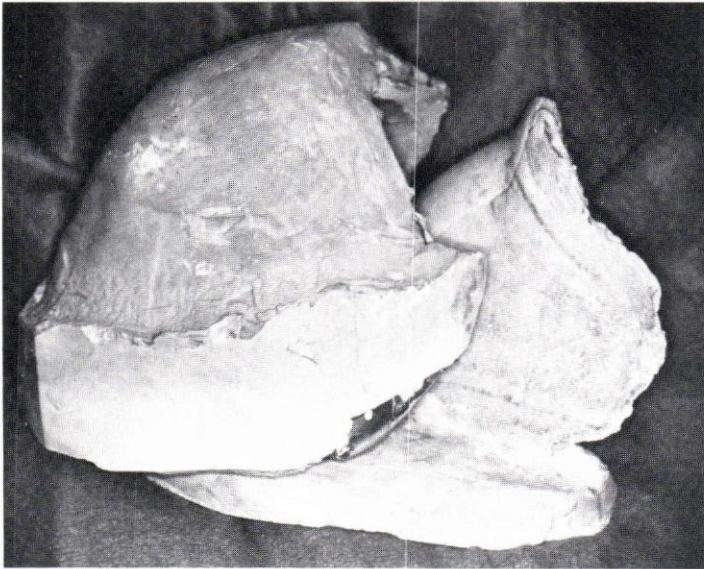


Figure 5. (left) Top and bottom of the mold are separated after the wax is boiled off, prior to tin foil substitute preparation.

Since it is desirable to have a very light weight prosthesis (i.e., a shell), initially only the top half of the mold is used. Auto-polymerizing Acrylic⁵ is adapted to the inner surface of the top half of the mold by means of a sprinkle-on technique in a patchwork fashion to prevent over-heating and excessive porosity of the curing acrylic. The patches are no bigger than two inch squares, and are joined after adjacent patches have cured. The thickness of the

acrylic should be approximately $\frac{1}{8}$ " overall. The entire inner surface of the top half of the mold is covered except for a border 1" wide short of the margins. Finishing of the inner surface of the prosthesis can be minimized by wiping the surface of the curing acrylic with monomer (the liquid portion of the acrylic) to smooth it.

Once the shell is adequately cured, the border is added by using a closed mold technique (i.e., top and bottom halves of

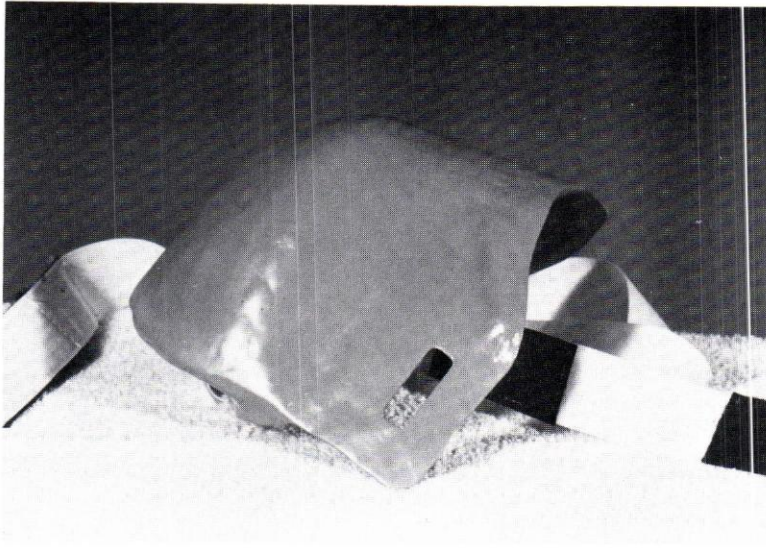


Figure 6. (left) A view of the finished prosthesis, showing straps.

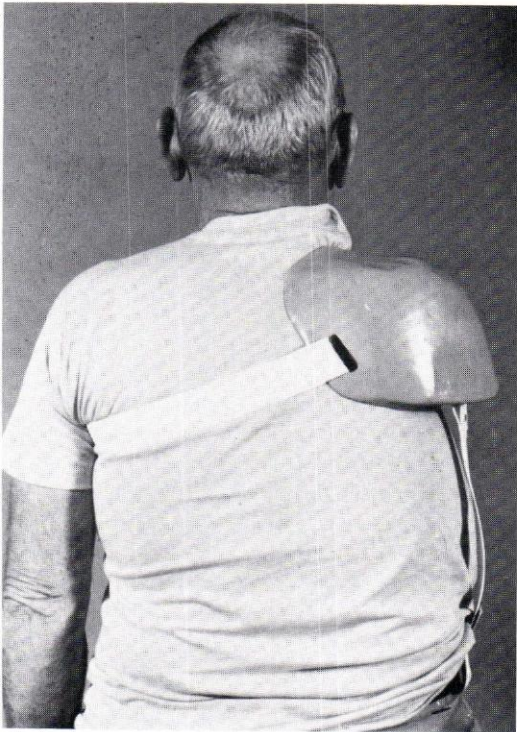


Figure 7. Posterior view of the patient wearing the shoulder prosthesis.

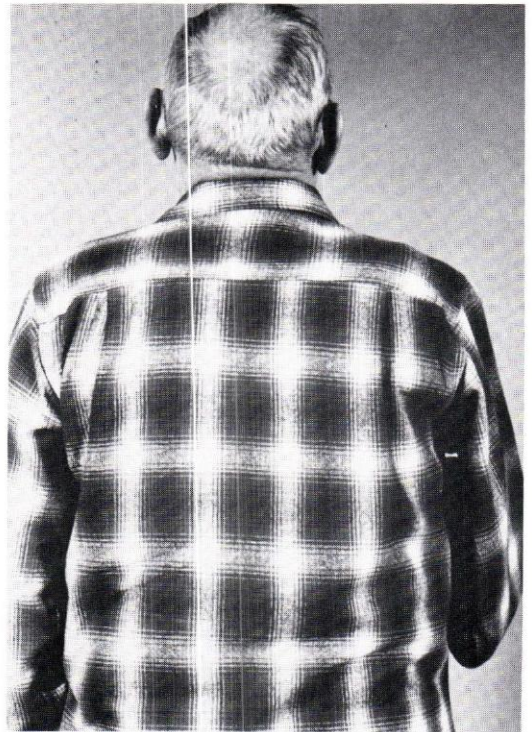


Figure 8. The patient, with the finished prosthesis under clothing.

the mold are put together). A mix of auto-polymerizing acrylic is prepared and applied to the border area left in the top half of the mold. A slight excess of acrylic is applied and both halves of the mold are reassembled and pressed together. The size of the mold prevents it from being placed in a conventional laboratory press, but large rubber bands can retain them after they have been pressed together with hand pressure.

After the acrylic has set, the prosthesis is recovered from the mold, flash trimmed both inside and out, and finished only with pumice on a polishing machine.

The prosthesis is retained by nylon straps with Velcro® fasteners. Slots for the chest strap are positioned slightly above the level of the opposite axilla. An additional strap from the inferior lateral aspect of the prosthesis to the patient's belt can act to prevent the prosthesis from riding up on the neck. Figure 6 shows the finished prosthesis while Figures 7 and 8 show a patient wearing the shoulder prosthesis. These prostheses can be painted to match skin tone or underclothing (which also hides any porosity), by using Krylon® enamel after first priming with Krylon primer (paint is quick drying and durable).

SUMMARY

A technique has been presented for the fabrication of an acrylic shoulder prosthesis. This technique not only achieves better contours than the cloth padding which has been used in the past, but is rigid, strong, and light in weight (entire prosthesis weighs less than a pound).

BIBLIOGRAPHY

Beumer, J.; et. al., *Maxillofacial Rehabilitation*, pp. 503-539, C.V. Mosby, Co., St. Louis, 1979.

REFERENCES

- ¹e.g., Jeltrate: L.D. Caulk Co., Milford, Delaware, 19963.
- ²e.g., Dental Modeling Plaster; Whip-Mix Corp., Louisville, Kentucky 40217.
- ³e.g., NeoWax: Dentsply/York Division; York, Pennsylvania 17405.
- ⁴e.g., Modern Foil: Columbus Dental; St. Louis, Missouri 63188.
- ⁵e.g., Repair Material: Dentsply/York Division; York, Pennsylvania 17405.
- ⁶Borden Ind., Columbus, Ohio.

AUTHOR

Robert L. Engelmeier, Colonel, United States Air Force, is Assistant Chairman, Department of Prosthodontics, David Grant USAF Medical Center, PSC #4, Box 9418, Travis Air Force Base, California 94535.

The opinions expressed herein are the personal views of the author and do not necessarily reflect the views of the United States Air Force.