

# The Patellar-Tendon-Bearing Below-Knee Prosthesis: Fabrication of A Silicone Rubber Soft Insert

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The Patellar-Tendon-Bearing Below-Knee (P.T.B.) Prosthesis, as developed by the University of California Biomechanics Laboratory, was first introduced to the field through courses the latter part of 1959. Three and one half years of experience has shown that this limb has a definite place in the armamentarium of the field of Prosthetics.

The P.T.B. Prosthesis, as described by Radcliffe and Foort (1), consists of three major components with suspension: a. The Soft Insert; b. The Plastic Shell; and c. The SACH Foot.

The Soft Insert was fabricated from 4 to 6 oz. horsehide, or its equivalent, and Kemblo (2113). This fabrication process has proven to be time-consuming, the wearing characteristics of the insert have not been satisfactory, and the insert is only a fair reproduction of the cast over which it has been formed. Therefore, it seemed desirable to search for a technique for fabricating the soft insert and materials that would mold to the stump model, wear indefinitely, and be easy and quick to use. Silicone rubber was the answer to our search.

Silicone rubber is chemically inert, that is, it does not corrode metals and does not cause allergies when brought in contact with the amputee's skin. It is heat stable, and does not age, that is, it neither hardens nor softens with heat or age. In addition, nothing sticks to silicone rubber, a property that is an advantage in fabricating P.T.B. soft inserts, but a disadvantage for many other uses. Finally it is hygienic.

Materials needed for fabricating the silicone rubber soft insert:

- (1) Silicone rubber and catalyst (Dow Corning's R.T.V. Silastic 5391)
- (2) Ban-lon Stockinette
- (3) Nylon Stockinette
- (4) Vaseline
- (5) Ambroid
- (6) P.V.A. Sheeting
- (7) Suction System
- (8) Silicone foam and catalyst (Dow Corning's R.T.V. Silastic 5370)
- (9) Injection Gun

The preparations for fabricating the silicone rubber soft insert begin with the pouring of the stump model and its modification. The stump model is prepared for suction by creating an air chamber, usually done by inserting a paper cup in the plaster slurry to a depth of the patella, and drilling the stump model, where maximum "pull" is desired, and the mandrel, (Figure 1). The stump model is modified in the way described in the P.T.B. Manual, (1), except that build ups of pressure sensitive areas are made with the use of tacks, to determine the amount of build up, and plaster slurry, (Figure 2). Instead of contouring the distal portion of the stump model, build this area up at least  $\frac{1}{2}$ ". This will create a void in the

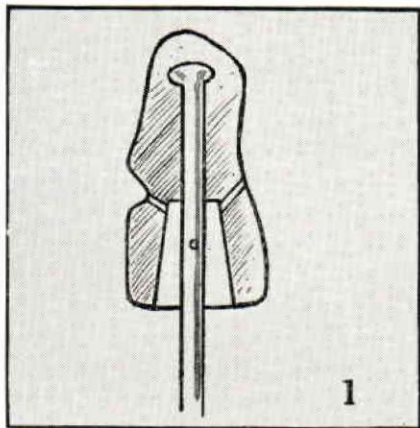


Figure 1—The stump model is prepared for suction.

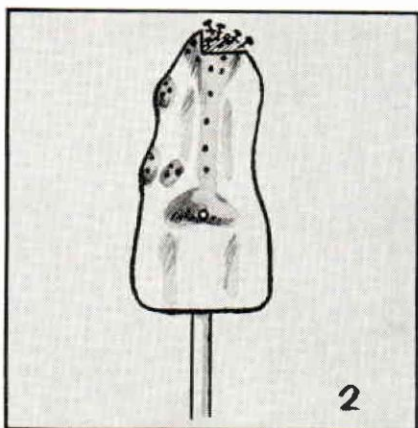


Figure 2—The stump model is modified using tacks to determine the amount of plaster build up on the pressure sensitive areas.

soft insert into which silicone rubber or foam will later be injected. Plaster of Paris must be used for these build ups instead of leather, as leather tends to leave rough edges in the silicone rubber soft insert.

When the stump model has been modified to the satisfaction of the prosthetist for the patient he is to fit, the mandrel should be placed securely in a vise with the model in a vertical position. The stump model need not be dry. Ambroid is used to seal the damp cast, then vaseline is applied and the P.V.A. bag is pulled over the model, (Figure 3). This acts as a parting agent between the model and the silicone rubber insert, but, more important, gives a smooth surface to the inside of the insert.

The layup for the silicone rubber soft insert consists of an inner layer of Ban-lon stockinette, six layers of nylon stockinette, and an outer layer of Ban-lon stockinette. Ban-lon is the type of stockinette used for the outer covering of porous laminates. Eight layers of nylon stockinette can be used, but the finish is not as satisfactory. Each layer of stockinette should be seamed distally, according to the contour of the stump model. A second P.V.A. bag is pulled over the layup and tied to the mandrel, (Figure 4).

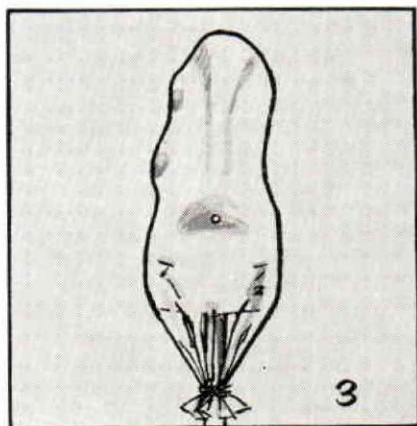


Figure 3—The stump model prior to layup.

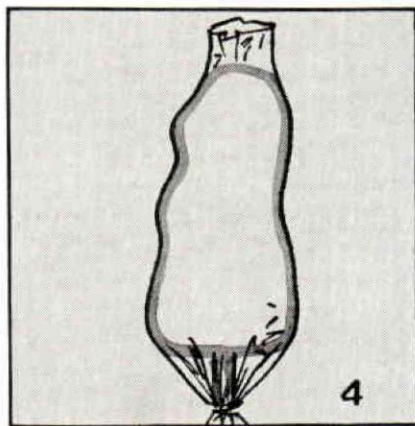


Figure 4—The stump model prepared for lamination.

Next, prepare the silicone rubber resin for lamination (Dow Corning's R.T.V. Silastic 5391). The average soft insert will require 400 grams of resin. Thirty drops of catalyst per hundred grams of resin should be added. The resin will set in 10 minutes and cure in 30 minutes. Pour the resin and catalyst mixture into the P.V.A. bag. Apply suction and string out the resin-rich areas. A suction system is necessary for the successful completion of the silicone rubber soft insert. A suction pump with about 20 inches vacuum capacity should be sufficient.

The silicone rubber soft insert cures at room temperature in approximately 30 to 45 minutes. It can be cured more quickly by adding more catalyst. It is not necessary to heat cure silicone rubber. The P.V.A. bag may be left in place to act as a separation for the lamination of the plastic socket.

Proceed with the completion of the P.T.B. Prosthesis. When the plastic socket has been cured and been removed from the stump model, the socket and insert can be trimmed. The edges of the insert can be sanded, then buffed, with a high speed grinder, and felt wheel.

When fitting the prosthesis on the adjustable leg cut a small hole in the distal portion of the socket wall and soft insert. Have the patient stand with equal weight on both legs. Inject either silicone foam (100 parts of Silastic 5370 to 100 parts of Silastic 5391) or silicone rubber (Silastic 5391) into the insert. This procedure insures perfect total contact.

Twenty patients have been fitted with the silicone rubber soft insert. They found it no warmer than the Kemblo and horsehide insert.

Several of these patients had previously worn P.T.B. Prostheses. They feel that the fit of the silicone rubber insert is better than that of the Kemblo and horsehide insert, and that the silicone rubber insert is easier to keep clean.

The silicone rubber soft insert discussed in this article gives the amputee a stronger, more durable insert that is easy to keep clean. It reduces the fabrication time for a P.T.B. Prosthesis from 1½ to 2 hours and gives a more accurate reproduction of the stump model.

#### REFERENCE:

(1) Radcliffe, C. W. and Foort, J. *The Patellar-Tendon-Bearing Below-Knee Prosthesis*: Biomechanics Laboratory, University of California, Berkeley, 1961.