Orthotics and Prosthetics, Vol. 34, No. 2, pp. 21-24, June 1980

The Selectively Placed Silicone Gel Liner System for PTB Prostheses[1]

JACK M. GRAVES, C.P.[2]

The Silicone gel soft insert has been developed and is available as a component for below-knee prostheses. The principal indication for use of a gel liner has been for amputees with badly scarred residual limbs where it has proven to be an effective system for protection of the residual limb. However, delamination of the bond between the gel and leather and migration of the gel have discouraged somewhat widespread use of the liner.

For walking and most other routine activities, a PTB with either a hard socket or a conventional liner is adequate and is usually preferred by the below-knee amputee. However, for activities more demanding than walking, such as skiing, mountain climbing, and participation in physically demanding sports, the below-knee amputee needs more protection than is generally provided.

A new interface system is described in this report. The Selectively Placed Silicone Gel Insert (SPSGI) is essentially a conventional soft insert design that uses a combination of Pelite and leather (Kemblo can also be used) with a "window" in the Pelite over the anterolateral surface and crest of the tibia. Where the Pelite is deleted Silicone gel is applied (Figs. 1 and 2). Because of its inherent properties, the Silicone gel provides constant volume

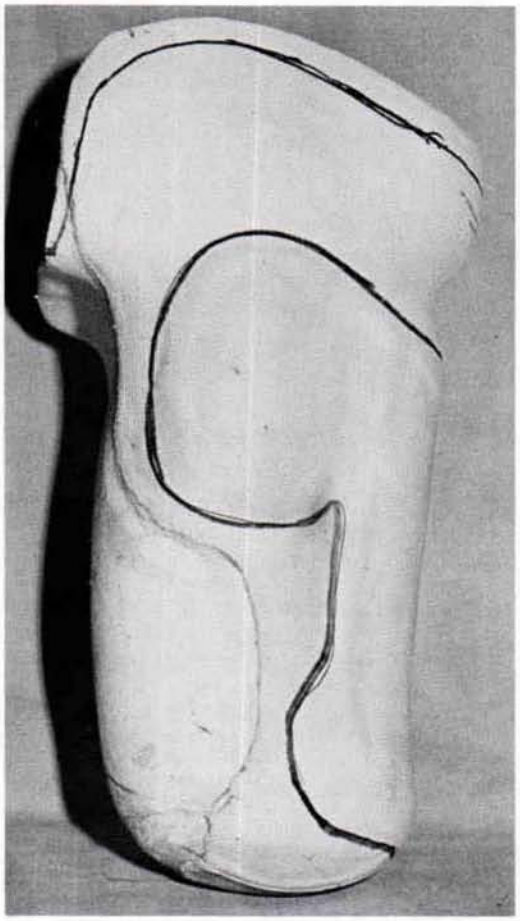

Fig. 1. Lateral view of positive model for PTB using the selectively placed Silicone gel liner system showing area of conventional liner where Silicone gel is used to replace the original liner material. See also Figure 2.

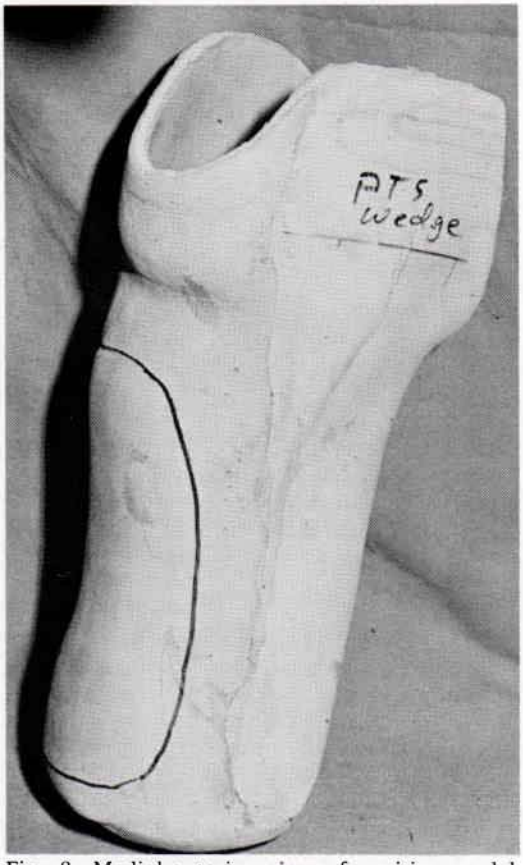

Fig. 2. Medial-anterior view of positive model shown in Figure 1.

Fig. 3. A cloth material is glued to the border of the window to provide a surface for adherence of the RTV Silicone.

with a displaceable, semi-fluid characteristic. The gel is unique in several respects. It possesses a "soft" kind of "hard", due to its volume constancy. It does not pack to a hard, unyielding interface as do most other materials used for interfaces. Although gel does have a tendency to pack, it retains its flow-like quality. There are several other advantages for its use. It provides excellent weightbearing support, and due to its containment, or, in a sense, being locked within the liner, is not subject to delamination or other problems associated with the all-gel liner.

Method of Fabrication

To bond gel in a given area and to the periphery of the window in the liner requires glueing a cloth material to the window's border so as not to saturate completely the cloth, but still bond it to the Pelite in order to provide an effective surface for adherence of the RTV Silicone (Fig. 3). This is used to glue the gel to leather but is not satisfactory for Pelite. An outer laminate of leather is used with RTV adhesive sealant in areas of gel. Conventional glues are used where the leather overlaps the Pelite surrounding the window.

The insert is fabricated over a PTB mold modification with a buildup over

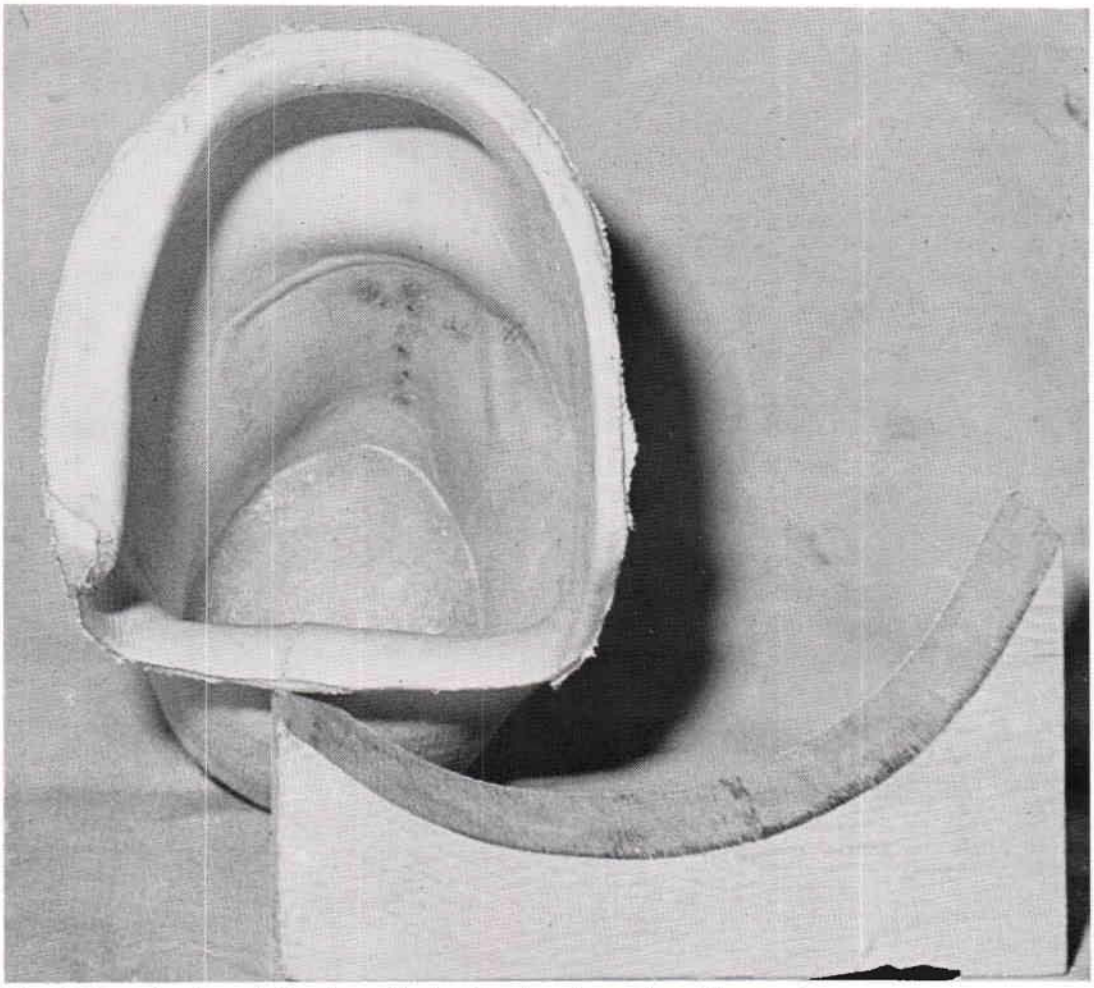

Fig. 4. The socket is molded so that a distal-end pad can be used to achieve total contact.

the distal end so that, within the SPSGI liner, a custom fit total-contact distal-end pad can be used (Fig. 4).

Leather is the most suitable material to use in conjunction with gel. It has an inherent elastic quality so the gel adhesive seals well to it. Care should be used by the prosthetist to seal the leather in all areas of the liner. When the leather interior eventually does deteriorate, it can be relined.

The prototype of the SPSGI liner has been worn daily by the author for several months. Virtually no problems were encountered using conventional alignment techniques and a SACH foot. The prosthesis had side joints, thighlacer, and included a waist belt since the lacer was not used on a daily basis. The belt was necessary since the lower joint halves remained on the prosthesis and a cuff suspension could not be made effective. This prosthesis was built for heavy duty. The SPSGI liner was especially effective when downhill walking was required during climbing expeditions. The author was

able to climb the summit of Mount Rainier twice in a ten-day period, a trek involving 9000 vertical feet of climbing. Extension force of the residual limb against the anterior socket and interface was necessary with virtually every step to prevent knee buckling and thus to maintain stability.

Whether the SPSGI liner is superior to the all-gel system for snow skiing is yet to be determined.

The experience of another below-knee amputee should be mentioned. The residual limb is approximately four and a half inches long with no muscle stabilization and thin skin covering so that the shape is essentially skeletal in appearance. He has bicycled literally thousands of miles using a conventional prosthesis with a Pelite liner. Bicycling was the only sport in which this individual could participate to the extent he desired without experiencing prosthetic problems. He has tried hiking but had skin breakdown.

The interior shape of the liner he had been using was duplicated and a SPSGI liner was fabricated. His new prosthesis consisted of a Greissinger foot and an Otto Bock endoskeletal shank system, polycentric hinges (so that the PTS brim shape could be retained) and thigh lacer for rotational stability and weightbearing support. The SPGIS liner retained the same mediolateral and anteroposterior brim fit provided by the other prosthesis. In fact the mediolateral fit was the essential factor involved in the weightbearing support provided by his socket. The day after receiving the new prosthesis the subject climbed to Camp Muir on Mount Rainier, a 5000-foot vertical elevation gain.

The author has examined another interface system that used gel with an acrylic resin skin. The suppleness of the leather was missing. It was difficult to deform the resin skin in a way that the gel would displace or flow as it does with leather. Also this particular socket interface system had gel incorporated into the socket and thus removal of a liner was not allowed. Because there was no liner, effective socket modifications was impossible without reducing whatever benefits might have been available from the gel, particularly in the anterior region of the socket.

When an all-purpose athletic or extra-ambulatory prosthesis is needed by a below-knee amputee, the Selectively Placed Silicone Gel Insert system should be given strong consideration as the one of choice particularly when the residual limb is long enough and strong enough to provide the extension forces needed about the knee for strenuous athletic feats, walking, and climbing.

Footnotes

[1]This work was performed under the terms of Veterans Administration Contract V663P-1081.

[2]Research Consultant, Prosthetics Research Study, Seattle, Washington.

References

1. Graves, Jack M., and Ernest M. Burgess, *The Extra-ambulatory limb concept as it applies to the below-knee amputee skier*, Bull. Pros. Res. BPR 10-20, Fall 1973, pp. 126-131.