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Technical Note: Cosmesis and the Knee Disarticulation Prosthesis

by Robert Gilley, C.P.

One central problem confronts the prosthetist when fabricating a knee disarticulation prosthesis with side joints, regardless of the socket style (laminated, molded, leather, or flexible frame) used. As the knee flexes, the space anteriorally between the thigh section and the inner edge of the shin increases in width (Figure 1). The result is cosmetically unacceptable. The gap develops because the radial distance from the knee joint center to the periphery of the socket gradually decreases from anterior to posterior (Figure 2). Resolution of the problem may be achieved by building up the distal end of the socket so as to maintain a constant spherical shape through the full range of motion (Figure 3). Observation over the years has led me to conclude that many younger prosthetists are not as familiar with the process as perhaps they should be. Therefore, these few notes are offered in hopes of redressing the situation.

Fabrication of the prosthesis begins by mounting the proximal portion of both joints to the thigh, and similarly, mounting the distal portions in a suitably sized block of wood. Obviously, every effort should be made to maintain the narrowest possible medial-lateral diameter at the knee joint center and to keep the joints square. Wood is removed from between the distal joint sections to permit proper mating of the shin block to the thigh and full range of motion. The interior inner edge of the shin block should fit closely to the thigh in the fully extended position, while allowing sufficient space distal to the edge for the material to be added to the thigh during finishing.

The distal end of the thigh is then built-up with rigid urethane foam. The convex shape of the anterior socket from medial to lateral, and at the level of the proximal anterior edge of the shin block, is repeated radially about the knee joint axis from anterior to posterior. This can be accomplished, rather laboriously, by first removing enough extra material from the thigh to permit it to be assembled with the shin block in the fully extended position. Then, as the knee is gradually flexed through the full range of motion, the anterior edge of the shin is used as a guide to judge how much material to remove at each successive position of flexion. Sufficient material is removed to permit full range of flexion. Care must be taken to maintain a smooth, even surface from medial to lateral and to not remove too much material. Nonetheless, it will doubtlessly be necessary to add material.

The posterior surface of the distal thigh is finished off flat from medial to lateral, so as to fill most of the posterior knee opening. It should not rise above the anterior rim of the shin in the fully flexed position, and at the same time, should not protrude too far posteriorly when in the fully extended position.

The process can be greatly expedited if the following simple apparatus is used. Two aluminum plates are modified so that a piece of stiff paper or cardboard can be clamped between them (Figures 4 and 5). The plates are cut away on one edge so as to span the largest socket. At the leading edge of the cut away side, two threaded rods with tapered points are

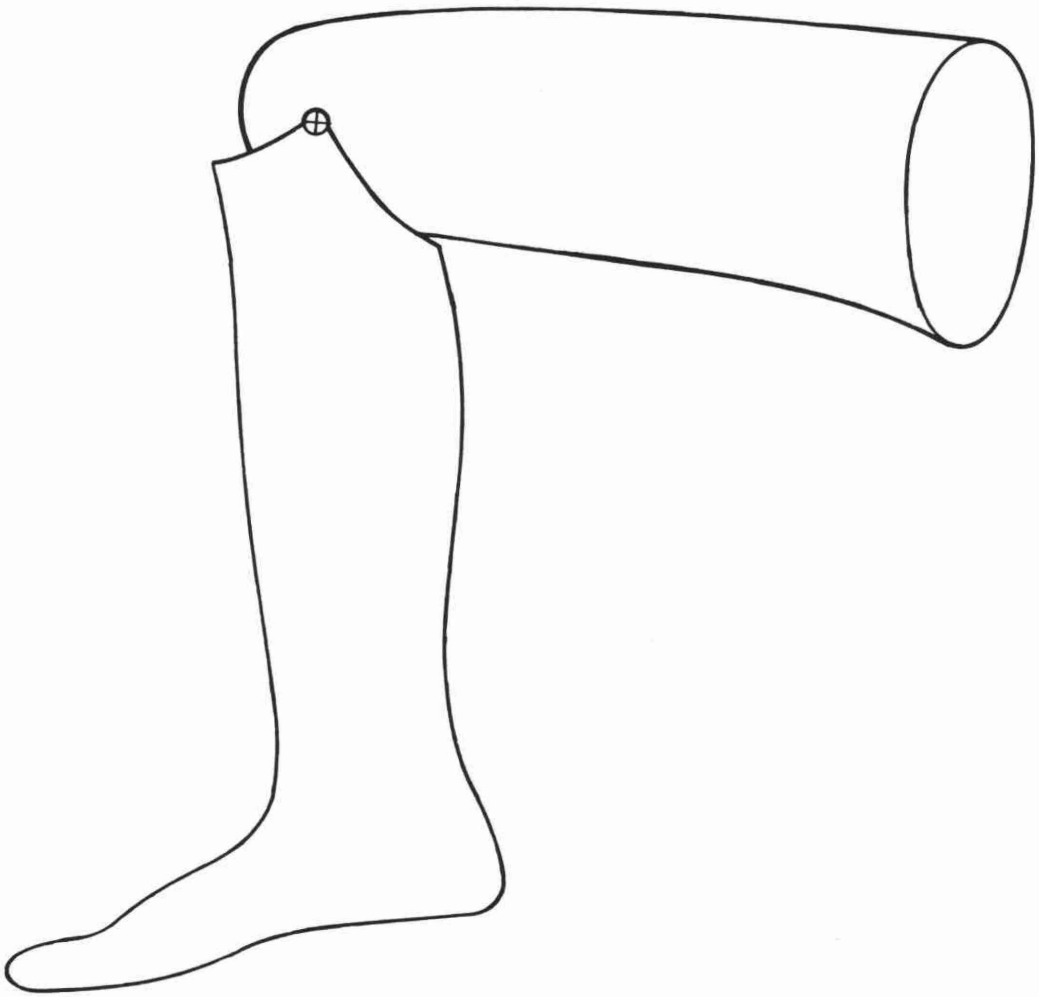

Figure 1. As the knee flexes, the gap anteriorally increases.

mounted on a common axis (Figure 6). These two rods permit the device to be mounted on the proximal knee joints and swung around the distal end of the thigh section (Figure 7). The stiff paper clamped between the two plates of the device is cut to match the shape of the anterior surface of the thigh at the requisite level. The resulting template is then used to duplicate the shape through the full range of motion. (Some prosthetists will of course identify the device as a simple adaptation of the templates that were formerly used when shaping the ball of the knee of a handmade knee-shin set-up for an above-knee prosthesis.) The device described has been in use by us now for over a year. It greatly speeds the process of finishing a knee disarticulation prosthesis.

In conclusion, it is hoped that these comments on the matter will aid a prosthetist confronted for the first time with the task of finishing a knee disarticulation prosthesis—a task that is rather infrequently confronted in the United States and not always addressed by the schools.

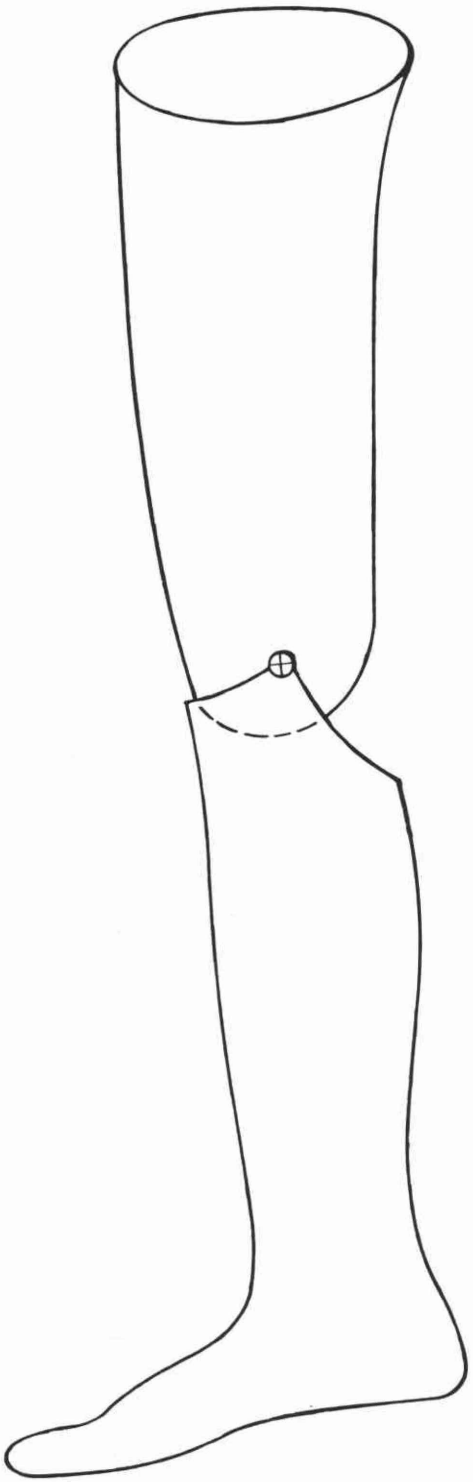

Figure 2 (left). This problem results from the fact that the radial distance from the knee joint center to the periphery of the thigh decreases from anterior to posterior.

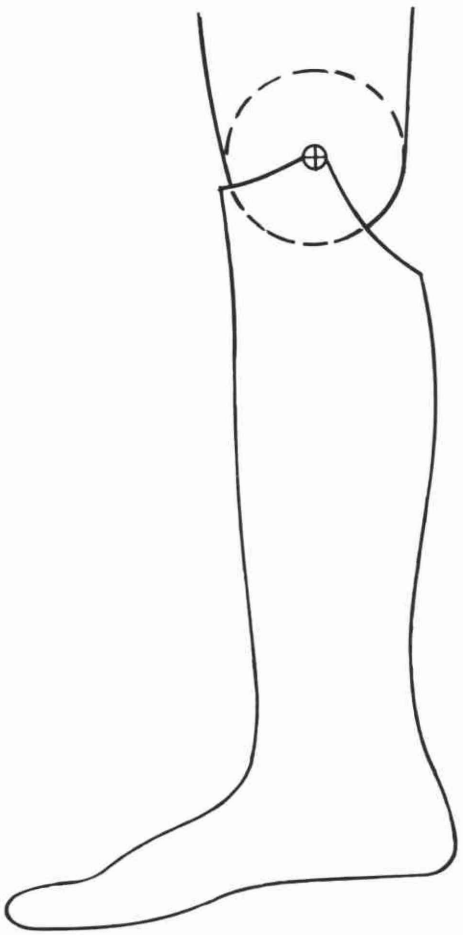

Figure 3. The distal end of the thigh has been built up so that the space between the thigh and shin is constant throughout the range of motion.

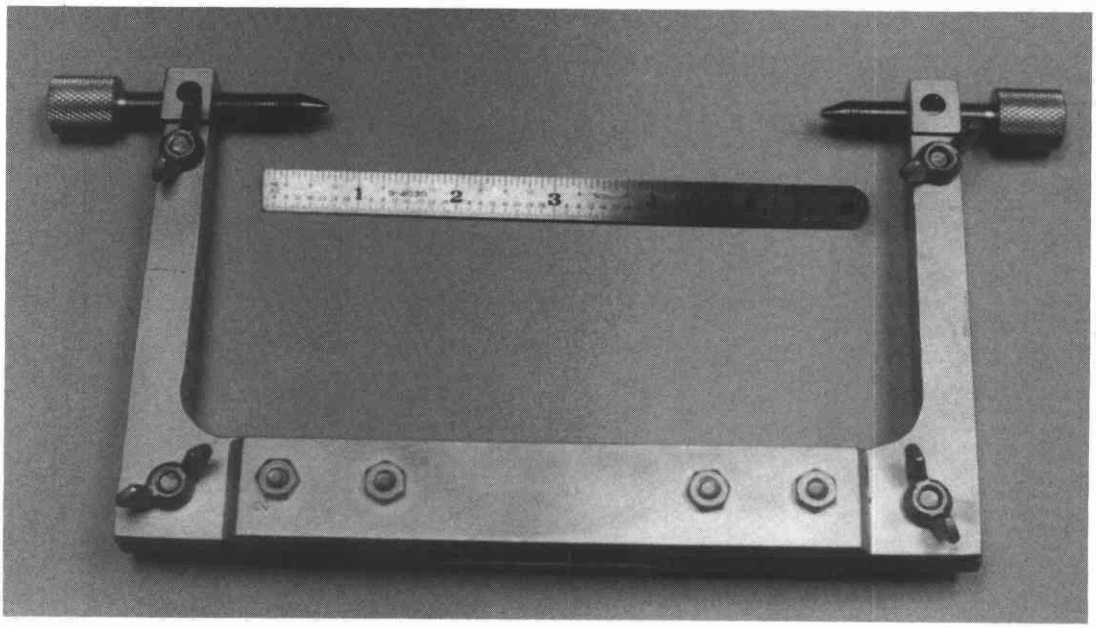

Figure 4. Knee spanning template holder. Six inch rule included in photograph to give a sense of scale.

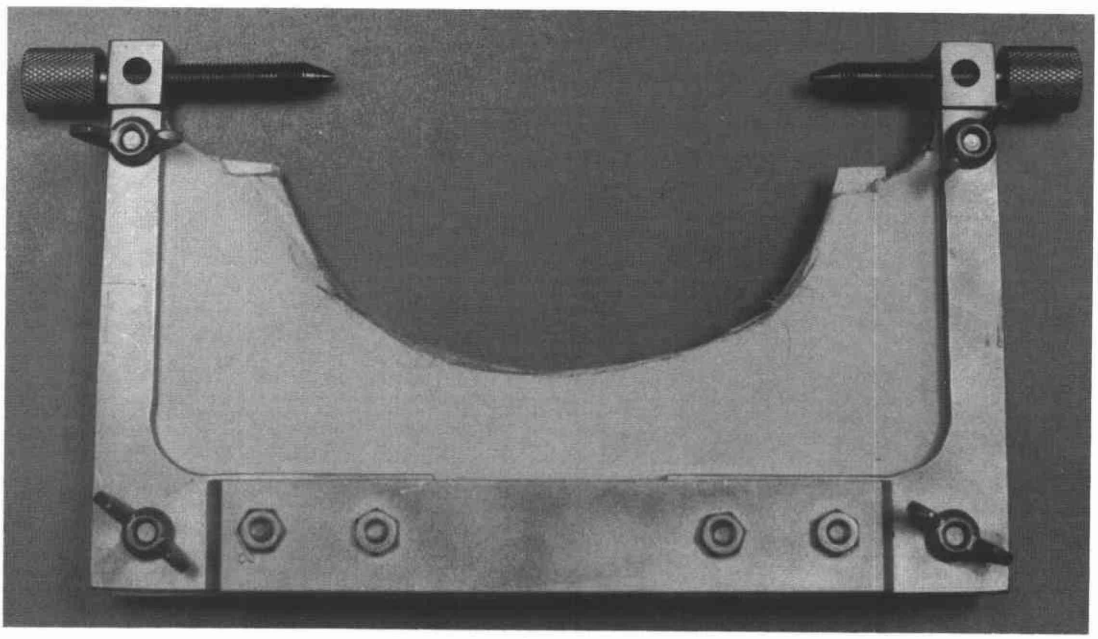

Figure 5. Template holder with stiff cardboard template clamped between the two plates of the holder.

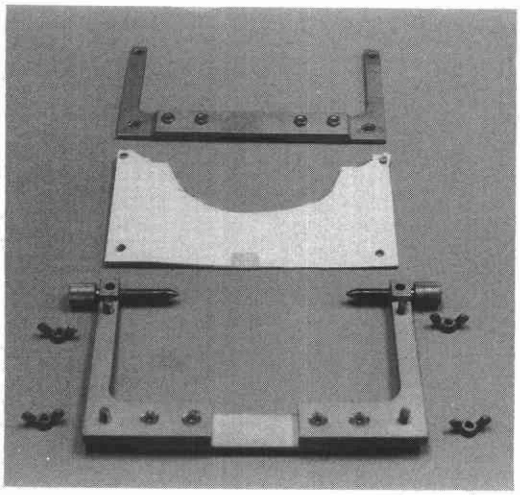

Figure 6. Exploded parts view of template holder and template.

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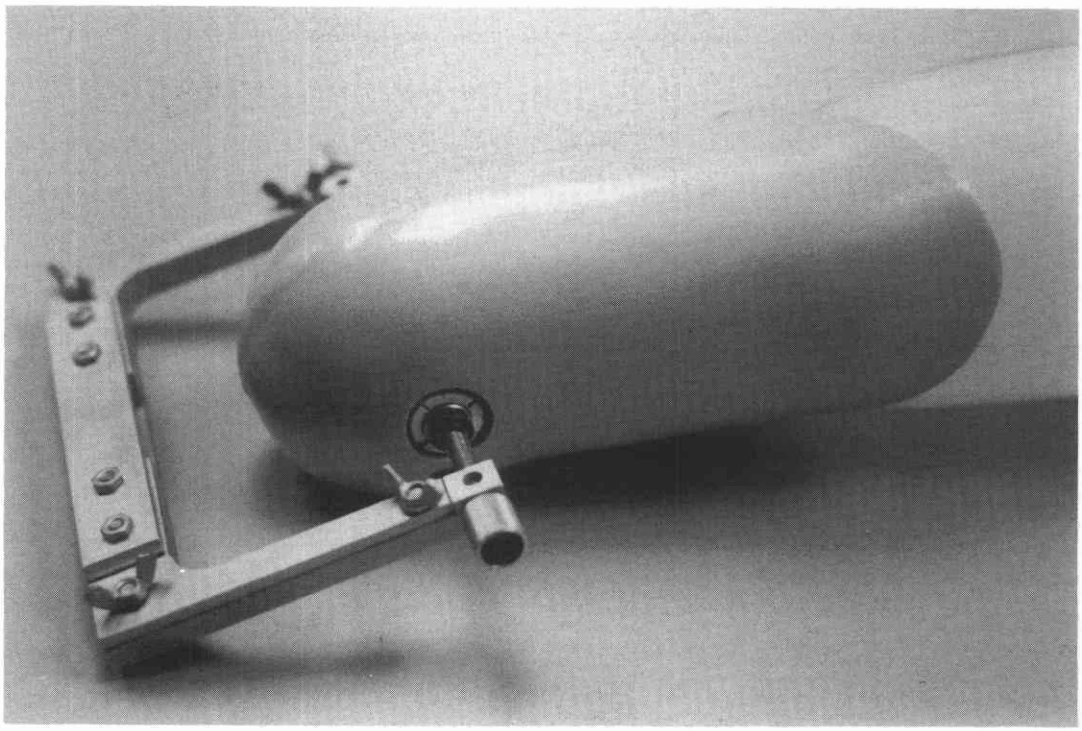

Figure 7. Template holder in place mounted on the knee bolt of a conventional above-knee prosthesis (for illustrative purposes only, a knee disarticulation prosthesis was not available at the time this article was prepared).