HYDRAULIC KNEE CONTROLS FOR KNEE-LEVEL AMPUTATIONS

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The "geriatric" amputee is rapidly becoming a common type of patient in many clinics. It is generally recognized that arteriosclerosis, with or without diabetes, is the most common cause of their amputations. Due to modern surgical techniques, an increasing proportion of geriatric patients are adequately treated by means of below-knee amputation. Nevertheless, a significant number cannot be adequately treated by below-knee amputation, requiring the surgeon to amputate either through the knee or above the knee. Today, the surgeon generally elects above-knee amputation despite the recognized advantages of amputation at a lower level. One of the reasons for election of above-knee amputation is the lack of adequate prostheses for the transcondylar or supracondylar stump. Recent experience in this area has shown the supracondylar amputation to be more advantageous for the geriatric patient than the through-knee amputation since fewer circulatory problems are encountered.¹

As compared to above-knee amputation, supracondylar amputation offers reduced shock since the major knee flexors and extensors are divided through their tendinous attachments, reducing damage to soft tissue. Muscular strength is preserved and a certain degree of end bearing is tolerable. However, due to a paradox, the maximum advantage of this type of amputation is not available for most patients. With a long and strong stump, hydraulic knee control mechanisms are superior to mechanical friction devices. But due to the length of the supracondylar stump it has been impossible until recently to give patients with this type of amputation hydraulic knee devices. To make available the use of fluid knee controls for through-knee prostheses, a yoke system was designed which spanned the posterior of the socket (Fig. 1). The yoke

¹Geriatric Amputee, Committee on Prosthetics Research and Development, NAS-NRC, Publication #919.
arms were pivoted on brackets fixed to the outside joint straps. The piston rod of the fluid knee control unit was connected at the bottom of the yoke.

Several patients were equipped with this system. Although an increase in knee control was noted, the lack of yoke rigidity caused motion to occur between the yoke arms which led to noise and mechanical failure of the yoke or piston rod. A new method has been developed to incorporate fluid control knee systems into the conventional plastic or molded leather sockets of transcondylar and supracondylar-type prostheses (Fig. 2 and 3). This relatively simple approach makes available the urgently needed fluid knee control devices in this most vital area of lower extremity prosthetics (Fig. 4).

The procedure provides for the installation of a fluid knee control
system directly through the prosthetic knee posterior to the distal stump. Using the Dupaco boring fixture which was designed for the installation of the Dupaco hydraulic unit in a conventional wood limb, transcondylar and supracondylar prostheses may be bored to receive the Dupaco fluid knee control unit. This procedure is possible only if adequate material is designed into the distal posterior socket (knee) area of the prostheses. An imaginary axis through the knee of the prosthesis is established by the location of the outside knee joints. The fluid control system's piston rod functions approximately 1⅛ in. posterior to this axis. Knowing these facts, one must place the side joints (knee axis) so as to center the piston pin position in the posterior socket and knee wall (Fig. 5). To provide adequate strength, a posterior wall of 1¾ in. minimum thickness is required. To locate the piston pin properly, the posterior of the inner socket wall should never extend more than ½ in. posterior of the knee axis and the outer posterior socket wall must be less than 1¾ in. posterior of the knee axis. After the knee joints are positioned to locate the piston pin properly, they are temporarily attached to the socket, the entire prosthesis is assembled, fitted, and aligned using
Figure 5.—The outside knee joints are located in an anterior-posterior position to place the piston rod pin through the thickened socket wall 1/4 in. posterior of the knee axis.
Figure 6.—Superacondylar prosthesis held in proper position for boring in the Dupaco boring fixture.

a check lace for extension control. Once the prosthesis has been aligned, the prosthesis is clamped in the Dupaco boring fixture b (Fig. 6). The prosthesis is held in a position of full extension. Holes are bored through the posterior knee socket wall and the shank for unit attachment. Boring and bushing procedures are outlined in the Dupaco Prosthetic Products Manual of June 1965.

b The fixed knee center holder on the boring fixture can be modified to receive wider knees. The shoulder of the fixed center is cut back 1 in. to permit moving the centers further apart.