# An Approach to Bilateral Shoulder Disarticulation Harnessing

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The most challenging problem in fitting patients with bilateral shoulder disarticulation amputations or congenital amelias has been to provide them with satisfactory bilateral terminal device function. In the past, separation of controls has been possible only by utilizing complex controls designs. Various approaches to this problem have been investigated, and a fair degree of success has been achieved with some adult amputees; however, attempts to provide bilateral upper-extremity child amputees with separation of controls have been totally unsatisfactory.

This failure has been due primarily to the musculoskeletal limitations of the patients: the bilateral shoulder disarticulation or above-elbow child amputee has very limited power and scapular abduction, and it is difficult if not impossible for him to operate a prosthesis throughout its functional range. However, he may have very good power sources in shoulder elevation, shoulder abduction, and trunk bending. In order to meet the excursion requirements, it seemed expedient to utilize these superior sources, if possible.

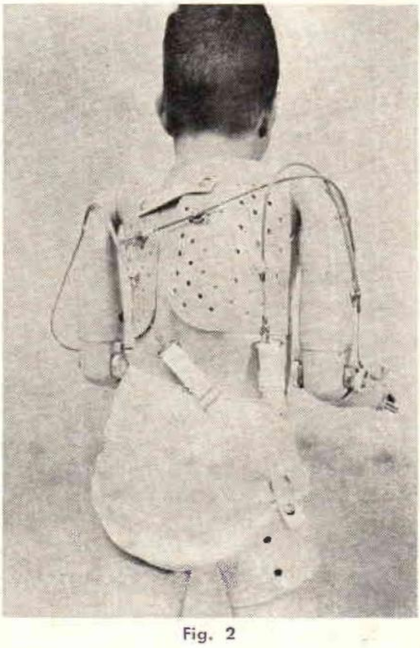

Fig. 2

Perineal straps have been used to tap these power sources, but the discomfort resulting from the use of a perineal strap made such designs unsatisfactory for children.

To overcome this problem of discomfort, and to provide a more stable anchor point than the perineal strap affords, a thigh cuff has been designed to solve these problems of comfort and function (Figures 1 and 2). This thigh cuff is similar to the top brim of an above-knee suction socket, and is quadrilateral in shape, thus allowing the forces exerted on the cuff to be distributed as evenly as possible.

Two types of material have been used in testing this design: the first was a laminated polyester (4110) which was found to have the disadvantage of being rigid, and caused discomfort when the patient was seated. Polyethylene sheet plastic was then tried and found to be much more suitable, providing the desired flexibility with no loss of strength.

When experimentation indicated that such a cuff would provide a very stable anchoring point, this anchor point was located on the lateral side and over the greater trochanter area. Both control straps were placed in approximately the same location, close to the hip axis: this provided automatic separation of controls, with a common anchor point but different control sources. No cross control mechanism was necessary. These bilateral controls can be operated singly or jointly, as the patient desires. Children who have been fitted with this type of control system now have sufficient power to achieve good bilateral function.

### Fabrication of the Thigh Cuff

The technique used in taking the cast is similar to that employed in fitting an above-knee total contact socket. The lateral brim of the socket should be carried over the greater trochanter to provide enough material for the anchor point with its necessary fastenings.

The cuff should be placed on the dominant side: this placement is more efficient and also conserves energy. (Only shoulder elevation is required to operate the prosthesis on the cuff side, whereas on the opposite side a combination of shoulder elevation, shoulder abduction, and trunk bending is necessary.)

The cast is filled in the usual manner, then smoothed down and shaped to the proper quadrilateral conformation. The cuff should extend from two to three inches below the ischial seat level. It should not fit too tightly: approximately zero tension should be maintained circumferentially at the rim of the socket. One-eighth-inch polyethylene sheet is used, with dot snap fasteners for anchor points.

The polyethylene is measured and cut, then laid on a clean piece of paper and heated with a heat gun. Polyethylene is opaque at room temperature, but starts to become transparent when it reaches the proper molding temperature. At this point the heated polyethylene sheet is wrapped around the cast, with the seams overlapping on the lateral side of the cast. This double thickness will allow some adjustment when fitting initially for size. Once proper fit has been determined, the seams can be riveted with speed rivets. This double seam will provide additional strength at the point where the anchor snaps are to be positioned. All trims can be made with a knife or scissors, and the edges can be burnished with a felt pad on a grinding wheel.

The thigh cuff is then fitted to the patient, the area of the greater trochanter marked, and the snaps put on.

As this is not to be a weight-bearing cuff, an ischial seat shelf is not necessary. A slight flare is desirable, because it increases comfort in the sitting position. The perineal area should be very carefully fitted to make certain that the cuff is not pressing against the pubis or ramis, and that there is sufficient clearance in the crotch area.

Compensations for growth can easily be made by removing the rivets on the lateral side, readjusting the cuff for better fit and comfort, and then reriveting the seam.

Note, in Figure 3, the crossbar near the end of the control cable. This crossbar is held in place on the shoulder cap by means of a polyethylene crossbar strap, which swings very freely around the rivet point, thus compensating for any movement and almost cancelling out any cable fraying or breaking at this point.

This thigh cuff design has made it possible to take minimal action cases and provide them with a degree of function which had been quite impossible to achieve previously. Although future designs may provide even more function for the severely-involved bilateral upper-extremity child amputee, the results of fitting with the thigh cuff have been very gratifying—far superior to any system of cross controls or perineal strap design used previously.

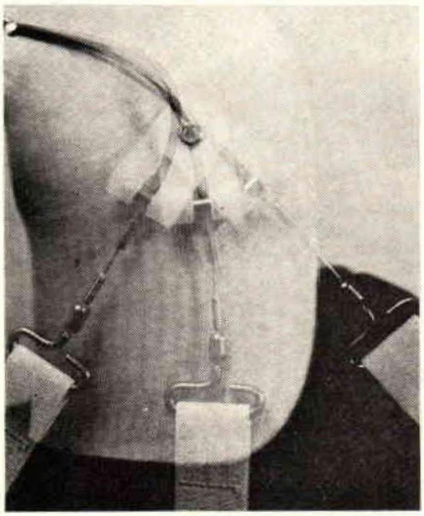

Fig. 3

CARL T. SUMIDA, C.P.O.

EDITOR'S NOTE: In reply to the *Journal's* request, Mr. Sumida has given us a brief biography. Originally a native of Honolulu, Mr. Sumida came to California in 1949, where he received apprenticeship training at the R. E. Huck Co. in San Francisco, and later was employed at Laurence Orthopedic in Oakland. He returned to Honolulu in 1953 to open his own prosthetics shop, which he operated until 1957. He was employed at Peerless Prosthetics in Los Angeles from 1957 until he joined the staff of the Child Amputee Prosthetics Project at the University of California, Los Angeles, in 1960. Mr. Sumida is now Associate Specialist in Prosthetics at CAPP.