A Revised A/K Adjustable Socket

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The Adjustable Above Knee Prosthetic Socket, originally developed at Rancho Los Amigos Hospital, is used both as an interim socket during the maturity process of the residual limb and as a lightweight adjustable socket for the marginal ambulator.[1] However, due to the construction at the distal attachment point, only the proximal four inches of the socket could actually be adjusted. This original design did not allow for distal atrophy of the residual limb, which resulted in the loss of total contact at the distal end of the residual limb, and patient discomfort. There also existed the possibility of proximal constriction from over-aggressive tightening. Since the distal dimensions could not be altered, the only solution we found to this problem was to change the socket at some point during the maturation process of the residual limb.

Our goal was to develop a socket which would be adjustable throughout the full length of the socket. This would eliminate the problem of changing the adjustable socket before the patient's limb had matured to the point where they could be fitted with a definitive socket. To determine the amount of adjustment necessary to fulfill this requirement, we measured 34 patients at the time of their initial preparatory prosthetic fitting and measured them again at the time of their first definitive prosthetic fitting (Figure 1). This time ranged from 3½ months to 14 months. Of the 34 patients (varying in age from 28 to 72 years old) six were eliminated from the study because of excessive weight change. The lengths of their residual limbs ranged from 8¼" to 10¾". The AP and circumference measurements were taken beginning at the ischial level and at 2" intervals increasingly distal on the residual limb (Figure 2). The results of these measurements were then used to determine the atrophy of the residual limb at each level (Figure 3).

This study documented that the residual limb usually atrophies in circumference uniformly throughout its length, and that some modification of the socket's adjustability was therefore desirable. Sanding the distal part of the shells does allow more flexibility, but it tends to weaken the structure, and increases the risk of socket fatigue. The solution was to modify the socket by adding slots at the socket pylon attachment point, and reducing the AP of the anterior shell (Figure 4).

The socket attachment plate was also modified to a rectangular shape to allow for the AP reduction. These modifications increased the proximal circumference adjustment range to 1½", the distal circumference adjustment range to 1⅛", and the

A/K SHRINKAGE REPORT

This study includes 28 sample measurements of residual A/K limb circumferences and AP measurements. It will demonstrate the atrophy that occurs in the residual limb between the initial (IN) fitting and the definitive (DN) fitting.

Minimal/Maximal/Average

The initial 0" level circumference (the most proximal measurement) ranges from 18.00 to 22.25 inches with the average 20.53. The definitive 0" level circumference ranges from 17.00 to 21.50 inches with the average 19.57. This indicates an average shrinkage of .96 inches.

The initial 2" level circumference ranges from 17.25 to 21.50 inches with the average 19.40. The definitive 2" level circumference ranges from 15.88 to 20.50 inches with the average 18.44. This indicates an average shrinkage of .96 inches.

The initial 4" level circumference ranges from 16.25 to 19.75 inches with the average 17.88. The definitive 4" level circumference ranges from 14.50 to 18.50 inches with the average 16.97. This indicates an average shrinkage of .91 inches.

The initial 6" level circumference ranges from 13.88 to 17.75 inches with the average 16.06. The definitive 6" level circumference ranges from 13.13 to 16.63 inches with the average 15.09. This indicates an average shrinkage of .97 inches.

The initial 8" level circumference ranges from 11.75 to 16.63 inches with the average 14.89. The definitive 8" level circumference ranges from 11.00 to 15.50 inches with the average 14.11. This indicates an average shrinkage of .78 inches.

The initial AP measurements ranged from 2.75 to 4.00 inches with the average 3.57. The definitive AP measurements ranged from 2.38 to 3.75 inches with the average 3.28. This indicates an average shrinkage of .30 inches.

Figure 1. Study of the 28 patients, showing average shrinkage.

IN AP		DE AP	
2.75	3.75	2.38	3.38
2.88	3.75	2.75	3.25
2.88	3.75	2.50	3.38
3.25	3.75	3.00	3.25
3.25	3.75	3.00	3.50
3.25	3.75	3.00	3.50
3.50	3.88	3.38	3.75
3.50	3.88	3.38	3.50
3.50	3.88	3.13	3.65
3.50	3.88	3.13	3.50
3.50	3.88	3.25	3.50
3.50	4.00	3.50	3.75
3.50	4.00	3.13	3.50
3.63	100.04	3.38	91.70
3.75		3.38	
AVERAGES		SHRINKAGE	
3.573	3.275	0.298	

Figure 2. Breakdown of AP shrinkage from initial to definitive fittings.

IN 0	DE 0	IN 2	DE 2	IN 4	DE 4	IN 6	DE 6	IN 8	DE 8
18.00	17.00	17.25	15.88	16.50	14.50	15.38	13.50	14.13	12.88
18.50	17.25	17.75	16.38	17.00	15.25	15.75	13.88	14.25	13.50
18.75	17.88	18.13	16.88	16.75	16.00	15.25	14.75	14.25	13.75
19.13	18.88	18.00	17.88	16.25	16.38	14.38	14.38	13.25	12.75
19.25	18.38	18.13	17.25	17.25	16.50	15.75	14.50	15.00	13.88
19.75	18.50	19.13	18.00	17.25	16.75	14.38	13.50	13.13	12.75
20.25	19.13	19.38	18.25	18.00	17.13	17.25	16.50	16.63	15.50
20.25	19.38	19.00	18.50	18.25	17.63	17.25	16.25	16.00	15.25
20.25	19.13	19.00	18.25	17.88	17.00	17.25	16.50	16.00	15.13
20.38	19.50	19.63	18.88	18.50	17.75	17.25	16.63	16.38	15.50
20.38	19.50	19.00	18.25	17.88	17.13	17.25	16.50	15.25	14.50
20.50	19.75	19.38	18.63	16.88	16.13	13.88	13.13	11.75	11.00
20.50	19.62	19.25	18.38	17.13	16.25	14.13	13.13	13.50	12.75
20.50	19.63	19.25	18.38	18.00	17.13	15.75	14.75	15.00	14.25
20.50	19.75	19.75	18.88	18.50	17.75	16.75	15.88	15.38	14.50
20.75	19.50	20.13	19.00	18.25	17.75	15.38	14.50	14.75	14.00
20.75	19.50	20.00	19.00	18.75	18.25	17.00	16.50	15.50	15.50
20.75	19.88	19.50	18.50	16.13	15.13	14.25	13.13	14.00	13.75
20.75	19.75	20.25	18.75	18.50	16.88	16.75	15.50	14.75	14.00
21.00	20.21	19.13	18.25	18.75	18.00	17.13	16.25	16.25	15.50
21.00	19.75	19.88	18.75	18.50	17.38	16.75	15.50	16.50	15.00
21.25	20.35	19.75	18.75	18.38	17.50	15.25	14.25	14.13	13.38
21.50	20.25	20.25	19.50	18.00	17.25	15.75	15.00	14.50	13.75
21.50	20.25	19.75	18.50	18.75	16.88	16.50	15.25	15.13	14.25
22.00	21.50	21.50	20.50	19.75	18.50	17.75	16.25	16.25	15.13
22.25	21.25	20.13	19.00	18.25	17.25	16.13	15.00	14.75	13.88
22.25	21.38	20.25	19.38	18.38	17.50	16.25	15.25	14.50	13.75
22.25	21.13	20.50	19.75	18.13	17.50	17.25	16.38	16.00	15.38
574.89	547.98	543.05	516.30	500.54	475.05	449.79	422.54	416.91	395.16
AVERAGES									
20.532	19.571	19.395	18.439	17.876	16.966	16.064	15.091	14.890	14.113
SHRINKAGE									
0.961		0.956		0.910		0.973		0.777	

Figure 3. Breakdown of the shrinkage at each level from initial to definitive fitting.

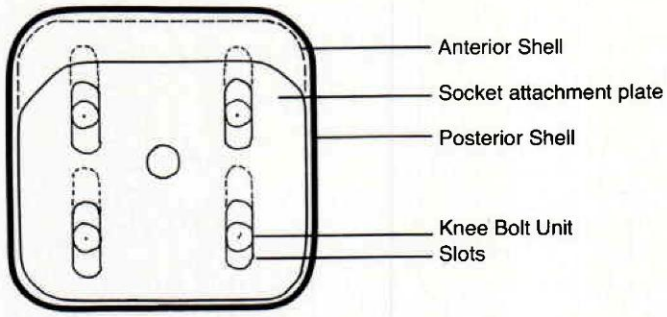

Figure 4. Diagram of distal attachment point.

AP dimension to ½" of adjustment. This allowed for a reduction of the socket's dimension throughout its length in direct correlation with atrophy of the residual limb, thereby maintaining total contact.

DISCUSSION

It must be pointed out that there are times when a prefabricated A/K socket will not provide an adequate fit, despite its greater adjustability. The need for a custom socket then becomes apparent. However, where indicated, the simple modifications described in this article allow the prosthetist a means for early fitting of the above knee amputee with a lightwight socket, which can easily be adjusted proximally and distally to accommodate for atrophy throughout the maturation of the residual limb.

NOTES

[1]Monsen D., Schmitter E., and Quigley M.: *Innovations in Rehabilitation of Amputees Associated with Malignancies*, 1981.

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