

THE BELOW KNEE SUCTION SOCKET

By JOHN GALDIK

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My first introduction to the idea of the suction socket, for below knee amputations, was at the first Above Knee Suction Socket School held at Mare Island Naval Hospital in late 1948. Although my interest was aroused, I gave no special thought to the below knee suction socket until I again attended school at Mare Island Hospital in 1949. We were studying fitting and aligning for the below knee soft socket leg and below elbow arm. At that time there were demonstrated two b.k. suction socket limbs as experimental fittings of the Mare Island Orthopedic Appliance Shop. From that time on, I have seriously worked on the problem of making a b.k. Suction Socket.

Late in 1949 an old customer of mine, a wearer of artificial limbs for approximately fifty-five years, agreed to assist as a subject for experiments in b.k. suction sockets. Many, many hours were spent in making and discarding sockets, and many preparations were tried without achieving the complete suction necessary to hold the limb securely in place. The accepted method of pulling the stump into the socket with the aid of a stump sock, was from the outset a stumbling block. It was rather uncomfortable and a difficult task to accomplish and definitely not favored by the amputee.

In 1950 Mr. Francis Byron came into the firm as a partner. He encouraged and assisted me as an additional subject in the experimental work. His stump was longer than the previous one. He was fitted with a soft b.k. suction socket. This experiment resulted in successful suction,

but other problems arose. After a few hours of wear, acute edema occurred at the end of the stump, and the limb could not be endured for more than four hours. The experimental limbs had been constructed with a selastic socket inserted in a plastic shin. Difficulty had been experienced in pulling the stump in the socket. This had been accomplished by the use of a thin silk stocking. Mr. Byron continued to wear the suction socket for periods of time, and tried various methods of bringing the stump into the socket. The silk stocking was soaked in soapy water. This seemed to ease the process of securing the stump in the socket, but produced irritation of the skin. He tried plain water but the skin became too dry after a time and stuck to the walls of the socket. Next Mr. Byron tried vanishing cream. The discovery of this simple procedure allowed the stump to enter the socket with ease and comfort. In addition suction was maintained satisfactorily. However, edema was still acute. I next put foam rubber sponge pads in the bottom of the socket to compensate for lost atmospheric pressure. I soon learned that too much padding tended to eliminate the accuracy of fit by pushing the stump out of the socket; and that too little padding resulted in edema. Correct use of the sponge pads at the bottom of the socket controlled edema.

At that time I was not favorably impressed with the use of the cream. It seemed to me unpleasant and distasteful to the wearer, as well as presenting deterioration problems. However, from the start no objection was made on this point by any amputee.

TABLE No. 1
Fittings to Jan. 1, 1955

	Fitted	Converted		
1950	19	5		
1951	30	6	Knee joints added	10
1952	31	1	No late record	6
1953	26	1		
1954	28	0		
<hr/> Totals	<hr/> 134	<hr/> 13		

Early in 1950 three other persons were successfully fitted with a b.k. suction socket. With this experience as assurance, I went to the Veteran's Administration. I suggested to Dr. Charles Bechtol that I be allowed to fit a few veterans, who were entitled to new limbs, with this b.k. suction socket. I made the proposal, offering, if the b.k. suction sockets were not satisfactory in every respect, to furnish a new limb, or convert the b.k. suction socket to a conventional soft socket limb. Dr. Bechtol approved of this proposal. He gave me permission to fit two Veterans. He further thought that two cases would not be a sufficient number for testing purposes and wrote to the Central VA Office for approval of additional experimental limbs. Of the 6 test limbs authorized, five were awarded to me, and one to C. H. Hittenberger Co.

From the first successful fittings of 1950 to the end of 1954 I have fitted 134 b.k. suction sockets for 101 amputees. These break down as 112 males, and 22 females—five bi-laterals and five "Symes" among them. (See Table No. I.)

The following represents the present knowledge of the b.k. suction socket limb as applied by me. The stump to be fitted with the b.k. suction socket should be a minimum of six inches below the knee. It should be fleshy and not tapered for best results. The bones do not seem to have much bearing on successful fittings. All types of stumps can be fitted with added supports such as knee straps, knee joints or fork straps, provided the stump is no shorter than four

inches. The difficulties encountered in early fittings occurred primarily because, in the learning process, I attempted to fit limbs not within the above limits.

The cast should be taken with very slight pressure on the bandage. A duplicator machine is used to obtain an exact replica of the cast. Scrupulous accuracy is essential. The bone cavities of the socket should be slightly enlarged and lowered. The socket is made about one eighth to one quarter inch smaller in diameter over all. The bottom of the socket, depending on the length of the stump, starting at a point two inches below the head of the fibula, should be enlarged to the size of the cast. A leather lining, well fitted, is placed in the socket. On the longer stumps vacuum can usually be attained, and held for some time, without sponge rubber lining being added to the socket. Only the bottom of the leather lining is glued to the wood. The top is folded over the socket, and either glued or tacked to the outside of the leg. This allows for ready access to the inside, when needed, for adjustment to relieve pressure points, and to fill in with felt or sponge neoprene rubber when the stump shrinks.

The tightening is done in the top half of the socket. Alignment should be very accurate. The leg should be under the person in such a way that, when he stands or walks, the weight is distributed evenly, without lateral leanings or hyperextension. The leg is made from two parts for better alignment adjustment. Usually, the

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socket is set in a slightly flexed position on the shin. The ankle is set in the foot approximately two thirds of the way from the end of the toe.

All the usual difficulties have been encountered by those wearing the b.k. suction socket. For example: 1. Edema.—2. Insufficient suction.—3. Pressure points.—4. Ingrown hairs.—5. Water blisters on outside rim of stump ends.—6. Irritations (Allergies).

(1) Edema can be caused by the tightness of the socket, or by too much pressure on the fibula. To overcome this I relieve pressure on the fibula, or loosen the entire socket.

(2) Insufficient suction is mainly the result of inaccurate fitting. The socket must be fitted carefully. It must be seated properly. It should not be so tight as to force the stump out of the socket. If loose, the stump enters too far, and thus is not properly seated, causing pressure on the bones, giving a choking sensation, and preventing proper circulation of the blood.

(3) Pressure points tend to cause insufficient suction. By relieving pressure points better suction can be obtained. Pressure should be relieved

carefully; too much or too little are both bad. Just the right amount is essential.

(4) Ingrown hairs are caused mostly by pressure. Relieving pressure points will prevent a certain amount of ingrown hairs. Some will continue to occur over the entire weight bearing area. There seems to be no cure for this condition, but those wearing the b.k. suction socket find this complaint seems to overcome itself in due time.

(5) Water blisters are caused when the sponge rubber pad on the bottom of the socket is too small. This allows edges of sponge rubber to curl when the end of the stump presses in the center than leaving an opening between the sponge and the socket wall. This allows direct vacuum on small portions of the outer rim of the stump. This may be overcome by fitting the pad large enough so no openings are left at the sides.

(6) Allergic irritations do occur and the causes are difficult to determine. Some amputees are allergic to the sponge rubber, finish of the leather, or to the tight fit. My opinion is that it results from a combina-

tion of all these. The irritation has been overcome by substituting something else for the foam rubber, using a different finish on the leather of the socket, or through loosening the socket itself.

It would seem the proper conclusion to give the viewpoint of those who have worn b.k. suction sockets. Without exception wearers find this limb light in weight, easy to put on,

free and natural in action, dependable and comfortable. The elimination of belts, lacers, stump socks, and hinges is appreciated by all, but particularly the women. It is clear that sitting and walking are more comfortable. Normal lacer atrophy is eliminated as muscles are reactivated and circulation improved. Finally, free knee action and generally better posture and gait are attained.

Comments on the Galdik B/K Suction Socket

CHARLES O. BECHTOL. M.D.

The below-knee suction socket cases were followed for a period of four years in San Francisco. Our general experience with them during that time was good and no serious complications were encountered in the use of this device. The successful use of the below-knee suction socket depends upon two factors; first, proper fitting and second, proper alignment. Fitting is an extremely critical matter in order to maintain suction. The fit must therefore be done with considerably greater care than usual in order to maintain suction. The use of the cold cream serves two purposes, first it allows the stump to be slid into the socket. If any rotation is necessary for the bony prominences to fit into their proper spots, the cold cream allows this to occur. The slight stickiness of the cold cream also aids considerably in maintaining suction. Although we anticipated the possibility that some skin difficulty might occur following the prolonged use of cold cream in contact with the skin, we saw no such difficulties.

There were two critical factors in the alignment of the leg. The first was the outset of the foot. If the foot was placed directly into the socket during weight-bearing a sideways shift to the

socket occurred tipping the socket against the stump and causing excessive pressure on the inner side of the brim of the socket. This was prevented by a proper amount of outset of the foot, so that the legs have a slightly knock-kneed appearance. This is something that must be determined by a process of trial and error. It is quite critical for proper use of the below-knee suction socket. The other critical phase of alignment is the proper adjustment of the heel bumper and front bumper so that the amputee may allow his knee to bend slightly after heel strike. Before this bend has become so great that his knee becomes unstable, the contact of the front bumper forces the knee back into extension. In this regard the suction socket wearer walks quite differently from the amputee wearing side hinges on a corset. The amputee wearing this conventional type of device does not allow his knee to flex at the moment of heel strike, but keeps his knee locked in extension by thrusting the knee back with the muscles of the hip. The problem of loss of suction has not been a severe one. If suction is lost, the leg falls off the stump immediately. For this reason some wearers use a light strap or a