

Cordo: A New Material in Prosthetics and Orthotics

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Owing to inevitable changes that take place in the volume and shape of the stump, it is often more difficult to maintain a proper fit, than it is to achieve a proper fit initially. There is no instrument that tells a prosthetist exactly where and to what extent adjustments are necessary. However, it is well known today that pressure is not always the main source of discomfort, but that force and space can create more difficult problems. Many materials have been tried through the years and a number are being used in the fabrication of more acceptable sockets for lower-limb amputees.

It is our opinion that the "hard socket" for the below-knee amputee

is most difficult to fit and adjust, and therefore is the least comfortable for many amputees, especially the older ones. A BK socket with a flexible liner has many advantages over the "hard socket." An insert can be considered to be a sort of "check socket" for locating trouble spots quickly and accurately. When the condition of the stump dictates, extra padding can be incorporated in any given area. In the case of the bulbous stump, the fleshy tissue may be "massaged" into the insert and then lowered into the socket for better displacement of the tissue. Most amputees in the United States are fitted by private prosthetists rather than in institutions, and therefore necessary adjustments very often require a long trip and loss of income for the amputee. We feel these are a few reasons a BK

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socket with flexible insert is a better means of achieving patient comfort and maintaining it over a longer period of time. The only major disadvantage of the liner as described originally for the patellar-tendon-bearing socket (3) seems to have been its deterioration in the presence of perspiration.

Since June 1970, we have been fitting BK amputees, except in a very few instances, with inserts made with "Cordo," a polyvinyl chloride compound (1) (2). During these years we have changed the technique and mixture and now are able to fabricate inserts to any thickness and density, and in some cases with pockets filled with either a gel or air. A Cordo insert does not absorb perspiration, and it is completely washable. We feel that inserts made from "Cordo" are also especially suitable for flexible liners of above-knee suction sockets, and for special prostheses and orthoses.

MIXING PROCEDURE

The Cordo solution we have found to be best suitable is a mixture of 65 percent Cordobond P-315-B2 and 35 percent Cordobond thinner P-371.²

The Cordobond and Cordobond thinner are placed in a covered container and heated to 180 degrees F. in an air-oven. Both materials are flammable and good ventilation is a necessary safeguard. When the solution has cooled Paraplex, 4 percent by weight, and the desired color are added.

² Products of the Ferro Corporation Composites Division, 34 Smith Street, Norwalk, Conn. 06851. These materials can be purchased in 5 gallon containers.

FABRICATION OF A FLEXIBLE LINER FOR A PTS SOCKET

The positive cast should be modified carefully to provide a very smooth surface. The cast is dipped into Cordo and allowed to dry fifteen minutes at 120 degrees F. in an air circulating oven. This first layer of Cordo acts as a sealer. A casting balloon is then applied over the cast to provide a smooth liner on the inside. Four coats of Cordo are then applied by dipping and allowing ten to fifteen minutes to dry between each dip. If the cast is rotated in front of a small fan after each dip, runners will be avoided. When the last layer of Cordo is dry, two layers of tube gauze are pulled over the mold loosely, each layer being saturated with Cordo and placed in the oven for 15 minutes. For extra protection of the anterior distal portion of the tibia, a 1/8-in. to 1/4-in. thick piece of Plastazote is shaped and cemented on the insert. The edges are sanded to the contours of the cast. Additional Plastazote padding can be installed over any other sensitive, prominent areas.

For suspension, a Plastazote wedge is installed over the area of the medial femoral condyle. For the average insert, four additional layers of gauze are saturated and then allowed to dry over night. The insert is then taken off the cast and allowed to dry for two days. When dry, the insert is replaced on the cast, and the areas of the patellar-tendon and the popliteal are heated with a heat gun to mold them against the cast in order to avoid any bridging. No special procedure is used for lamination of the socket.

ADJUSTMENT

In our experience, adjustments to the Cordo insert can be made easier than with any other types of insert. Complete or partial liners may be added by applying tube gauze on the outside, and saturating with Cordo. In cases of drastic changes of the stump, other materials may be incorporated into the insert and covered again with Cordo. When a stump becomes enlarged, the insert can be stretched by heating with a heat gun, and pulled over the stump, or the change can be made by sanding the insert on the outside.

THE SYME'S SOCKET

Cordo inserts have proven to be very successful for the Syme's amputation. Because openings in the socket walls are not necessary when a Cordo liner is used, the socket can be made much lighter, yet stronger. The same procedure is used to fabricate the Syme's insert as for the BK prosthesis, except for configuration of the Plastazote build-up. The thickness of the Plastazote build-up is determined by the difference of the measurement of the bulbous distal end and the smallest circumference above it. The Plastazote may be thicker in places according to the contours of the stump. The measurement around the smallest area of the stump, after the build-up, should be $\frac{1}{4}$ in. less than that of the distal end to aid in suspension. After the build-up, the insert is finished in the standard manner and then laminated. To insure that there will be no damage to the insert, the cast must be broken out carefully.

At the fitting, the insert is pulled

as far onto the stump as possible, and from the point the bulbous end has reached in the insert, it is slit distally as far as necessary to allow the stump to slide into position (Fig. 1). The patient then eases the insert into the socket. The $\frac{1}{4}$ -in. difference in circumferences has proven to be such an effective means of suspension that it has sometimes been necessary to drill a small hole in the distal end of the socket to release the vacuum and allow removal of the limb.

The patient with Syme's amputation shown in Fig. 1 had an unusual amount of shrinkage because of loss of weight and the insert had to be built up three times with layers of tube gauze and Cordo. Although this finally pulled the material along the posterior slit apart, the amputee felt no discomfort.

ABOVE-KNEE ORTHOSIS

An above-knee orthosis with Cordo insert (Figs. 2 & 3) was developed to deal with three basic problems experienced by a polio patient who had very limited function of her right lower limb. The first problem was the inability to change shoes because of a two-inch shortage of the limb. A special shoe had been fabricated and fixed permanently to her orthosis. By casting the extremity in the degree of plantar flexion that allows the patient's toes to enter the shoe, but keeps the heel out of the shoe, it was possible to compensate for the length discrepancy. After the first lamination was made, the heel was built up to maintain the proper alignment under weight-bearing. Change of shoes was then practical, limited only by restrictions to heel height.

The second problem was pronounced unilateral muscle atrophy making the extremity unsightly. Bet-

ter cosmesis was obtained by using a Cordo-Plastazote insert. The insert was fabricated so as to copy

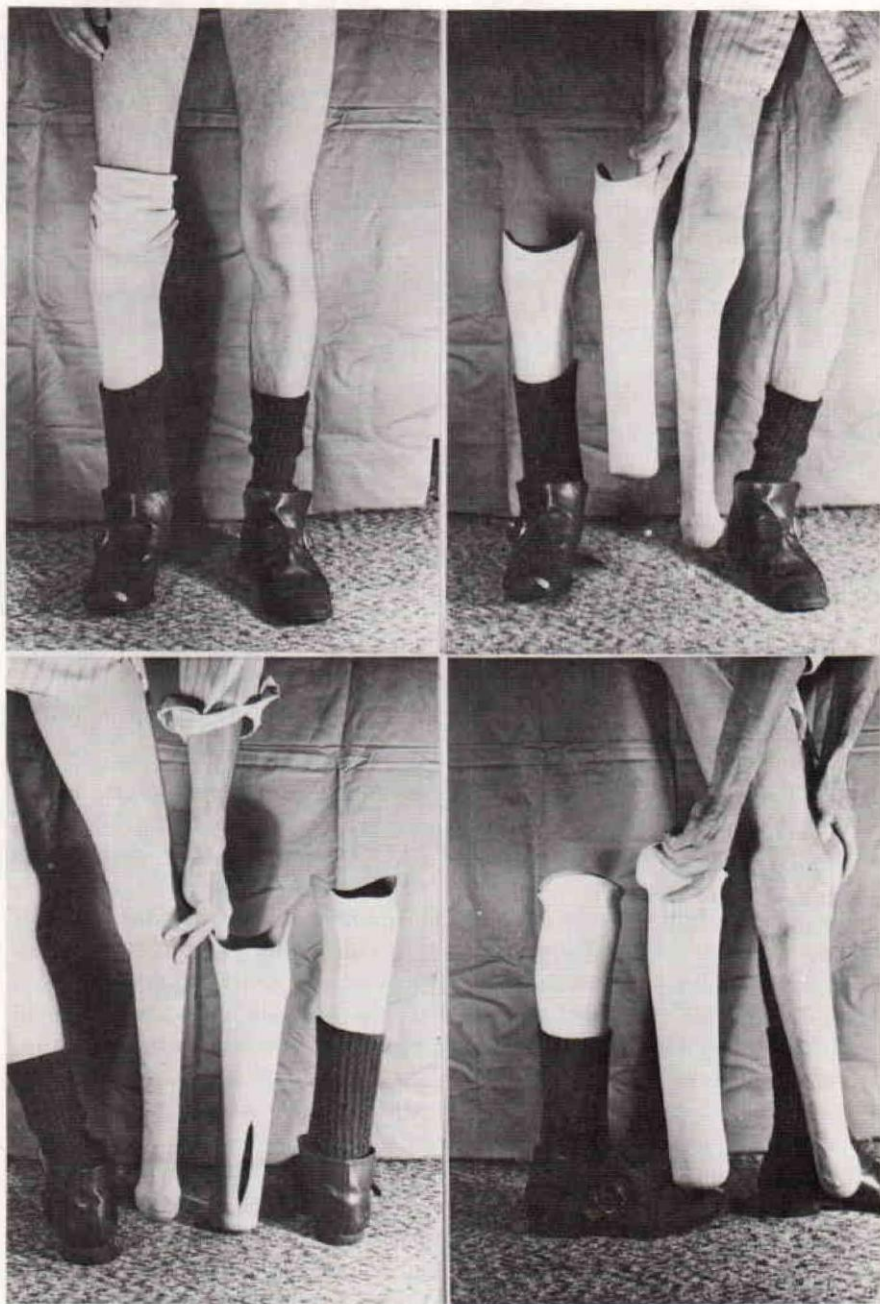


Fig. 1

Syme prosthesis using a Cordo insert.

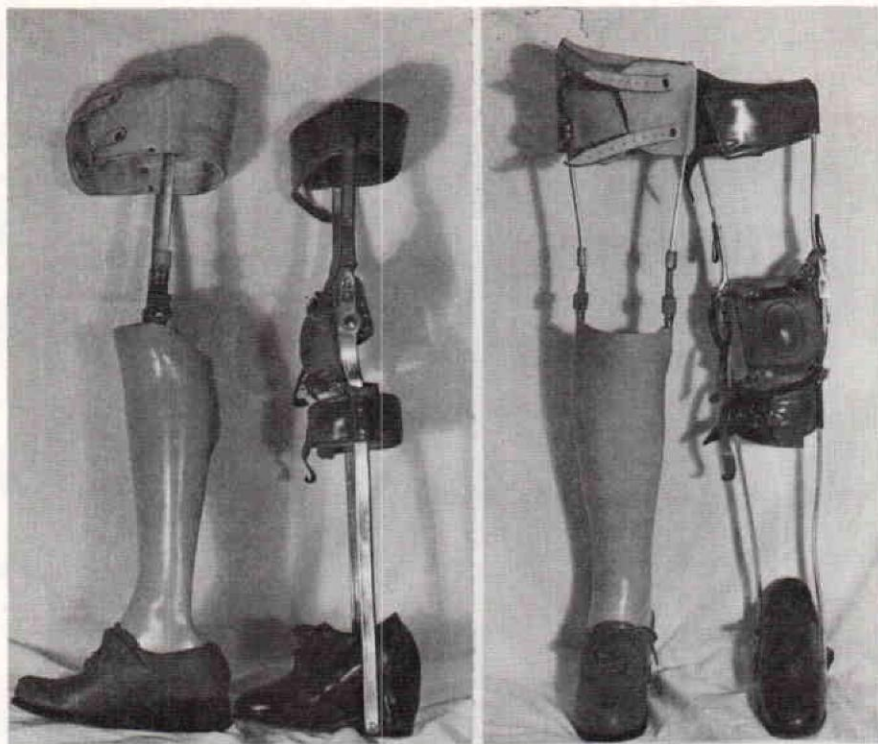


Fig. 2

Two views showing contrasts between the old and new orthoses for a polio patient with shortened leg.

the shape of the sound leg while at the same time maintaining a total-contact relationship between the extremity and orthosis.

This total-contact relationship brings us to the third problem, stability. The patient complained of a tendency to slide forward in the shoe, due mainly to the plantar flexion angle which was needed to compensate for the shortness and to obtain as much cosmesis as possible. Total contact provides stabilization of the extremity within the orthosis.

The insert fabrication was much the same as that for the Syme's prosthesis, taking care to copy the shape of the sound limb with the Plastazote buildups. An anterior

slit was used in the insert, and a posterior opening in the laminated shell allowed the foot to pass into the socket.

After wearing the orthosis for several weeks, the patient complained of excessive perspiration, a condition which was to be expected. The front portion of the Cordo insert was eliminated and the patient became much more comfortable.

ABOVE-KNEE SOCKETS

Cordo inserts have proven to be very useful for many above-knee amputees as well. We have fabricated flexible liners for patients with very bony stumps, and added padding where very little natural pad-

ding is present in such areas as the lateral distal femur and the ischial tuberosity. This not only greatly

increases patient comfort, but adjustment can very easily be made between the liner and socket.

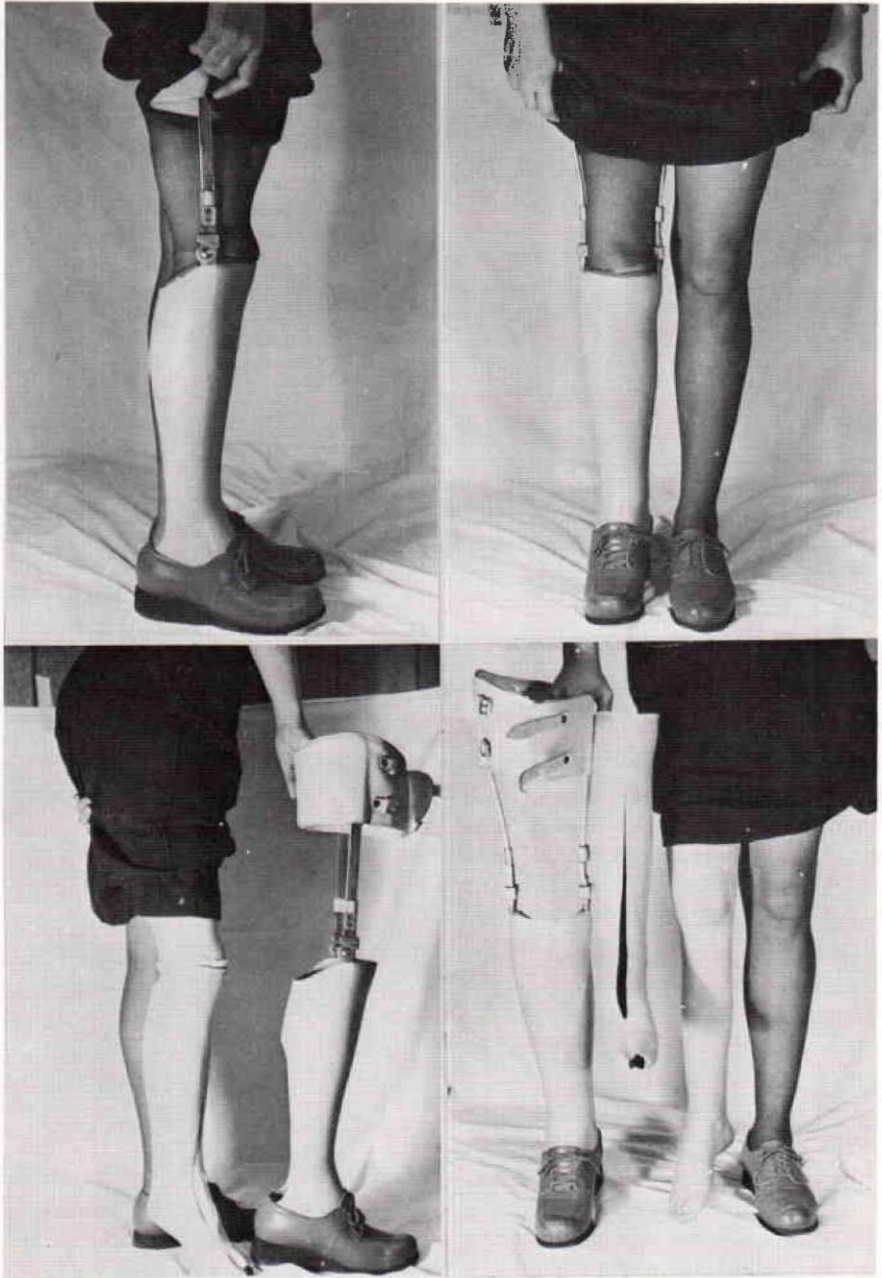


Fig. 3

Four views of an orthosis for a polio patient with leg-length discrepancy.

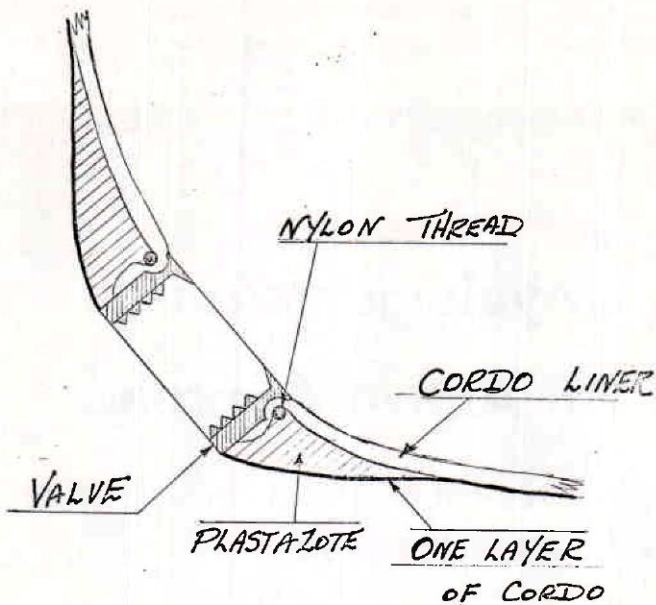


Fig. 4

Schematic view showing installation of a suction socket valve when a Cordo liner is used.

In cases where suction sockets are required, Cordo inserts are very useful. The largest obstacle is maintenance of the valve within the flexible insert. We found that when the valve is inserted into a hole $\frac{1}{2}$ in. in diameter after the area around the hole has been heated, the flared portion of the insert can be tied off with a nylon cord in the valve's groove to make a permanent seal between the two (Fig. 4). The nylon cord is saturated later with Cordo to eliminate the possibility of slippage. The areas around the valve may then be built-up with Plastazote and blended into the contours of the stump. When desirable the last layer of Cordo may be left off until after the Plastazote has been added, and used to finish off the liner (Fig. 4).

IN CONCLUSION

It does not suffice to say Cordo has its place in prosthetics and orthotics. Cordo is a material with sufficient versatility to provide an answer to a problem that has long been the greatest complaint by the advocates of hard sockets, hygiene. It is not our contention that Cordo is the ultimate answer, but it most definitely provides an improvement.

REFERENCES

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