

NEW DIMENSIONS FOR PROSTHETIC SOCKS

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Although the basic designs and fitting procedures for prosthetic socks have been standardized for many years(2), Knit-Rite, Inc.(5) and others(3) have become increasingly aware that correct fitting of standard socks is sometimes complicated by "irregular contours of the stump, the presence of skin grafts, or the lack of sensation in some areas"(4). Furthermore, improved socket designs have made it more desirable in some cases to have more contoured socks rather than additional layers of socks for more padding.

Knitting Standard Socks

Historically the contour or shape of a standard prosthetic sock has been achieved by increasing or decreasing the stitches (wales for width, courses for length). Since each wale is controlled by a single needle on a knitting machine, increasing or decreasing wales means increasing or decreasing needles. This can only be done on the side edges of the sock and is called fashioning. A sock is knitted beginning at the "toe" and widened (fashioned) one needle each side, each row to achieve the desired "toe" width (Fig. 1). The sock may then be knitted straight and widened at evenly spaced intervals often enough to achieve the necessary width desired for the top. When the sock comes off

the knitting machine, the "toe" is the shape of a squared-off semicircle, and the fashionings are on the sides (Fig. 2A). After the sock has been processed, blocked, and fleeced, it is soft and full, and most often the fashionings are positioned in the center rather

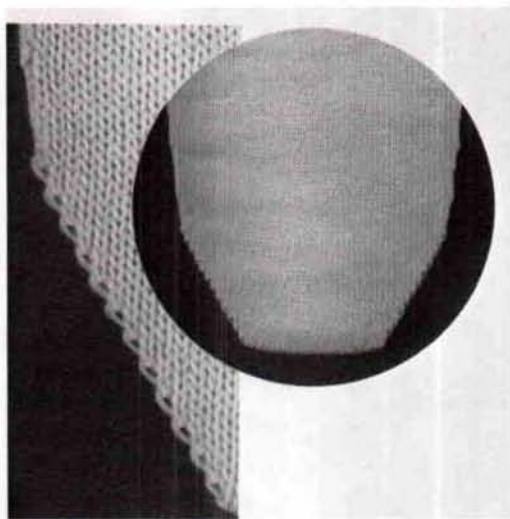


Fig. 1. "Toe" section of sock as it comes from the knitting machine. Each stitch (wale) across the "toe" end was made by one needle. Loops (fashionings) on the sides indicate where needles were added to increase the width of the sock. Needles may also be deleted gradually to narrow the sock for special contours as socks for Syme's amputation.

than on the sides to make the "toe" rounded rather than squared-off (Fig. 2B).

Sizing Standard Socks

Prosthetists usually determine "toe" and top by taking circumference measurements. For socks "toe" and top are expressed in flat measurements which are equivalent to one

half the circumference or slightly less. The "toe" width of a sock may be measured in several ways. One way is to measure the width two inches from the tip of the sock(6). If measures are taken at the top of the widenings, the standard "toe" will approximate a semicircle. The top width of a sock is almost uniformly measured at the very top of the sock. "Toe" and top widths are scaled to each other in seven size ranges, two for up-

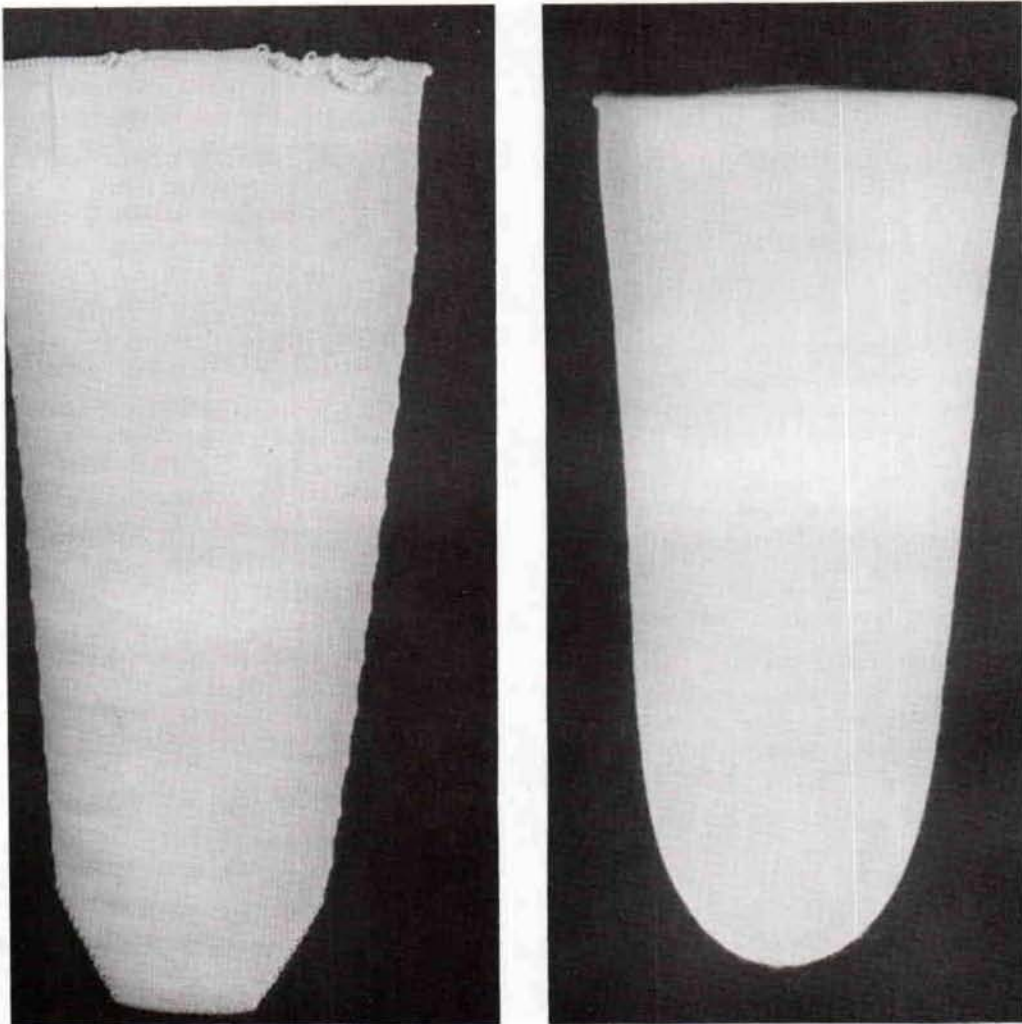


Fig. 2. Left, The knitted sock. "Toe" is shape of squared-off semi-circle. Fashionings are on the sides. Right, Sock ready to be delivered to the amputee. It is the same size as sock shown on the left, but has been processed, blocked and fleeced. Fashionings are now in the center of the sock and the "toe" has a rounded contour.

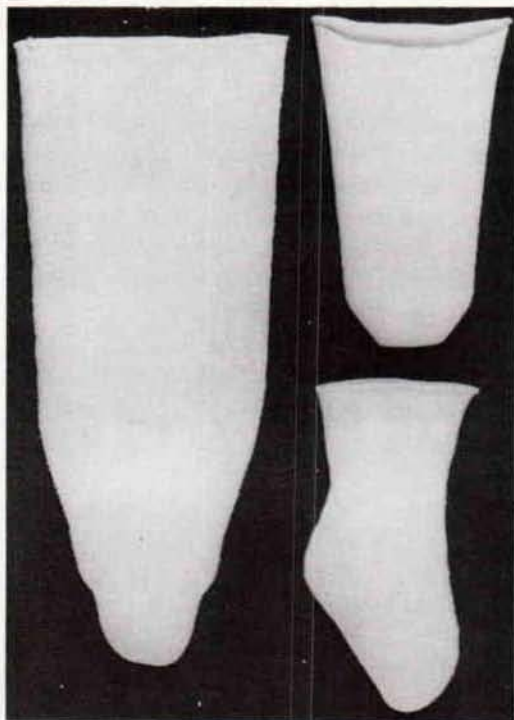


Fig. 3. Two amputees were originally fitted in a standard sock such as the 3-ply Orlon/Lycra® one at upper right. Amputee "A" had a narrowing at the distal end. Although the actual stump contour was not symmetrically narrowed, the sock (left) was made symmetrical, and in this case the stretch of the fabric conformed to the actual curvatures without the wrinkling that occurred with the standard sock. When a symmetrical configuration can give equal comfort, it is preferred because the amputee can then turn the sock and get more wear from it. Amputee "B" had an uneven side. The standard sock did not stretch enough to prevent wear in the protruding area. A sock, lower right, which followed the contour exactly gave superior wear and comfort.

per-limb amputees and five for lower-limb amputees³. In each size range, standard lengths are available in increments of two inches from 10 to 32 inches. PTB sizes are a separate range as are the Syme's sock sizes which require an additional measurement across the narrowed part. Measurements for all socks are expressed traditionally with the length first and other measurements in order from top to "toe".

Evaluating Fit

The ranges of sizes available and the knit construction of the standard sock does allow a good fit and an adequate amount of stretch and shaping for most, but not enough for all, amputees. Indications that socks are not fitting correctly have been related to wrinkling of the "toe" caused by irregular contours of the stump (Fig. 3A), inadequate wear from a sock because of pulling to stretch over a protruding area (Fig. 3B), and discomfort. There are many variations of these and other irregularities, any of which may indicate the need for a special prosthetic sock. Some special socks merely require knitting a wider "toe" called a box "toe", whereas, others may require much more complicated patterning to give proper fit and comfort. Making socks for some of these variations on a knitting machine is extremely difficult and sometimes impossible, but a way has been found to tailor a sock to the specific measurements of any amputee—in fact, even to a scale drawing or a pinned up sample (Fig. 4).

Tailoring Special Socks

Tailoring is achieved by a seam which flattens to the extent that it is impossible for the average wearer to feel and is less distinctive than the widenings created by fashioning a sock on a knitting machine. The seam is made on a modified serger. Many seaming yarns were tried before the specific stretch yarns were finally selected. They allow wool, silkoline (mercerized cotton) and Orlon/Lycra® knitted fabrics to be seamed

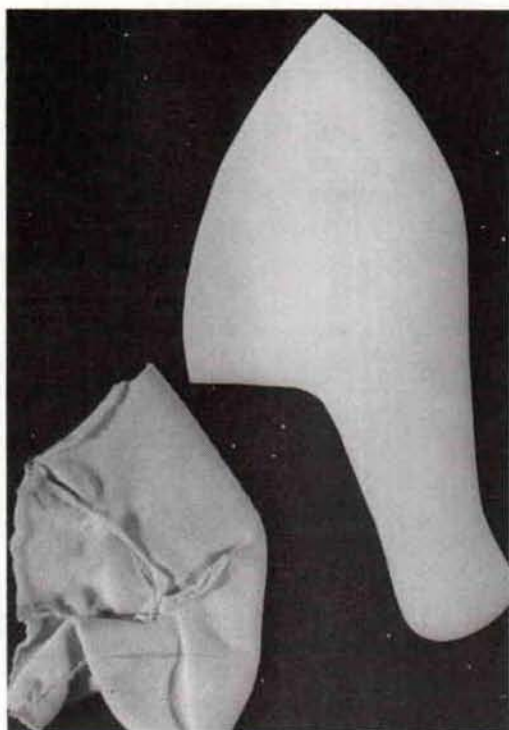


Fig. 4. At right is a scale drawing. No measurements were needed. Drawing was followed exactly for 100 percent wool and decreased 10 percent for Orlon/Lycra.[®] Fitting sock was sent.

At left is pinned-up sample. This was to fit a shoulder amputation and some measurements were also given.

and the seam to be stretched so that it is absolutely flat. This seam does not deteriorate in laundering. It does give a new dimension to prosthetic socks. The limitations of widenings and narrowings imposed by the knitting machine do not have to be adhered to anymore, and socks may be made now to fit unusual shapes smoothly and snugly. The squared-off "toe" can now be rounded and narrowed as gradually or abruptly as needed.

When a prosthetist is ordering a special sock for a new patient, he may find that the fitting sock is tailored since this is a faster

process than setting up a knitting machine for one sock, and results in a sock to which alterations can easily be made if necessary. Once the dimensions have been established, the prosthetics facility may specify "knitted" or "tailored" when ordering and the sock will be made as closely to specifications as each method allows (Fig. 5).

Another new dimension has been the tailoring and knitting of 2- and 3-ply Orlon/Lycra[®] socks. This material was originally developed for fitting amputees immediately postoperative⁽¹⁾ and is relatively new in conventional prosthetic socks. Because of its increased elasticity, it is particularly suitable to certain amputations (Fig. 6), and the stretch seaming yarn is very compatible with the stretch fabric when a sock is tailored.

Tailoring seams were originally used on hip-disarticulation socks for the purpose of inserting a soft, pad-like wool panel into a supportive, elastic, snug-fitting Orlon/Lycra[®] body (Fig. 7). At first only 2-ply Orlon/Lycra[®] was used with 3- and 5-ply wool panels. Now 3-ply Orlon/Lycra[®] has been developed and is especially compatible with the 5-ply wool panel. Tailoring also allows 100 percent wool hip-disarticulation socks to be made in widths up to 26 inches and with many variations such as smaller waists, a tighter fit for a smaller area on one side of a bi-lateral and added protection down the thigh of the contralateral leg (Fig. 8).

Washing Orlon/Lycra[®] Socks

Hip-disarticulation socks of 100 percent Orlon/Lycra[®] both 2- and 3-ply have been found to be beneficial in immediate postsurgical prosthetic fittings¹ and can be supplied in plastic bags to accommodate sterilization. They are also being recommended by prosthetists for daily wear because the superior elasticity allows for a really supportive snug fit and the ease of laundering is especially important in this type of sock. Mild detergents and warm rather than hot water temperatures are recommended—cool dryer or air drying—no chlorine bleach—and the am-

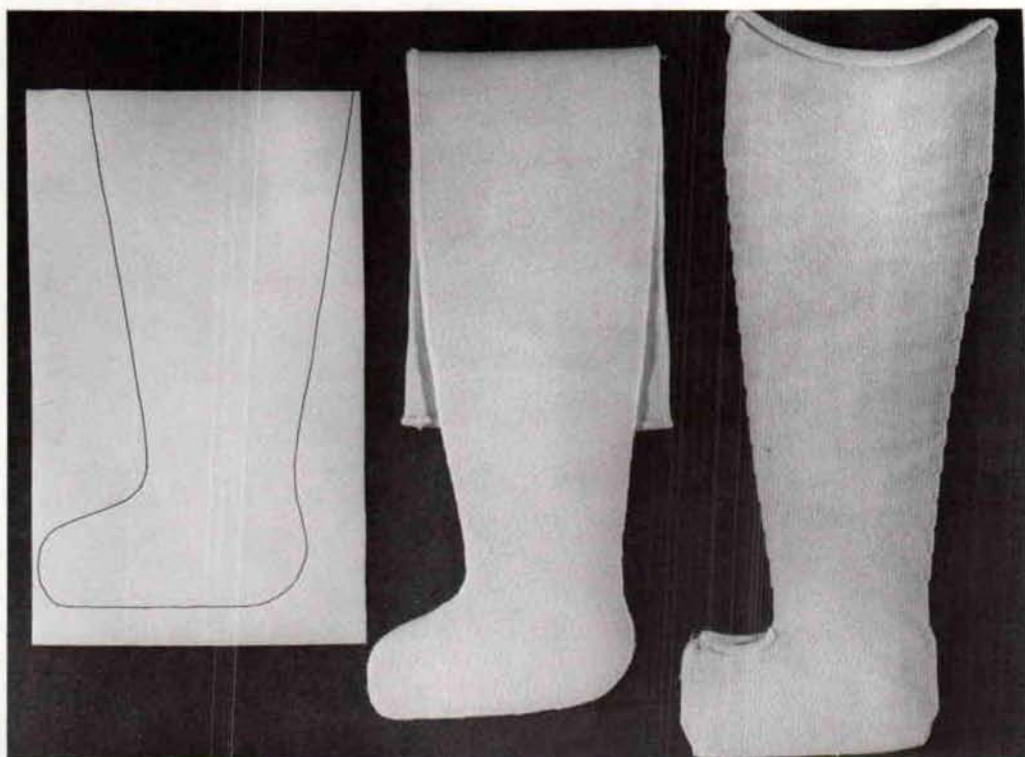


Fig. 5. At left is pattern made from measurements supplied by prosthetist. In the center is the tailored sock sent for a fitting. At right is knitted sock, requested by the amputee, as it looked after being knitted. When narrowing is so abrupt, stitches must be connected by hand.

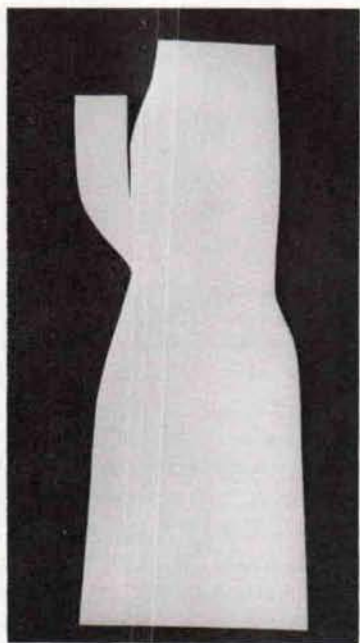


Fig. 6. Pattern for mitt which was tailored in 2-ply Orlon/Lycra®. In this case the elasticity of the fabric is imperative.

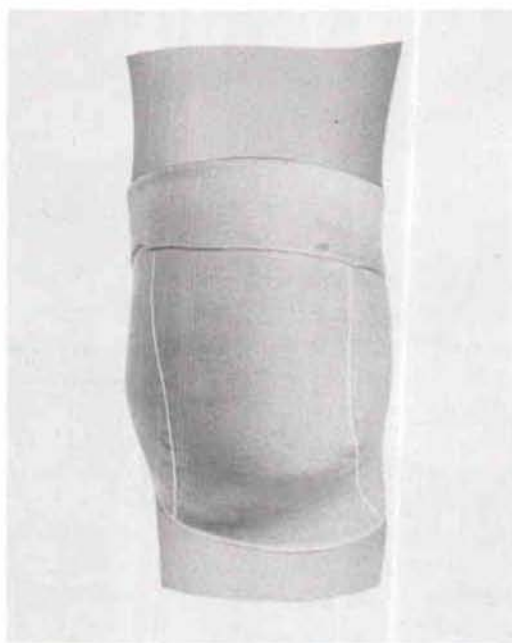


Fig. 7. Side view showing Orlon/Lycra® body seamed to wool panel to pad and protect sensitive areas.

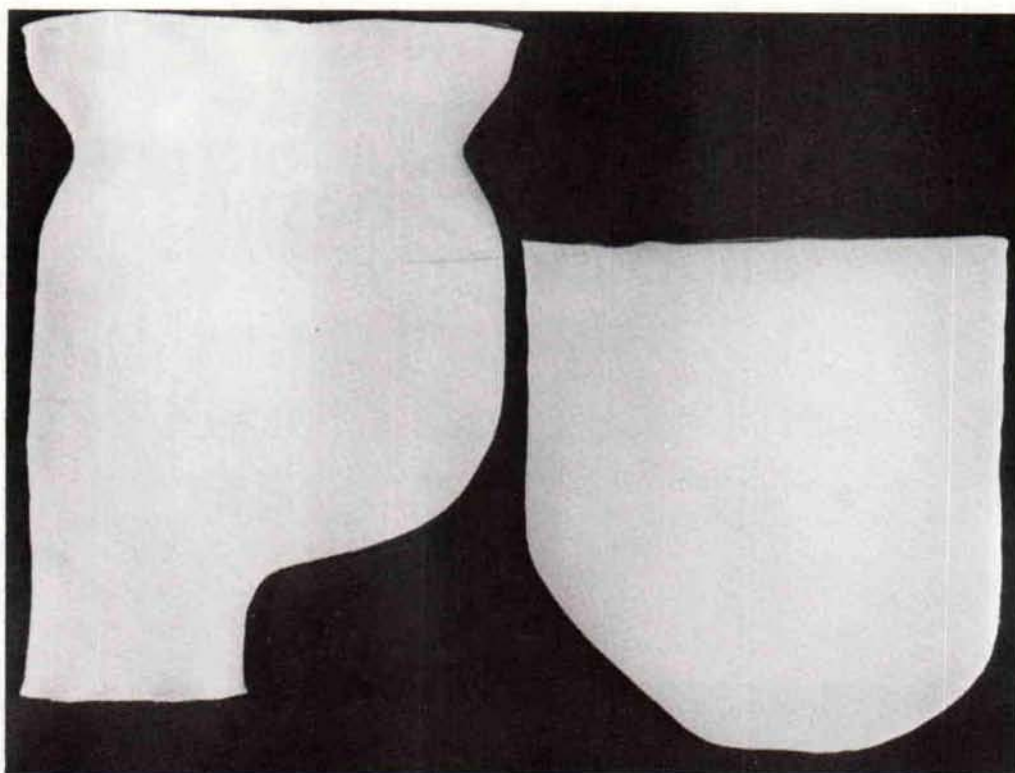


Fig. 8. Hip disarticulation sock (left) was tailored with a smaller waist and added protection for the unimpaired leg. Bilateral sock (right) was made smaller on one side for a snugger, wrinkle-free fit.

putee will find that the elasticity is retained for the life of the sock. Orlon/Lycra hip-disarticulation socks and regular socks are ordered in regular wool sizes but will measure up to 10 percent less than the same sized sock to assure proper fit considering the elasticity of the yarn as well as of the knit. Orlon/Lycra® socks with the wool panel should be washed like a wool sock.

Main Conclusion

Prosthetists should now feel that all amputations can be correctly fitted with wool or Orlon/Lycra® socks to give comfort and protection to the amputee. They should also be aware that socks knitted or tailored of 2- or 3-ply Orlon/Lycra® yarns allow for snugger, smoother fittings and easier maintenance by the amputee.

Acknowledgments

I wish to express sincere thanks and appreciation to William B. Smith, Larry Pierce, and the entire Production Dept. of Knit-Rite, Inc. for their guidance and cooperation in

developing these new techniques and adapting them to the specific needs of amputees.

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Footnotes

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