

The Development of a New Interface

by Martha Field, M.S.

INTRODUCTION

As changes occur in prosthesis design and fabrication, prosthetic socks must adapt to be compatible with these developments. According to Murphy,¹ the major function of a prosthetic sock is to give comfort and enhance the efficiency of the prosthesis by "providing cling to the residual limb and slide with respect to the socket wall." Over the years, this has been accomplished efficiently by wool socks and nylon sheaths. The three, five, and six ply thicknesses of socks have given adjustment for edema and atrophy, have afforded the resiliency that provides comfort between the socket and the residual limb, and have supported the distal tissue within the closed "toe" of the sock.

New sockets are being fitted more closely, wearers are becoming more active, and the skin condition is being given more attention.² As a result, the prosthetic sock function has added the importance of "absorbing perspiration, providing a wick-like action, and allowing for ventilation."¹ To answer these needs, a new prosthetic sock has been developed in a light weight construction.

LITERATURE REVIEW

Selecting a fiber content was the first step. Polypropylene olefin, which has become a staple in several major running wear lines because of its wicking ability, was tried. Wicking refers to the drawing of body moisture from the skin up through

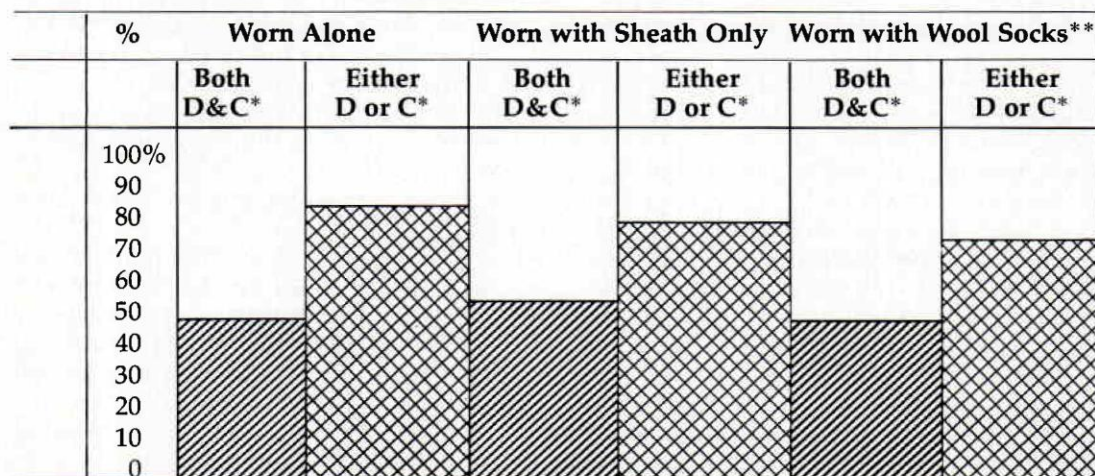
the fabric;³ as for example, when it is used for the facings of disposable diapers. With Lycra spandex, the polypropylene had the right amount of elasticity to contour or stretch-out, thus offering wicking, ventilation, and closefit in one yarn.

Prosthetic socks have historically been made by knitting several wool strands of yarns together to achieve desired weights and thicknesses. The size of these wool yarns has been usually between $\frac{1}{18}$ " to $\frac{1}{16}$ " as measured on the worsted system. A sock knitted of one end (strand) of such a yarn is said to be a one ply; two ends, two ply; etc. The three, five and six ply are standard in wool sock production. Other fibers such as cotton, Orlon/acrylic, and Lycra/spandex yarns are knitted to approximate the thicknesses of wool socks. In Orlon/Lycra, two ply and three ply are considered to be equivalent to three ply and five ply wool.⁴

As usage of Corespun yarns (Orlon, cotton or polypropylene with small amounts of Lycra) expanded into socks for fracture casting and orthotic and torso interface, a new thickness-weight designation became important. Socks using Corespun yarn became known as heavy weight, medium weight, and light weight depending on the number of ends and the yarn sizes used. The stretch characteristics of socks knitted from Corespun yarns is related to the thickness-weight designation and to the size of the Lycra core used.

Projecting the available knowledge, a sock of polypropylene fiber with Lycra core in a light weight construction should address a number of objectives, such as the

Effectiveness of Dryness and/or Comfort



*D—Dryness C—Comfort

**One or more wool socks, with or without a sheath

Table I.

reduction of skin moisture, accomodating closer fit, adjustments to edema and atrophy, and provision of a soft interface. After such a sock had been made, the feel suggested the name, "Soft Sock." To determine whether or not the sock achieved the stated goals when worn, a testing program was initiated.

TESTER GROUP

Names of facilities were selected from the files of the knitter. Of the 100 facilities originally contacted, 27 responded by supplying the knitter with the names and sizes of people who would be testers. Each tester received three free Soft Socks packaged with an insert card. The insert card gave pertinent information about the sock and specific care directions. Each tester was requested to make a written evaluation. From the 103 testers, 75 evaluations were received.

Among the respondents, 39 percent were ages 21 to 40 years, 29 percent were 41 to 60 years of age, 24 percent were over 61 years of age, and seven percent were younger than 21 years of age. Sixty-five percent had worn their prosthesis less than 21 years (one facility used socks on new fittings

only); 18 percent had worn their prosthesis between 21 and 40 years; 10 percent between 41 and 60 years; and six percent over 61 years. Seventy-eight percent were men; 22 percent were women. Sixty-two percent described themselves as very active, 28 percent as moderately active, and 10 percent as slightly active.

Respondents identified the kind of prosthesis they wore as BK, AK, PTB, PTS, knee disarticulation, joints and corset, below elbow, or of wood construction. Lining materials were listed as follows: 33 Pelite® liners; 14 leather liners; 17 plastic prosthesis with no liner or insert; one silicone gel liner; one wood socket. Eight individuals gave no answer.

RESULTS

Wearing the Soft Sock with a wool sock was originally thought to be most desirable; however, 19 of the respondents said they wore Soft Sock by itself. Of the 56 who said they wore it with other socks, 20 said they wore it with one wool sock, either a three ply, a five ply or a six ply; 12 wore it with a wool sock(s) and a sheath; eight wore it with two (or more) wool socks; six wore it with only a sheath; five wore it with

an Orlon/Lycra or other sock; and five did not specify with what else it was worn.

The specific function of the sock was described as follows: 31 percent said they used it as a liner; 28 percent said they used it as a filler; 16 percent said they used it as a spacer and 18 percent said they used it for more than one of these functions. Two specified its use as a sheath, two as a wicking sock, and three gave no answer.

Two questions on the evaluation were most critical in judging the effectiveness of the sock: 1) Did you notice any improved dryness of your skin when wearing these socks? and, 2) Did you notice any improved comfort of your skin when wearing these socks? Seventy-nine percent indicated improvement in either dryness or comfort; 52 percent indicated improvement in both dryness and comfort. This response pattern was similar whether respondents wore the Soft Sock alone, with only a sheath, or with wool sock(s) (Table I).

Eighty-one percent of the respondents said they would purchase Soft Socks if they were available to them; eight percent said they would not; and 11 percent gave no answer to this question.

Since the Lycra spandex used in the Corespun yarn for Soft Socks has stretch potential several times its relaxed length, a reduction in inventory sizes without sacrificing fit was tested. The new size range is shown in Table II.

Corresponding Sizes

Soft Sock Sizes	Standard Sock Sizes
Child Short	#A
Narrow Short	#B, #0, #1, Length 10"-15"
Narrow Medium	#B, #0, #1, Length 16"-21"
Narrow Long	#B, #0, #1, Length 22"-28"
Regular Short	#1, #2, Length 10"-15"
Regular Medium	#1, #2, Length 16"-21"
Regular Long	#1, #2, Length 22"-28"
Wide Medium	#3 & Above, Length 16"-20"

Table II.

Ninety-four percent of the respondents evaluated the fit as satisfactory; two percent felt the socks were too tight; two percent felt they were too elastic; and two percent gave no answer. Fifty-one percent felt the length was satisfactory; 44 percent felt the socks were too long; and four percent gave no answers.

Care directions were listed on the insert card as follows:

1. Wear fresh socks and sheath each day.
2. Pre-spot socks before washing with mild soap or detergent, and cool water.
3. Fleece side should be inside for washing (wool socks are washed with the fleece side out).
4. Wash with a regular load of white laundry, eight to 10 minutes, warm (not hot) water temperature, ½ cup mild detergent (NO BLEACH). If Ivory detergent is used, use soft or softened water.
5. Rinse in warm or cool water for four to five minutes.
6. After washing, take tip of the toe in one hand, top of sock in other hand, and pull taut to smooth sock.
7. Dry in dryer set on low temperature for 30 to 40 minutes.

Ninety-six percent of the testers said they had no washing problems. Of the three who had problems, one bleached the socks, one complained of the seam failure because of very tight fit, and one lamented a loss of fluffiness even though the socks were handwashed. The loss of fluffiness was further tested by sending three additional socks and asking the tester to be sure socks were washed fleece side in.

Eighty-four percent of the respondents said the washing directions were helpful. Those who responded "no" commented that they "didn't read," "laundered with normal wash," "hand washed with Ivory or a mild detergent," and those who gave no answer commented that "wife does it" or "in hospital." Disturbing was the fact that 31 percent of the testers said they washed their socks after two or more wearings. Maximum number of wearings before washing was five.

CONCLUSIONS

The testers in this study were diverse in age, sex, and in how long they wore their prosthesis. They would seem representative of the general amputee population, although the 62 percent describing themselves as "very active" may be a little higher than average. These testers wore Soft Socks by themselves, with a wool sock(s) (and in some cases a sheath), with Orlong acrylic/Lycra spandex or other socks, and with only a sheath. Soft Sock was worn as a liner, a spacer, and a filler. Some testers stated they wore it instead of a conventional sheath and some wore it specifically as a wicking sock.

The new size range fit this group of testers satisfactorily except for length. As a result of this study, the knitter has reduced the length of the socks in the narrow range. Testers in this study who indicated excessive length of socks in the regular range could have received a better fit from the narrow range. A local tester indicated that the socks would give superior wear if a slight amount of slack is allowed at the "toe," particularly when the prosthesis fits snugly or several socks are being worn.

Care was viewed as no problem by the wearers. However, the knitter would pre-

fer having Soft Socks washed after every wearing by all wearers.

The most significant aspect of the study is that 79 percent of the testers reported improved dryness or improved comfort after wearing Soft Socks. Some comments indicated that these socks fulfill a need which had existed for many years.

ACKNOWLEDGMENTS

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REFERENCES

- ¹Murphy, Eugene F., "Sockets, Linings, and Interfaces," *Clinical Prosthetics and Orthotics*, 8:4-10, Summer, 1984.
- ²Levy, S. William, *Skin Problems of the Amputee*, Warren H. Green, Inc., St. Louis, Missouri, 1983.
- ³Dlaboha, Ihor, "Propylene Re-emerges as Fiber for Winter, Summer Athletic Wear," *Knitting Times* 52: 59-61, February 21, 1983.
- ⁴Field, Martha, "New Dimensions for Prosthetic Socks," *Orthotics and Prosthetics*, 32: 10-15, March 1978.

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