A New Plastic Soft Socket For Below Knee Prosthesis

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For many years some of the most troublesome problems encountered by the prosthetist have arisen from the lack of a satisfactory material for soft sockets in below knee prostheses. About ten years ago, stimulated by difficulties in fitting and maintaining a client with a body weight of about 220 pounds, we began an intensive investigation of available materials, finally developing a soft but resilient plastic sheet which we believe far superior to any of the other materials currently available for fabrication of soft sockets. In many respects, we believe, it offers the definitive answer to this annoying problem.

Experience with 850 cases, both veteran and civilian, over the last six years has been highly gratifying. This new soft socket (*Flexolimb,* Bardach-Schoene Co., Inc., Chicago) is made of a plasticized polyvinyl chloride acetate faced with a smooth fabric. It is now being produced under contract to the U. S. Government and, under certain conditions, is available to the profession generally.

Every competent prosthetist is familiar with the theoretical criteria for a satisfactory below knee soft socket. The material should be soft enough to cushion sensitive stumps comfortably, but it should also be tough and flexible, and resist shrinking, warping, or other distortion. In addition to retaining its strength and resilience with aging, it should offer the maximum possible resistance to moisture, grease, acids, or alkalis.

When measured by these standards, soft sockets conventionally used in the past have manifested certain inadequacies with which both the prosthetist and the below knee amputee—in fact, all members of the rehabilitation team—have become acutely aware. These inadequacies probably have presented the crucial difficulty in fitting and servicing below knee clientele. Among the materials tried have been sponge and foam rubber faced with soft horsehide; sheet rubber with leather covering; rubber alone; vulcanized rubber latex; fibrous materials such as felt with binders or surface coatings.

Although initial results might be good with sponge or foam rubber, the cushioning effect is quickly lost because of the tendency of these substances to pack and distort. Sheet rubber, on the other hand, retains its shape but its cushioning effect is negligible; moreover, perspiration enters the leather facing to hasten deterioration and present insoluable problems of cleaning. Vulcanized rubber latex hardens when molded to form and becomes progressively harder with use. Felt soon packs down, losing its cushioning capacity and becoming displaced. Rubber placed directly against the skin not only deteriorates from body acids, but retains bodily moisture and heat, and, because of its non-skid properties, causes skin irritation and abrasions.

Waldemar Schoene, a native of Germany received his training in artificial limbs and braces there, and came to the United States in 1926. Through the years since then, he has been active in the making and fitting of braces and appliances for both upper and lower extremities. Mr. Schoene established his own business in September, 1935 and is now president of the Company. He is a Certified Orthotist and Prosthetist, and attended the Course in Upper Extremity Appliances at the University of California, and the New York University Course in Above-Knee Prosthetics.

In patients with prominent bony structure the drawbacks presented by these materials become increasingly apparent. The heavy patient referred to at the beginning of this report, whose weight rested on a stump which extended only 3 inches below the tibial plateau, experienced a succession of difficulties such as stump sores, swelling, and acute discomfort due to the pressure of his weight. Several fittings were required and refitting of three or four stump sockets.

In the course of our quest for a better material, it was suggested that we investigate a plastic used as a lining and shock-absorber for dental plates where sensitive gums were a complication. This plastic material held forth promise, but it was only 1/16 inch thick and 3 square inches in area—obviously not even remotely adapted to the purpose we had in mind. Needed was a sheet of sufficient thickness and surface area to cover and cushion a stump socket properly, and no such material was available. It appeared that our only recourse was to make it ourselves.

Acquiring the raw materials—resin and plasticizer—did not present a problem. However, the plastisol had to be fused and molded under heat and pressure into sheets of desired size and thickness. Here we encountered difficulty because no such presses were available. After consultation with engineers, we had the necessary capital equipment constructed: a hydraulic press with electrically heated pressure plates thermostatically controlled.

Since the plastic itself has non-skid properties similar to rubber, its abrasive action on the skin would be similar. To avoid this, the plastic is faced with a smooth fabric bonded to the plastic sheet under heat and pressure. In this way it becomes an integral part of the material, offering a smooth surface over which the skin slides easily and comfortably. This surfacing material is waterproof, and its consequent ability to resist perspiration not only prevents deterioration but gives obvious hygienic advantages as well. There are no chemical irritants which might induce topical dermatitis.