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Investigation of the Optimal Load-Bearing Characteristics of Patellar Tendon Bearing (PTB) Prostheses

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Purpose—The long term goal of the research team is to automate the construction of the lower limb prostheses using Computer Integrated Manufacturing (CIM) techniques. To accomplish this, our understanding of the amputee-prosthesis system must be broadened. This ongoing project is specifically looking at load transmission through the stump-socket interface. This information will be combined with the results of two other investigations; one looking at the dynamic and structural characteristics of the prosthesis as a whole, and the other looking at the amputee and his/her compensatory activities due to physiological attitudes or physiological limitations.

These studies will provide us with the information necessary to develop a method for automated design of customized prostheses. This method will be integrated into a CIM process. The ultimate result of this project is expected to lead to an improvement in the quality of prosthetic care delivery, based on quantitative and objective measures.

Methodology—Instrumented prostheses are manufactured for each subject. Interfacial forces are measured at the patellar tendon, as well as pressures at the distal end of the stump. The socket geometry is altered in the patellar tendon and the stump-end regions. These forces and pressures are collected simultaneously with ground reaction forces and kinematic data.

Progress—Fourteen below-knee amputees (11 men, 3 women; ages 28 to 67) were fitted with the experimental prostheses, and several more subjects are currently being sought. Data has been collected on 10 of the subjects (4 could not complete the protocol), with information gathered on a variety of socket geometries.

Results—The following is a summary of results for the past year: 1) The original design of the instrumented prosthesis has been modified extensively to decrease weight and improve accuracy; 2) A mathematical model of the stump-socket interface is being developed for a better understanding of the interdependency of load bearing regions of the residual limb; 3) Preliminary results have led to an investigation of the cause of instability at the stump socket interface, and its probable causes. This information was presented at the 1988 East Coast Clinical Gait Analysis Conference; and, 4) Other experimental results have been analyzed and reported.

Publications Resulting from This Research

Structural Synthesis of Lower Limb Prostheses for Optimal Gait Performance. Seliktar R, *Proceedings of the 13th Northeast Bioengineering Conference,* Philadelphia, PA, 237-240, 1987.

Toward Automation of the Manufacturing of Lower Limb Prosthesis. Seliktar R, *Proceedings of the Special Congress of the International Society for Prosthetics and Orthotics,* Israel, 1987.

Gait Performance Following Skeletal Modification or Lower Limb Amputation. Seliktar R, Mizrahi J, Vachranukunkiet T, Besser M, Kuenzig D, *IEEE Engineering in Medicine and Biology Society 10th Annual Conference,* New Orleans, 1988.

Human Performance with Prosthetic Devices and Surgically Modified Skeletal Elements. Seliktar R, Mizrahi J, Vachranukunkiet T, Besser M, Kuenzig D, *Automedica* (accepted for publication).