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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 lower limb prostheses using computer integrated manufacturing (CIM) techniques. This ongoing project is specifically investigating the 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 psychological attitudes or physiological limitations.

The ultimate objective of this project is to lead to an improvement in the quality of prosthetic care delivery, based on quantitative and objective measures.

Methodology/Progress—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. The project was broadened to include additional interfacial measurements of forces acting at the tibial crests and the tibial flares. This expansion will be administered with two experimental systems on two amputees. The systems are currently being installed on one prosthesis of a new subject, and a second subject has been selected. Subsequently, the project will be terminated and final conclusions will be drawn.

Results—The following is a summary of results for the past year in this ongoing study: 1) the original design of the instrumented prosthesis has been modified extensively to decrease weight and improve and accuracy; 2) the measuring systems have been revised considerably for the purpose of expanding their measuring capabilities as stated above; 3) a mathematical model of the stump-socket interface is being developed; 4) preliminary results have led to an investigation of the accuracy of the gait studies performed, and to conclusion as to 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, *5)* other experimental results have been analyzed and reported in the relevant literature.

Publications Resulting from This Research

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

Toward Automation of the Manufacturing of Lower Limb Prostheses. Seliktar R, in *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, LA, 1988.

Human Performance with Prosthetic Devices and Surgically Modified Skeletal Elements. Seliktar R, Mizrahi J, Vachranukunkiet T, Besser M, Kuenzig D, Invited Paper, *Automedica, 11:145-162,* 1989.