

VETERANS ADMINISTRATION PROSTHETICS CENTER RESEARCH

INTRODUCTION

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In logical succession to those activities on standards and specifications described in our last report (Bulletin of Prosthetics Research, BPR 10-7 Spring 1967) our VAPC program has now encompassed several additional classes of items for which standards development is becoming increasingly mandatory. The preliminary steps to development of functional standards for lower-extremity orthotic components and upper-extremity powered hands are treated. Moreover, reconsideration of clinical checkout procedures is introduced by specifying the need for research and development on more simply managed procedures for inspection and functional analyses of artificial limbs.

Our other work is still there. Some progress (not nearly as great as desired) is reported on direct forming of sockets with synthetic materials and on the introduction of definitive or permanent prostheses using metal, "skeletal" structures. Cosmesis problems with the so-called "pylon" definitive prosthesis persist. The cosmetic cover systems under investigation look promising but not to be overlooked are pre-shaped soft foam fillers to be covered secondarily with pigmented "stretch-fabric" stockings.

But our major offerings in this report period are discussions of powered hands and lower-extremity braces.

It has often been said that very little attention has been paid to orthotics by our National Research Program. We think however that the emphasis is now gradually being altered although there are still too few researchers interested in or engaged in fundamental studies related to orthotics. Stimulus is now being provided by committees of the American Orthotic and Prosthetic Association, the American Academy of Orthopaedic Surgeons, and the two committees of the National Academy of Sciences-National Research Council: the Committee on Prosthetics Research and Development and the Committee on Prosthetic-Orthotic Education. AOPA and the AAOS have treated the problems of nomenclature and classification, starting with the lower-extremity brace. The committees of the National Academy of Sciences are now planning surveys of orthotics practices; the CPRD has a panel on lower-extremity orthotics attempting to correlate the existing research and

development effort to stimulate proposals fitting the pattern of earliest needs in lower-extremity orthotics research. (The CPRD in a special meeting in December 1966 specified quite precisely some recommendations for orthotics research and development which should constitute the pattern of effort in the near future.)

Apparent in the deliberations of the several committees is the need for definition of the problems by establishing sensible nomenclature, by classifying existing hardware functionally, and by relating pathology to appliance design in current practices. Thus, surveys need to be made and as soon as possible. It is hoped that the CPRD and CPOE will be able to organize such studies to provide guidelines to help the research and development groups.

Meanwhile, it is essential that logical nomenclature and classification systems be organized. The American Academy of Orthopaedic Surgeons is moving rapidly on this matter. To assist the Academy's committee and the survey planners, the VA Prosthetics Center has developed the tabulation contained in this report. Our presentation is an attempt to classify functions of existing lower-extremity brace components. The table suggests a nomenclature although the present listing is based on current "trade" terms. Most of all, the table presents essential functions; eventually, a nomenclature should be based on these. Following that, an appropriate classification and then later still, functional standards for existing and new hardware can be developed. The VA Prosthetics Center expects to take an active role in all these phases.

The Army Medical Biomechanical Research Laboratory (AMBRL) has taken the initiative in the development of a set of functional standards for externally powered hands (not yet published). Again an excellent piece of work was done by that Laboratory. Years ago, under its previous name, APRL, it did a similar job for body-powered mechanical hands and other upper-extremity components. These standards are still being applied by the Veterans Administration in its compliance testing program.

To follow the lead taken by AMBRL, the VA Prosthetics Center has reviewed a number of powered hands either commercially available or under development throughout the world as of November 1967. Analyses based on laboratory investigations when possible or on available written material are published in this issue. From these analyses, one can draw some preliminary conclusions about the hands available and the developments now underway.

Development of powered hands is certainly consuming a disproportionate and extraordinary share of the creativity and funds available for prosthetics and orthotics research both here and abroad. An increasing number of scientists and engineers have become engaged in such projects. Perhaps this is good, but now that they have been lured might they now be directed to other, more appropriate problems?

Administrators of research and development have meanwhile been faced with decisions on deployment of available funds; these people need to know more fully the relative value of the various powered hands and to which types allocation of development monies should be applied. Such decisions are always difficult especially since there has been no systematic evaluation of one development concept against another. Preferably each should not be evaluated alone, out of context with the functions offered by the others. And has any powered hand been fully evaluated in comparison to the most modern and best fitted conventional devices which it is designed to replace?

Each of these powered hands has been described in the literature but for the administrators of research and development the descriptions, although erudite, are not the most communicative. Engineers are now communicating with other engineers. But clinicians must prescribe; for them, there is only confusion. Therefore analyses such as the one offered in this issue may be of value. Perhaps these can be expanded, preferably with more in-depth laboratory and patient evaluation on each of the devices contained in this presentation plus those others in still earlier stages of development.

I. LOWER-EXTREMITY PROSTHETICS

A. Basic Studies

1. Effects of Compression of the Lower Extremity
2. Work and Energy in Walking

B. Development (Components)

- ✓ 1. Adjustable Below-Knee Standard Prosthesis
- ✓ 2. Standard Above-Knee (Multiplex) Prosthesis
- ✓ 3. Cosmetic Covers

C. Development (Techniques)

- ✓ Direct Forming of Below-Knee Sockets

D. Evaluation (Components)

1. Follow-up Evaluation of UC-BL Pneumatic AK Swing Control Mechanism
2. Follow-up Evaluation of the Navy Intermittent Friction Knee
3. Evaluation of the Teufel DAW Protective Nylon Sheath

E. Evaluation (Techniques)

- Objective Checkout Procedures

II. UPPER-EXTREMITY PROSTHETICS

A. Development

- ✓ Humeral Rotator

B. Evaluation (Components)

1. AIPR (American Institute of Prosthetic Research) Externally Powered Components
2. Functional Analysis of Externally Powered Hands
3. Perlon Cable Transmission System

C. Evaluation (Techniques)

- Direct Forming of Below-Elbow Sockets

III. LOWER-EXTREMITY ORTHOTICS

- ✓ A. Development
 - ✓ Development of Specifications for Orthotic Components
- B. Evaluation (Components)
 - ✓ VAPC Single-Bar Ankle Brace

IV. ORTHOPEDIC AIDS

- A. Development
 - None
- B. Evaluation (Components)
 - 1. Power-Aid for Wheelchair
 - 2. Clinical Study of Stryker Floatation Pad

V. TESTING

- A. Standards Development Program
 - ✓ Elastic Hosiery
- B. Compliance Testing
 - 1. Stump Socks
 - 2. Upper-Extremity Components

VI. OPERATIONS REPORT FOR FISCAL YEAR 1967

- A. The Orthopedic Shoe Service
- B. The Prosthetics-Orthotics Service
- C. The Restorations Service
- D. Special Clinic Team
- E. Special Service for Vietnamese Wounded

REPORT

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This report details the progress and status of studies conducted in various laboratories and services of the VA Prosthetics Center. It was compiled with the assistance of Donald W. Wright, Research Physiologist.

I. LOWER-EXTREMITY PROSTHETICS

A. Basic Studies

1. *Effects of Compression of the Lower Extremity.* As reported in the previous issue we have been attempting to relate arterial blood pressure to gravitational and compressive forces applied to the leg. The purpose of these studies is to develop a simple measure of the physiological effects of compression applied by elastic hosiery. To date we have been able to demonstrate a fairly close correspondence between diastolic pressure in the dorsalis pedis artery and the normal gravitational forces applied to the limb. Diastolic pressure was reduced as a patient, initially positioned vertically on a tilt