VETERANS ADMINISTRATION PROSTHETICS CENTER RESEARCH

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INTRODUCTION

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We report again on work aimed at improving pylon-type devices for temporary (or preparatory) prostheses as well as for permanent ones employing a properly designed plastic cosmetic cover. We have also resurrected the problem of proper control of the knee in the through-knee prosthesis. Although not presented in this report, our development effort in the design of the through-knee prosthesis shown has been diverted to a pylon device designed for this level that permits the use of fluid-controlled devices which are especially appropriate for this level of amputation.

Our purposes here are simple. We should like to achieve in prostheses for lower-extremity amputations some standardized hardware which will permit flexibility in function and fitting method, the latter especially by alignment adjustability. And we would like the alignment device to remain in the prosthesis for future use to permit alterations in geometry which might later solve some comfort problems without random modifications or major overhauls on the socket. Beyond this, we are still striving to achieve both arm and leg sockets by direct forming. Our work on using an appropriate plastic material in upper-extremity sockets has been reasonably successful so that now we are preparing to disseminate information on the material and the technique.

The work on elastic hosiery has yielded a bit of a surprise. The variation shown in the results of our measures of pressures being applied by elastic hosiery may not indicate a serious problem in that the body itself might not be sensitive to the magnitude of differences in the almost random pressure variation, but we still must measure whether it is or is not. One thing however can be concluded: elastic hosiery, although providing an increased circumferential pressure on the lower extremity, does not appear to yield any graduated pressure pattern variation designed specifically to assist venous return.

Our testing program of course continues with a number of new devices

from Germany. We welcome being able to look at devices from other countries presently through an evaluation of the Teufel devices and the Otto Bock Greissinger Foot and Ankle. An international interchange of information has resulted which may benefit our disabled as well as the disabled of other countries.

We feel quite strongly about the importance of our international contacts. For example, in this report, we have started to provide numbers based on the metric system as well as the English system. Perhaps we can reach some additional readers in this manner. Often we have noted how difficult it is for one familiar with the metric system to try to interpret data provided with our standard English units and vice-versa. So throughout the VAPC report the reader will notice the use of both units in specifying quantitative data.

The UCB pneumatic above-knee swing-control system has come along quite well and is now being prepared for wider-scale testing, perhaps in a number of VA clinics. We have learned from testing this fluid-controlled knee and from our clinical experiences with the hydraulic systems that the wood shank and knee block are not structurally adequate for maintaining critical dimensions. With humidity changes, wood will expand and contract; a designer's attempt to fix bushing locations and set the critical parallel orientation of functional axes in wood will in time only produce difficulties not only manifest in bushing noise but also in unit malfunction. Therefore, the plan of the University of California to use a metal shank with the pneumatic system makes great sense. It coincides with our own intention to develop the Multiplex above-knee pylon designed to take a number of knee control systems. We sincerely believe that in the next several years the gradual elimination of wood in shanks and knee blocks will be noted in our clinics.

Incidentally, by elimination of wood shanks and by direct forming of sockets on stumps, we may be taking the first step in making plastic lamination obsolete. Although plastic lamination was one of the early contributions of our Research Program, we do think that it is tedious and time-consuming and should be eliminated, if possible.

We now intend also to branch out a bit more from our previous work in evaluating the American Institute of Prosthetic Research externally powered (CO_2) components. Our tests reported in this and previous issues were quite educational and our relationship with Dr. Kiessling, the developer, stimulating. We intend to continue to work with him on these devices, perhaps on a larger sample of amputees. But we now wish to consider electric power as well, as in our work with Gil Motis on his devices. We also wish to study the possibilities of using myoelectric sources to control CO_2-powered apparatus. Important in these programs is the location of reliable control sources proximal to the levels now used; we need con-

trol sites for powered elbow locks, wrist rotators, and elbow flexion devices for the high-level amputee. The several well-publicized, powered terminal devices now only applied at the below-elbow level, thus providing clinical contributions of questionable value, must similarly be controlled by sources proximal to the biceps and triceps outputs presently employed.

Our wheelchair work, of course, keeps progressing and although we have developed a set of tentative functional standards for the ordinary type of chair, we still have to continue checking chairs of many types against these standards. We still must also revalidate our laboratory-developed standards by accumulating additional clinical data to dispute or support the criteria we have proposed. This clinical program is now being planned.

It is well to point out that although VAPC research is primarily based on clinical needs of VA beneficiaries, as delineated especially through the VA Prosthetic Representatives and the Orthopedic and Prosthetic Appliance Clinic Teams, we still perform with the guidance of the NAS-NRC's Committee on Prosthetics Research and Development and its several subcommittees. Through these subcommittees we are able to determine whether indeed our work is not repetitive and that our procedures are based on the maximum amount of information available. Through the CPRD we are able to have detailed technical contacts with our colleagues in the United States and Canada, to sharpen our approach, and to have confidence in our conclusions. We would certainly be operating in the dark without this arrangement. Moreover, we have been enabled by our superiors in the Veterans Administration to broaden our contacts to include many European and some Asian colleagues. These have been extremely fruitful, and to our superiors we express our gratitude.

Dr. Edward Peizer, as Chief of the Bioengineering Research Service of this Center, has been instrumental in assuring productivity in our research and development efforts. He and Henry F. Gardner of the Center should receive credit continually for the progress we have made and for the report which follows.

We also here again provide some data on our clinical operations. For these data, we sincerely appreciate the efforts of Mr. James Cohen, a Prosthetic Representative recently appointed to my staff.

I. LOWER-EXTREMITY PROSTHETICS

A. Basic Studies

1. Effects of Compression of the Lower Extremity
2. Work and Energy in Walking
3. Early Postsurgical Weight Bearing

B. Development (Components)

1. Adjustable Below-Knee Standard Prostheses
2. Standard Above-Knee (Multiplex) Prostheses

3. Fluid Control for Through-Knee Prostheses
4. Torque Absorber

C. Development (Techniques)
1. Pneumatic Casting
2. Direct Forming of Below-Knee Sockets

D. Evaluation (Components)
1. UCB Pneumatic AK Swing Control System
2. Joints for Hip-Disarticulation Prostheses (NHJ-100)
3. Otto Bock "Greissinger" Foot and Ankle Assemblies with Compressible and Non-Compressible Heel Wedges
4. Teufel SACH-Type Foot and Ankle
5. Teufel Telasto Foot and Ankle Assembly
6. Navy Intermittent Friction Knee
7. Secura Knee

E. Evaluation (Techniques)
None.

II. UPPER-EXTREMITY PROSTHETICS

A. Development
1. Improvement of Force-Excursion Relationships for Shoulder-Disarticulation Amputees
2. Direct Forming of Below-Elbow Sockets

B. Evaluation (Components)
1. AIPR (American Institute for Prosthetic Research) Externally Powered Components
2. Northwestern University Center Control Hook
3. CAPP Terminal Device (Sumida Hook)
4. Gilmatic Elbow Lock

C. Evaluation (Techniques)
None.

III. LOWER-EXTREMITY ORTHOTICS

A. Development
None.

B. Evaluation (Components)
Becker Polycentric Knee Joint

IV. ORTHOPEDIC AIDS

A. Development
Clinical Evaluation Study on Wheelchairs

B. Evaluation (Components)
1. Reevaluation of Hydro-Crutch (Model FP–2100)
2. Sears Wheelchair (Model 8A1516N)
3. Colson "Classic" Wheelchair (Model A83F147151–270)

4. Cetrone Contoured Support Belt
5. Seat Lifts
6. Proreco Curb-Climbing Wheelchair Assembly
7. Evaluation of Prototype Staircane
8. Preliminary Evaluation of Joe J. Stump Socks
9. Knight Spinal and Taylor Brace with Detachable Coverings and Aprons

C. Evaluation (Techniques)
None.

V. TESTING

A. Specifications Compliance
1. SACH Feet
2. Stump Socks
3. Upper-Extremity Components
4. Lumbo-Sacral Corset Material

VI. OPERATIONS REPORT FOR SECOND HALF, FISCAL YEAR 1966

A. The Orthopedic Shoe Service
B. The Prosthetics-Orthotics Service
C. Special Service for Vietnamese Wounded

REPORT

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I. LOWER-EXTREMITY PROSTHETICS

A. Basic Studies

1. Effects of Compression of the Lower Extremity. A two-part study has been undertaken to develop functional specifications for elastic hosiery in order to provide an objective basis for their design, prescription, and procurement. In one portion of this study, samples of commercially available elastic hosiery were evaluated with respect to the pressures which they apply to the limbs for which they are prescribed. At the present time, neither the magnitudes nor the gradients of the pressures applied by elastic hosiery are known. The rated or assumed pressures are only estimated from the dimensions, knit geometry, and ratio of elastic to non-elastic elements in the hose.

Compressive forces applied by four commercially available samples of elastic hosiery have been measured by means of the standard formula for