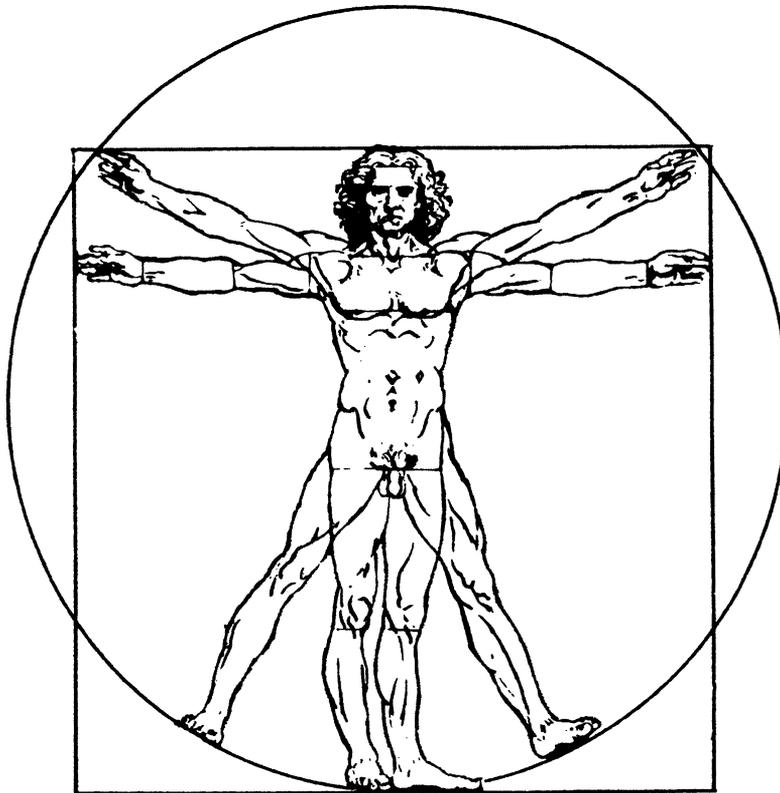


# PROSTHETIC PRINCIPLES UPPER EXTREMITY AMPUTATIONS

Fabrication and Fitting Principles



*Published by*

Prosthetics-Orthotics Education Program -- Division of Orthopedic Surgery  
University of California, Los Angeles

# PROSTHETIC PRINCIPLES

## UPPER EXTREMITY AMPUTATIONS

### Table of Contents

Introduction	ii
I. Anatomical Positions, Directions, and Planes	1
Bones of the Upper Extremity	3
II. Anatomical Movements	4
Body Landmarks	8
III. Components	
Terminal Devices	11
Wrist Units	16
Elbow Joints	18
Shoulder Joints	22
Control System	25
IV. Materials, Tools & Techniques	
Materials	27
Tools	46
Techniques	56
V. Hand Prosthesis	
Introduction	71
Partial Hand - Thumb Remaining	74
Special Devices	90
IX. Cosmetic Components	
Introduction	92
Cosmetic Gloves	92
Passive Lower Arms	102
Passive Upper Arms and Shoulders	103
X. Wrist Disarticulation Prosthesis	
Wrap Cast	105
Wax Check Socket	113
Check Socket Model	115
Wax Check Socket Fabrication	120
Wax Check Socket Fit	123
Harnessing the Flexible Hinge Prosthesis	203
XI. Rigid Hinge Prosthesis	
Wax Check Socket - Rigid Hinge	130
Single Joint Spacer	137
Break Out Mold	140
Plastic Socket	141
Forearm Extension	146
Fitting	155

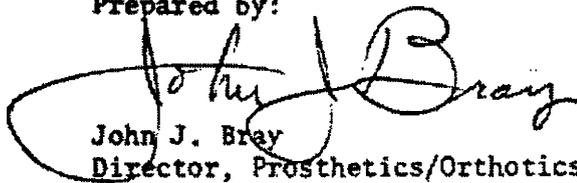
XII. Step-Up Hinge Prosthesis	
Wrap Cast	161
Wax Check Socket	173
Wax Check Socket Fit	175
Installation of Multi Action Hinge	184
XIII. Muenster Prosthesis	
Prescription Criteria	208
Wrap Cast	209
Check Socket	218
Forearm: Extension Pre Flexion Angle	227
XIV. Above Elbow Prosthesis	
Introduction	237
Measurement	239
Wrap Cast	244
Wax Check Socket	250
Harnessing	298
Controls Training	310
XV. Outside Locking Hinge Prosthesis	
Introduction	262
Measurement	264
Wrap Cast	266
Check Socket Model	272
Wax Check Socket	277
Plastic Socket	285
Making the Forearm	289
Harnessing	298
XVI. Shoulder Prosthesis	
Introduction	316
Shoulder Joints	318
Measurement	322
Wrap Cast	324
Check Socket Model	327
Wax Check Socket	329
Making the Mold	334
Socket & Humeral Section	337
Harnessing	348

PROSTHETIC PRINCIPLES  
UPPER EXTREMITY AMPUTATIONS  
Fabrication and Fitting Principles

Grant No. 1793M

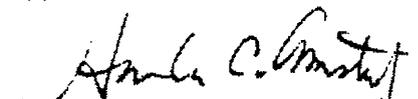
This investigation was supported in part by  
Grant No. 1793M from the Division of Research  
and Demonstration Grants, Social and  
Rehabilitation Service, Department of Health,  
Education and Welfare, Washington, D.C., 20201.

Prepared by:



John J. Bray  
Director, Prosthetics/Orthotics Education Program

Approved by:



Harlan C. Amstutz, M.D.  
Professor and Chief, Div. of Orthopedics

Published by

Prosthetics-Orthotics Education Program - Division of Orthopedic Surgery  
University of California, Los Angeles

I. INTRODUCTION

Prior to the completion of this research, the only published data available on Upper Extremity Prosthetics was published by the University of California at Los Angeles with a publication date of **1958**. Obviously many advances in the state of the art have occurred since that time. Vast improvements in materials, **hardware** and techniques have been made as well as improvements in the methods of presenting the materials for maximum utilization.

The work is now complete and makes available for the first time a comprehensive test covering **all phases of Upper Extremity Prosthetics.**

## II. METHODOLOGY

The preparation of the material was approached using basic information sources.

1. An extensive review of literature and publication in the field of Upper Extremity Prosthetics. This research formed the reference information which insured that the data presented was representative of the current state of the art.
2. Review all commercially available materials and hardware and include descriptive data and instructions for application on all items where usage rates indicated substantial distribution.
3. Conduct a series of clinical application studies covering all levels of amputations to verify fitting and fabrication techniques and to establish photographic references for the step by step procedures to be used in the text.
4. A series of review conferences were conducted in which educators and other recognized authorities review the compiled data.

The data compiled was carefully reviewed. As theory was substantiated by practice, the information was incorporated into the manuscript section by section.

Each section was further validated by repeated actual classroom use by the students of prosthetics at the University of California Prosthetics/Orthotics Project.

Several review sessions by faculty members of the UCOPE proved to be extremely valuable.

New materials such as the various polyurethanes, polysar acrylics and silastics were carefully tested in applications where they seemed most suitable.

Those which proved to be useful either as a replacement or substitute material are reported in the manuscript.

All commercially available components were reviewed and applied to prostheses for clinical evaluation with careful patient follow-up to confirm results.

✓

This final report represents the completion of 5 years of research and compilation. It was originally undertaken by Doctor Charles O. Bechtol, Principle Investigator and Miles A. Anderson, E.ed., past Director of the Prosthetics-Orthotics Program. The initial outline and preliminary layout were accomplished by Maurice **LeBlanc** with the cooperation of the review committees of CPRD and the University Council on Orthotic-Prosthetic Education (**UCOPE**).

We wish to thank Mr. A. Bennett Wilson, Executive Director of CPRD for the support and coordination of special committees on Upper Extremity Prosthetics.

We are also indebted to Mr. Joseph E. Traub as agency representative to UCOPE in providing his knowledge and expertise in the field of Prosthetics Education and Research.

Recognition of the many professional prosthetists who participated in the discussions and review sessions is also acknowledged with appreciation.

We wish to especially acknowledge the technical assistance and instructional backup of Mr. Alvin Muilenberg.

The final report represents mainly the efforts of Mr. John Bray, the present Director of the Prosthetics-Orthotics Program. **He** was assisted by Mary Louise **Histon**, photographer, Charles Scott, B.S.M.E., Associate Director, Keith Vinnecour, Timothy **Staats** and Bruce Nelson, **Instructors of** the Prosthetics-Orthotics Program who participated in the research and writing of **portions of** the text. The report was edited by Mrs. Flick **Conat**.