

THE JAIPUR FOOT

DR POOJA MUKUL, MD
REHABILITATION PHYSICIAN
TECHNICAL CONSULTANT
BMVSS, JAIPUR FOOT ORGANIZATION
&
CLINICAL DIRECTOR
CENTER FOR RECONSTRUCTION & REHABILITATION
JAIPUR

INTRODUCTION

- The JAIPUR FOOT is an original research product of Jaipur ,INDIA
- The foot was developed in response to specific socio-cultural needs of Indian Amputees ,however the design that evolved has features that make it suitable for use anywhere in the world.

_HISTORY



EVOLUTION

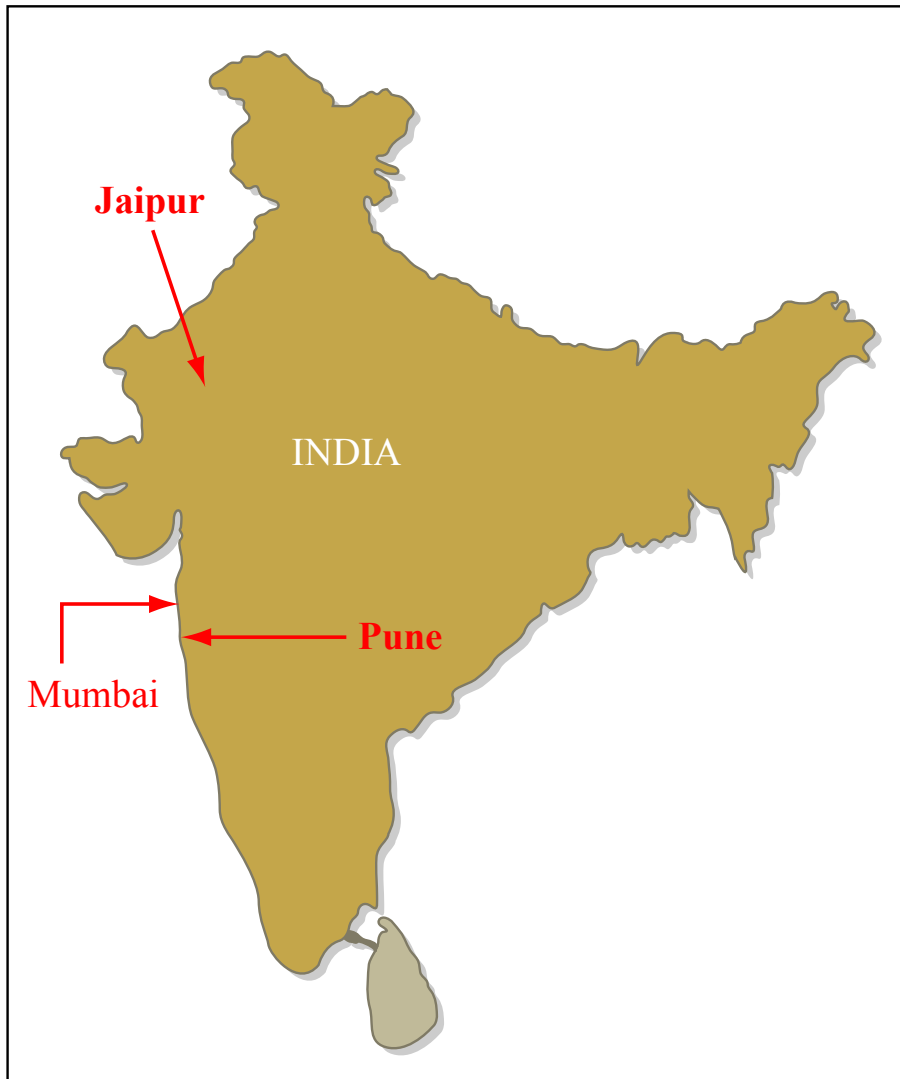


Image by MIT OpenCourseWare.

To overcome this problem, a centre was set up in Jaipur, India.



Courtesy of Dr. Pooja Mukul, Bhagwan Mahaveer Viklang Sahayata Samiti - Jaipur Foot Organization, Jaipur, India.
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EVOLUTION

- JAIPUR centre started providing conventional lower limb prostheses.
- Rejection rates -HIGH

EVOLUTION

ANALYSIS OF REJECTION

The reasons were not technical OR biomechanical

BUT

Socio-cultural



The team at Jaipur centre realized that besides functional aspects, socio-economic and cultural demands of amputees needed to be addressed.

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PROSTHETIC FOOT



- Look like a human foot
 - Permit squatting
 - Adapt to uneven terrain
 - Should be waterproof
 - Permit barefoot walking
 - Permit use within footwear
-
- Should be affordable
 - Should be made of locally available materials

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PROSTHETIC FOOT – CONCEPT & DESIGN

OBJECTIVES

1. It should look like a normal foot.



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PROSTHETIC FOOT – CONCEPT & DESIGN

2. The exterior should be water proof and durable .
3. It should allow enough dorsiflexion to permit the amputee to squat.
4. It should permit certain amount of transverse rotation of the foot on the leg.



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PROSTHETIC FOOT – CONCEPT & DESIGN



5. It should have sufficient range of inversion and eversion to allow the foot to adapt to uneven terrain.
6. It should be inexpensive.
7. It should be made of locally available materials.

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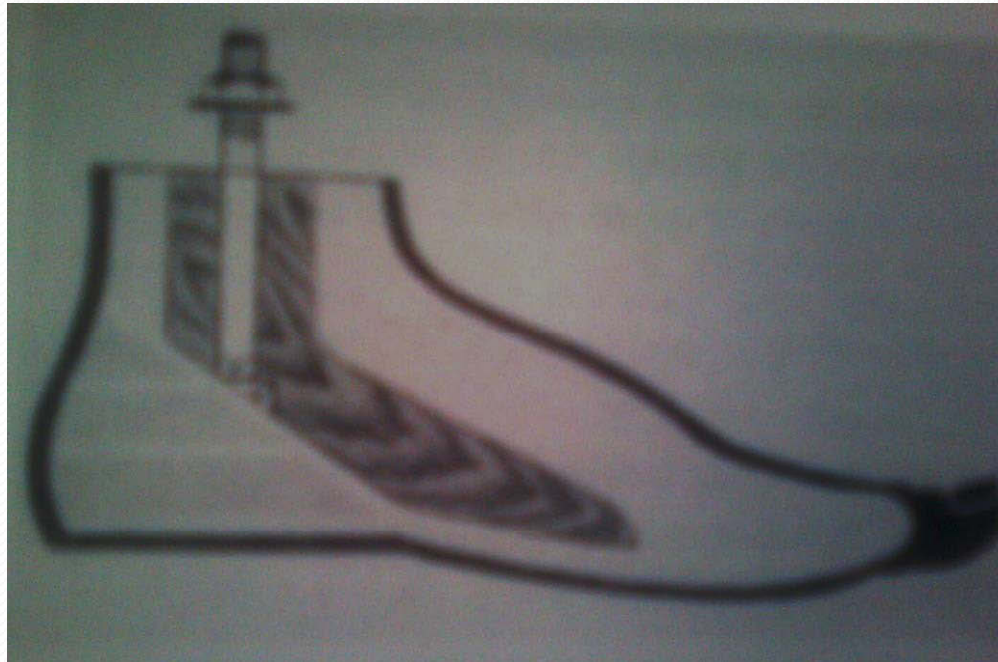
EVOLUTION

SACH FOOT

TO

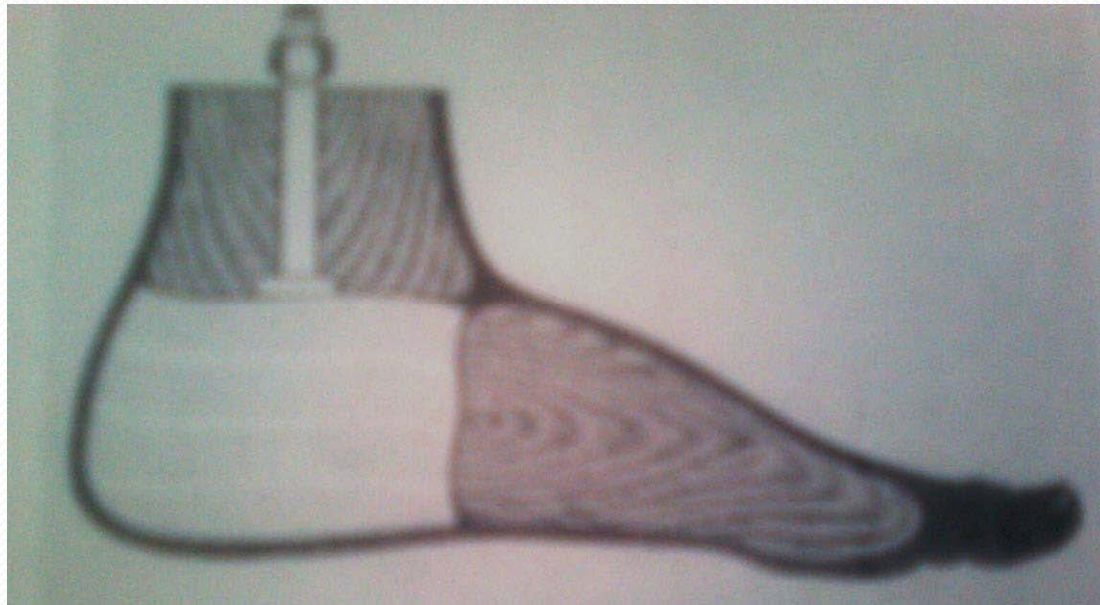
JAIPUR FOOT

SOLID ANKLE CUSHION HEEL (SACH)



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JAIPUR FOOT



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JAIPUR FOOT

- The JF is a non-articulated foot –ankle assembly .
- It consists of three structural blocks replicating normal foot anatomy.
- The forefoot & hindfoot are made of microcellular rubber and the ankle block is of light wood.
- These three blocks along with the toes are bound together by tyre cord and encapsulated in skin colored cushion compound.
- This structure is then vulcanized at 120° under 23 psi for 30 minutes.

JAIPUR FOOT

RANGE OF MOTION

Dorsiflexion	:	$20^{\circ} - 35^{\circ}$
Heel compression	:	.8 mm to 2.8 mm.
Pronation	:	$26^{\circ} - 29^{\circ}$
Supination	:	$15^{\circ} - 22^{\circ}$
Axial Internal Rotation	:	$10^{\circ} - 12^{\circ}$
Axial External Rotation	:	$4^{\circ} - 8^{\circ}$

POST FITTING TRAINING

- Weight bearing surface
- Peer Training

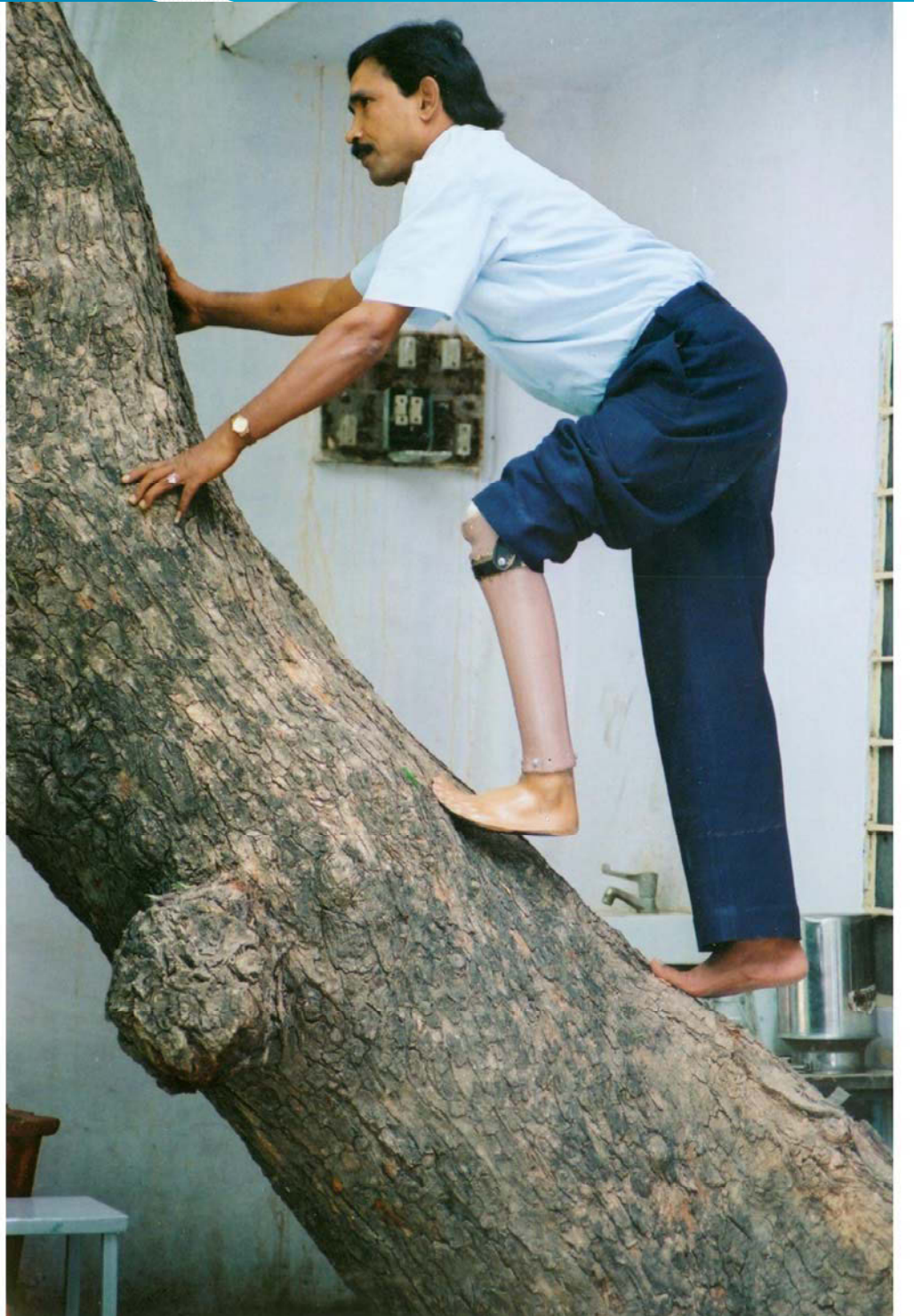


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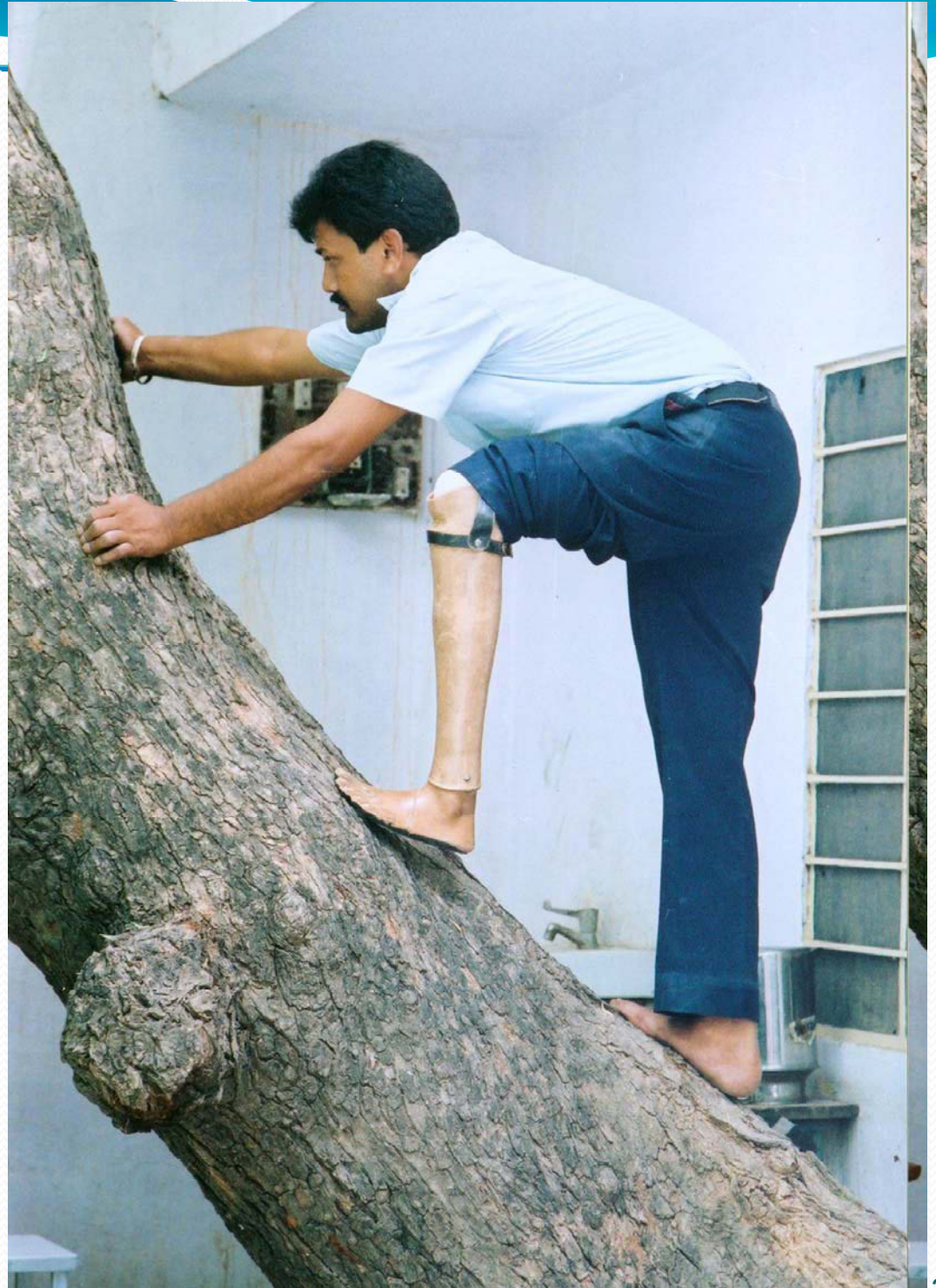
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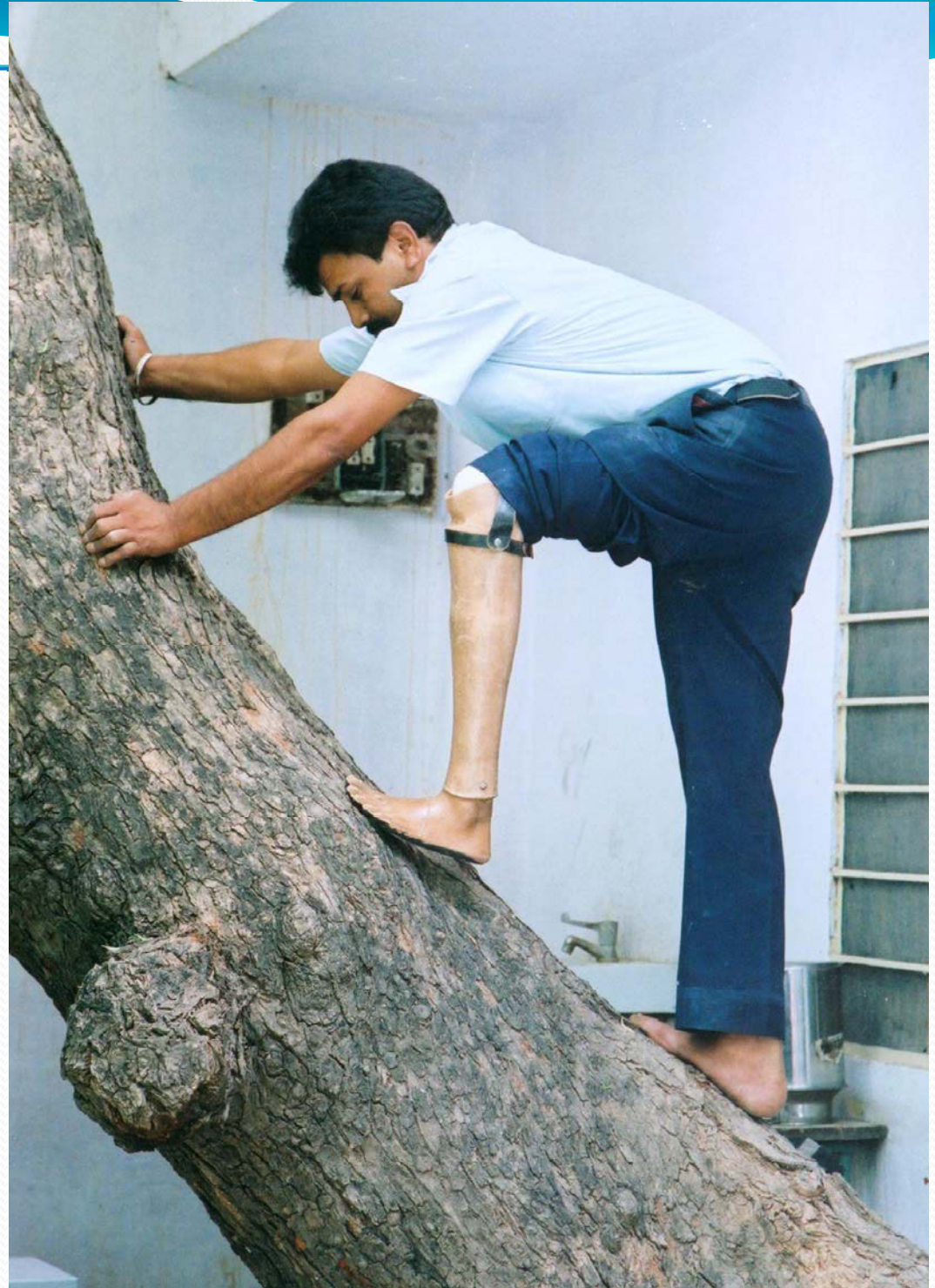


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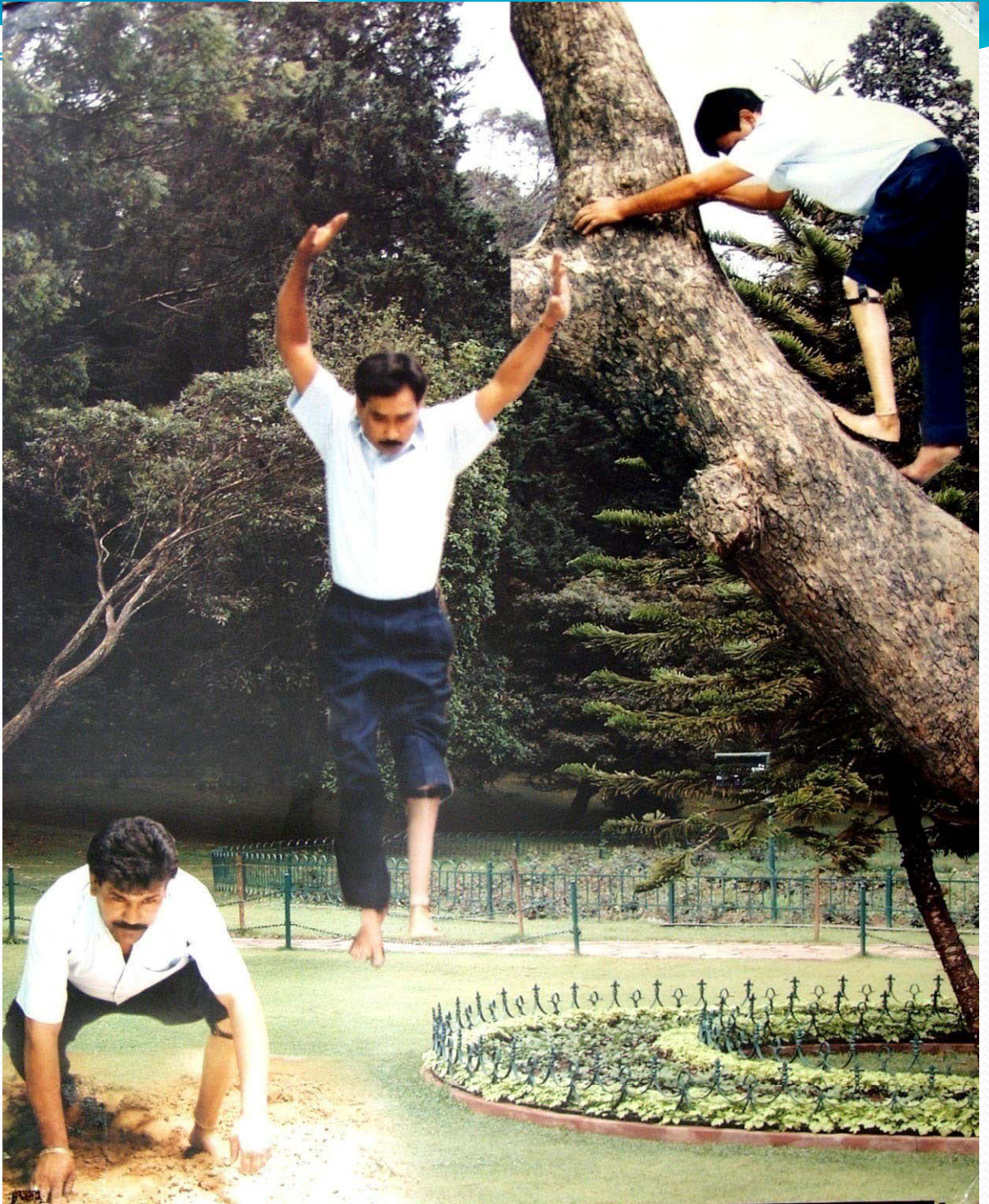


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JAIPUR FOOT :Biomechanical Analysis

A comparative study was conducted by Klenerman et al at Liverpool, U.K.

Two shock absorption variables-

- Impact Peak Force

- Impact Load Rate

Four gait style variables –

- Propulsive Force Peak

- Support Impulse

- Braking Impulse

- Propulsive Impulse were studied.

JF : LIVERPOOL STUDY

The study concluded –

“The performance of the Jaipur Foot is more natural and nearer to the normal foot as compared to the SACH and Seattle Foot.”

INTERNATIONAL STANDARDS

ISO-10328

VETERANS ADMINISTRATION PROSTHETIC CENTER
STANDARDS FOR FOOT & ANKLE ASSEMBLIES



STATUS OF JAIPUR FOOT

DOES NOT WHOLLY CONFORM TO
INTERNATIONAL STANDARDS

ACCEPTANCE IN THE DEVELOPED WORLD

UNACCEPTABLE

CRAFTSMANSHIP & FITTING – POOR IN 86%

PATIENT ACCEPTANCE – 94%

HOW ILLOGICAL /CONTRADICTORY !

INTERNATIONAL ACCEPTANCE DEVELOPING WORLD

Afganistan

Bangladesh

Dominican Republic

Honduras

Indonesia

Malawi

Nigeria

Nigeria

Nepal

Kenya

Pakistan

Panama

Philippines

Papua New Guinea

INTERNATIONAL ACCEPTANCE DEVELOPING WORLD

Rwanda

Sudan

Trinidad

Vietnam

Zambia

Zimbabwe

Somalia

Mozambique

Columbia

Sierra Leone

TIME MAGAZINE(Fall 1997)

‘ People who live inside the World’s many war zones from Afghanistan to Rwanda may never have heard of New York or Paris but they are likely to know to a town in northern India called Jaipur. Jaipur is famous in strife-torn areas as the birthplace of an extraordinary prosthesis or artificial limb, known as the Jaipur foot, that has revolutionized life for millions of landmine amputees. The beauty of the Jaipur foot is its mobility – those who wear it can run, climb trees and pedal bicycles – and its low price.’

COUNTRIES AWAITING ASSISTANCE

- Iraq
- Haiti
- Sri Lanka
- Chechnya
- Fiji
- Turkey
- Senegal

JF STATUS

THE JAIPUR FOOT WAS DEVELOPED IN 1968 .

RESEARCH HAS BEEN ONGOING TO IMPROVE ON THE DESIGN.

SOME ASPECTS THAT STILL REMAIN TO BE ADDRESSED ARE :

1. JAIPUR FOOT IS NOT AVAILABLE IN INTERNATIONAL STANDARD SIZES.
2. JAIPUR FOOT IS NOT COMPATIBLE WITH DESIGNS OF WESTERN LIMBS.
3. JAIPUR FOOT IS HEAVIER THAN THE SET INTERNATIONAL STANDARDS.
4. JAIPUR FOOT STILL DOES NOT COME WITH QUALITY ASSURANCE CERTIFICATION.



JF : CONVOLUTION IN RESEARCH

DESIGN OF THE JF HAS STOOD THE TEST OF TIME.

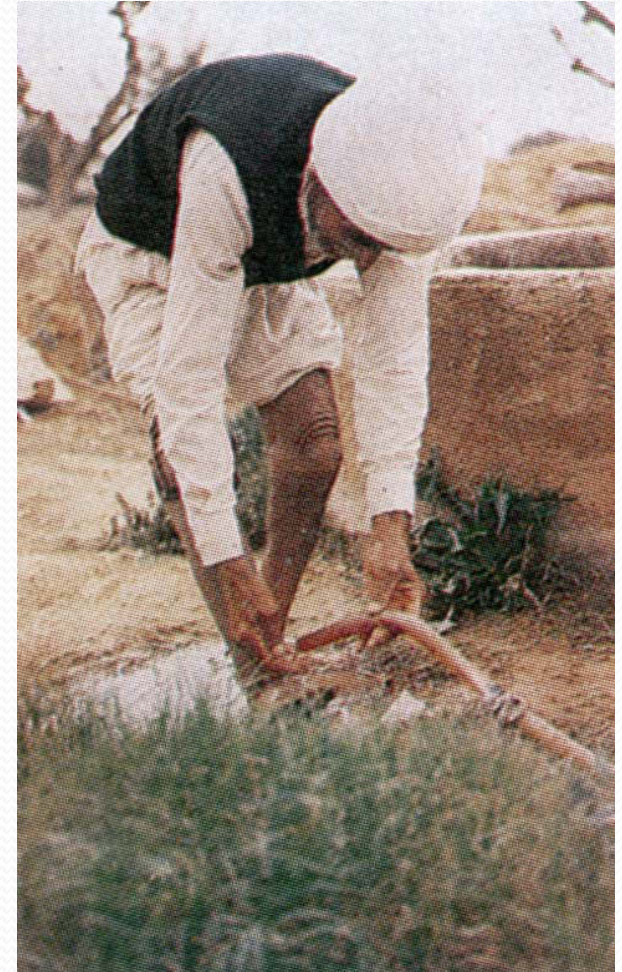
HENCE

ALL RESEARCH HAS TO GYRATE
AROUND THE BASIC STRUCTURE & ITS
FUNCTIONAL CHARACTERISTICS .

FUTURE COURSE

- SIZING THE JAIPUR FOOT TO MEET INTERNATIONAL STANDARDS LAID DOWN BY THE VETERANS ADMINISTRATION PROSTHETIC SERVICES, NEW YORK.
- DESIGNING THE JAIPUR FOOT TO BE COMPATIBLE WITH THE WESTERN PROSTHETIC DESIGNS.
- MATERIAL MODIFICATIONS TO REDUCE WEIGHT AND INCREASE DURABILITY.
- STANDARDIZING TESTING EQUIPMENT FOR QUALITY ASSURANCE.

Jaipur Foot & Limb Technology



BMVSS SURVEY -Patient acceptance rate of Jaipur Limb - 98.7%

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Sahayata Samiti - Jaipur Foot Organization, Jaipur, India.
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Jaipur Foot & Limb Technology



ISPO Retrospective Study Patient acceptance rate of Jaipur
Limb- **94%** (JPO Volume 28 No.3)

Courtesy of Dr. Pooja Mukul, Bhagwan Mahaveer Viklang
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FINAL WORD

USER REACTION & USER ACCEPTANCE



THANK YOU

BMVSS- As an organization

- Established in 1975 at Jaipur
- 19 Centres across the country
- Open door and patient friendly policy
- Delivery System
- Free assistance not charity
- Academic activities
- R&D

BMVSS- Achievements

- Provided 59 prostheses in the first year of its inception.
- Today provides more than 20 thousand prostheses in a year (largest limb fitting centre in the world)
- Total beneficiaries are > 1.1M

Jaipur Socket History

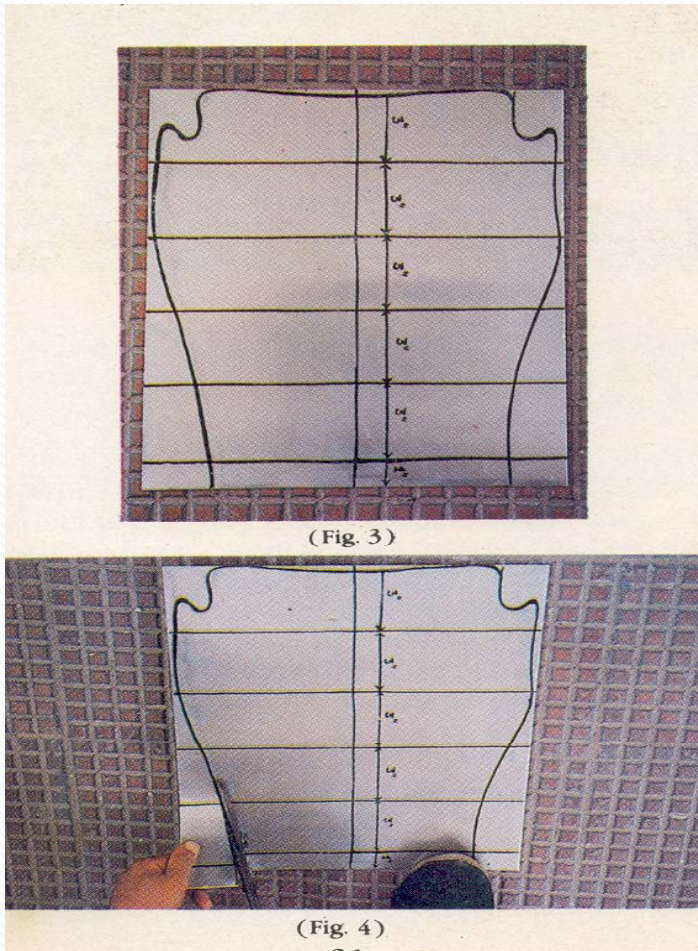


First Phase- Aluminum Sockets

Aluminium Sockets (1968–1987)

At that time

- the demand was huge,
- services were limited
- lack of trained manpower
- lack of materials
- non-availability of any other suitable technique
- huge resource of artisans having traditional knowledge of technology

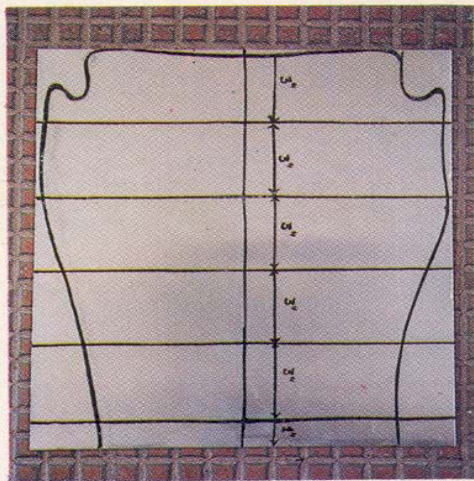


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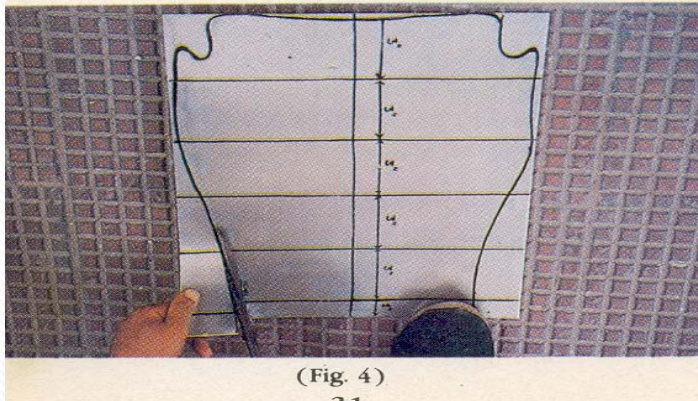
First Phase- Aluminum Sockets

Aluminium Sockets (1968–1987)

- ease of Fabrication
- able to withstand climate changes
- easily available in the local market



(Fig. 3)



(Fig. 4)

Courtesy of Dr. Pooja Mukul, Bhagwan Mahaveer Viklang Sahayata Samiti - Jaipur Foot Organization, Jaipur, India.

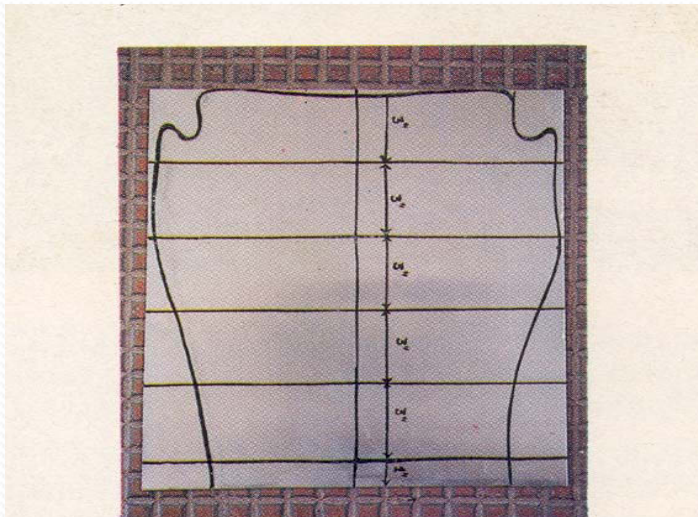
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First Phase- Aluminum Sockets

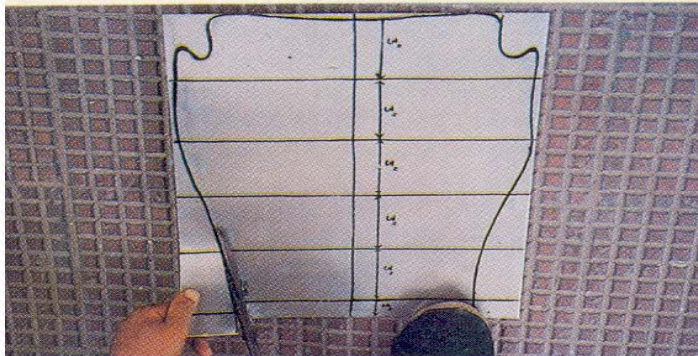
Aluminium Sockets (1968–1987)

The combination of Jaipur Foot and Aluminum socket:

- Really filled the void and became very popular
- Was a cross breed of standard PTB and conventional plug fit sockets



(Fig. 3)



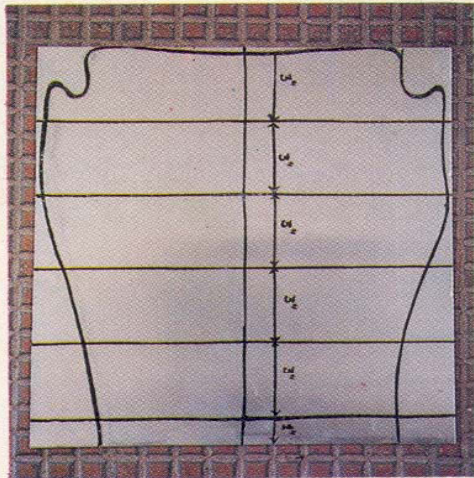
(Fig. 4)

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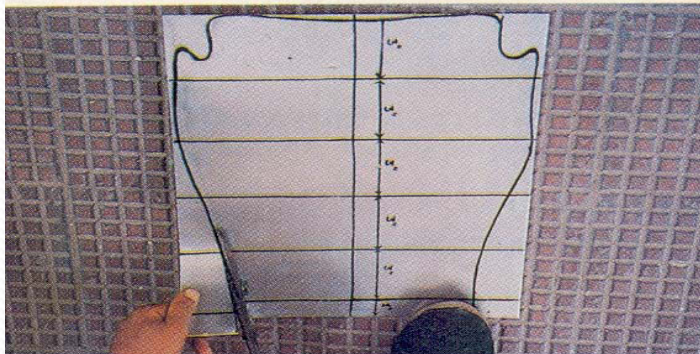
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First Phase- Aluminum Sockets

Aluminium Sockets (1968–1987)



(Fig. 3)

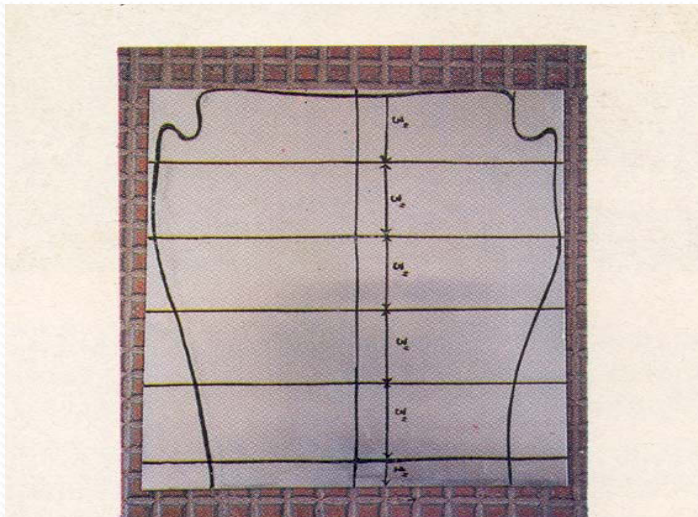


(Fig. 4)

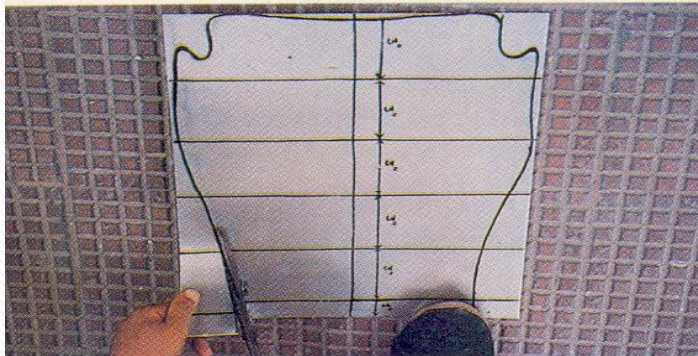
- This cross breed design suited to amputees in Indian climatic conditions
- Could be fabricated in an hour
- Delivery time was reduced significantly

First Phase- Aluminum Sockets

Aluminium Sockets (1968–1987)



(Fig. 3)



(Fig. 4)

- This led to an unprecedented rise in the number of prosthetic fittings
- And lowering of cost

Courtesy of Dr. Pooja Mukul, Bhagwan Mahaveer Viklang Sahayata Samiti - Jaipur Foot Organization, Jaipur, India.

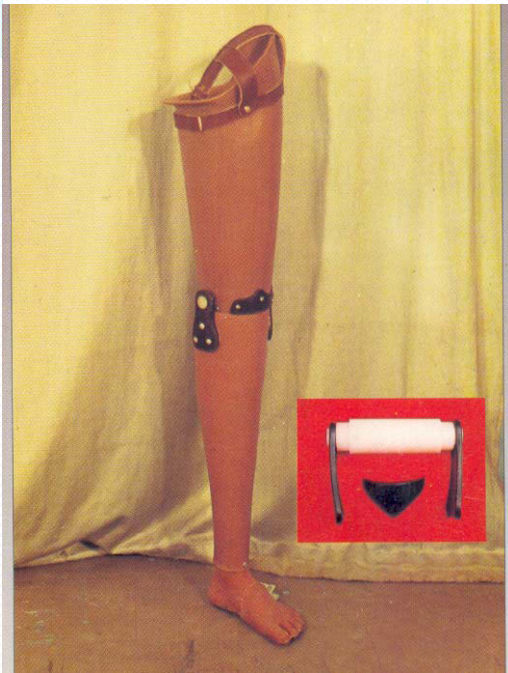
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Second Phase-HDPE Sockets

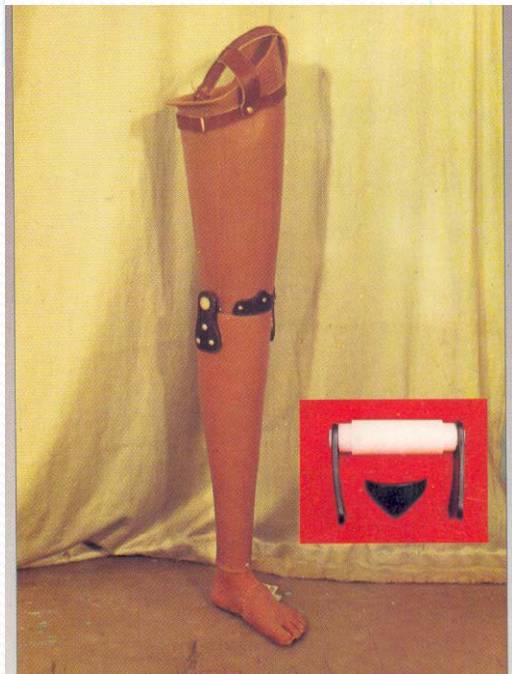


High density polyethylene (HDPE) pipes have the properties of:

- high impact strength
- high flexural strength
- high fatigue strength
- are inert
- withstand climate changes
- easy to handle
- good moldability
- available in the market



Second Phase-HDPE Sockets



HDPE Open Ended Sockets (1987-1995)

- using conventional POP wrap cast technique
- seamless
- light in weight
- fabrication time <one hour
- cost-effective material

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Third Phase – Total Contact



Total Contact Sockets
(1995 – continuing)

- using conventional POP Wrap cast technique
- inner socket was made of HDPE or PP Co-polymer sheets



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Jaipur Foot & Limb Technology



In-process alignment technique to incorporate the total contact socket with shank

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Jaipur Foot & Limb Technology



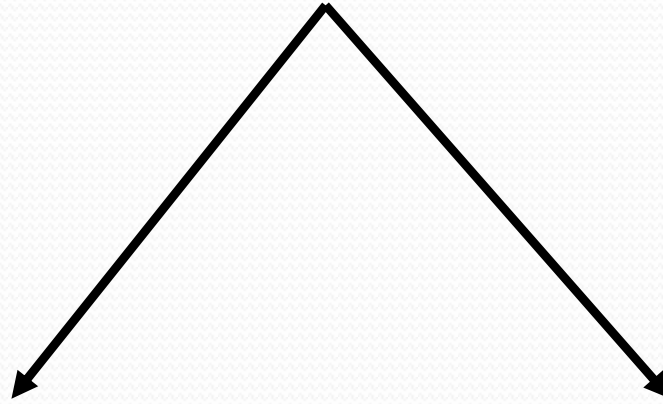
Alignment Transfer technique is also used to align the inner socket with shank

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BMVSS- R&D

Standards



International
Standards known as
ISO:10328

Indian Standards
known as
BIS Standards

ISO:10328

- These standards were developed in collaboration with ISPO and are very rigorous and strict
- Do not take care of normal human requirements and meant for specific Prosthetic feet
- Testing Load is applied only at forefoot and heel
- No dorsiflexion, inversion or eversion

ISO:10328

- In an recent article published by ISPO, the authors have observed that lab test as per ISO :10328 showed little wear to the foot sole
- We should develop our own standards considering the gross physical, social and cultural needs of our people.
- And standards should be such that even other countries should copy them

BIS Standards – Prosthetic Feet

- At present there are no standards available for prosthetic feet in India
- Draft standards for SACH foot are in circulation for comments
- We have applied to BIS to formulate standards for Jaipur Foot

BIS Standards – Sockets

Sockets are custom made

BIS Standards – Calipers

- The standard for calipers is very old
- Thermoplastics are being used extensively and proving very effective
- Standards should be revised in accordance with the gross requirements of our people

BIS Standards – other aids

- BIS standards for tricycle, wheelchairs, crutches and other items are very strict and good.
- Scope of customization should be there to enhance the effectiveness of assistive devices

BIS Standards

- In the end, our congratulations and thanks to BIS for developing standards for prosthetic and orthotic and rehabilitation aids and appliances.
- And revising them from time to time.

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EC .722 Special Topics at Edgerton Center:Developing World Prosthetics
Spring 2010

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