PARTIAL FOOT

AN ILLUSTRATIVE GUIDE

Design & Fabrication for a
Partial Foot Prosthesis that will...

- Reduce Friction
- Reduce Shearing
- Reduce Pressure
- Restore Propulsion
- Restore Limb Length
- Preserve Residual Limb

allard INT

Support for Better Life

Introduction

This book is in response to requests from practitioners interested in a comprehensive prosthetic program to manage partial foot amputations.

Reimbursement Codes

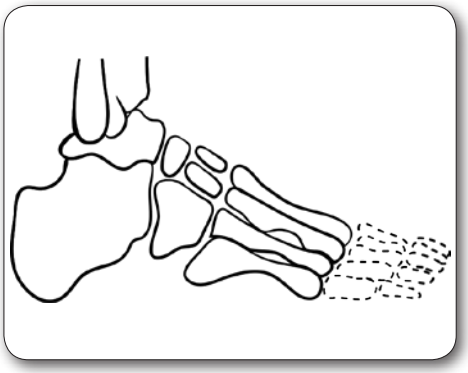
Any reference to reimbursement codes are based on suggestions from practitioners using these techniques and are not suggested by Allard USA or validated by any reimbursement agency.

Copyright

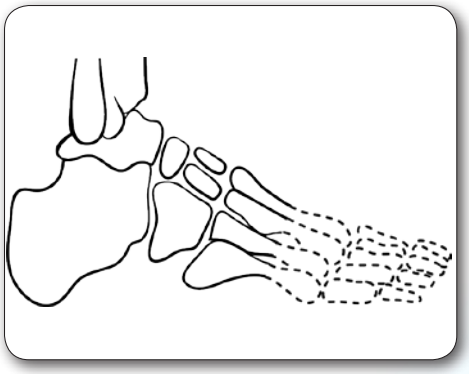
Applicable Amputation Levels

The concepts in this book apply to any partial foot amputation first ray or shorter.

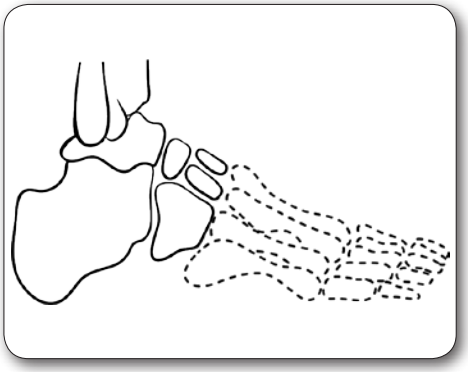
About three-quarters of all PFA involve the toe(s) and/or disarticulation of the meta-tarsophalangeal joint.



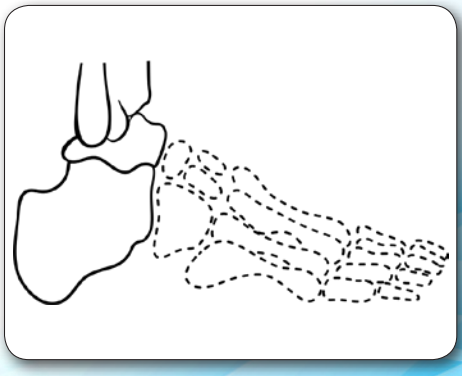
Metatarsophalangeal (MTP)



Transmetatarsal (TMT)



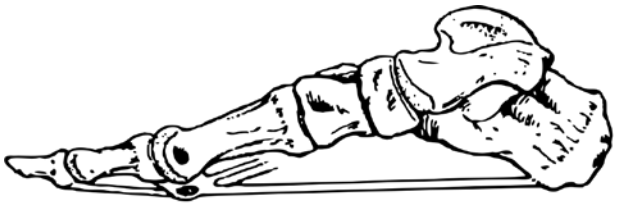
Tarsometatarsal (Lisfranc)

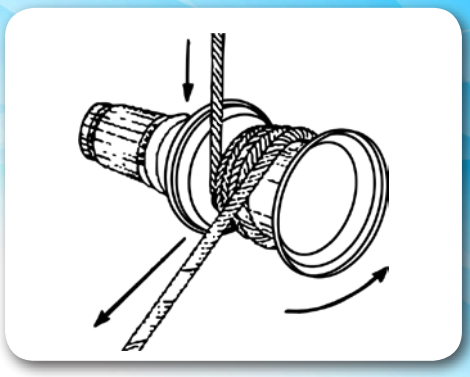


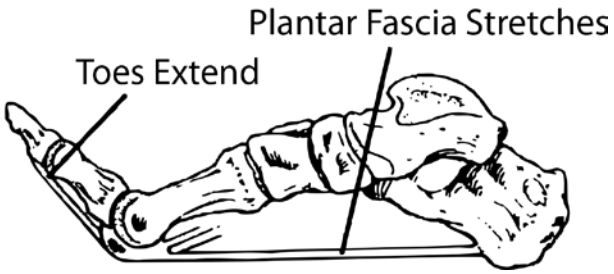
Transtarsal (Chopart)

PARTIAL FOOT CHALLENGES

1. Loss of Propulsion





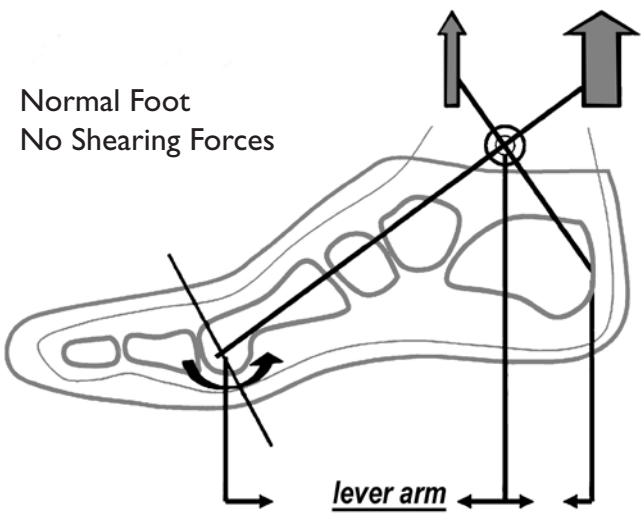


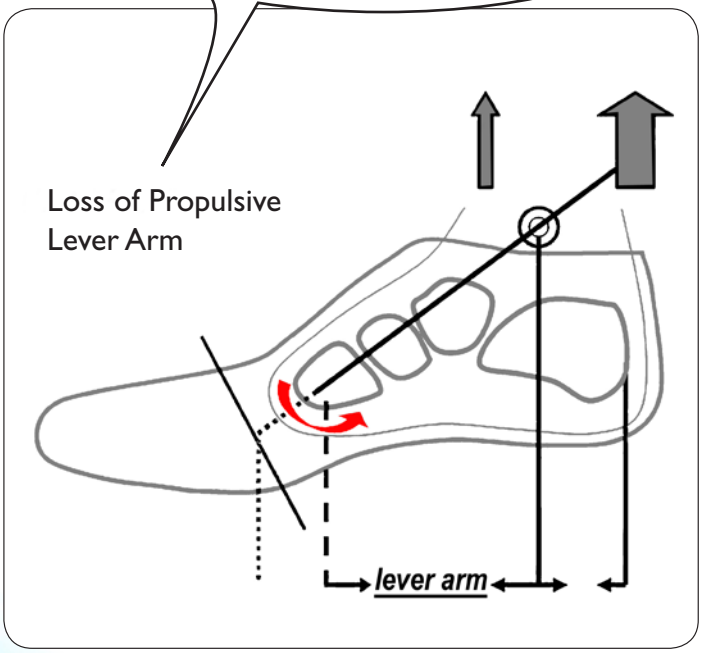
The term 'windlass' comes from sailing where it is the winch mechanism where the rope is wound around a drum, so in the foot the windlass is the plantar aponeurosis being wound around the metatarsal head.

Without the first ray windlass mechanism, the foot is considered "apropulsive"

2. Shearing Forces

Lever arm is the distance between the point of application of force and pivot.





Normally calf group muscle strength is balanced by foot lever arm length.

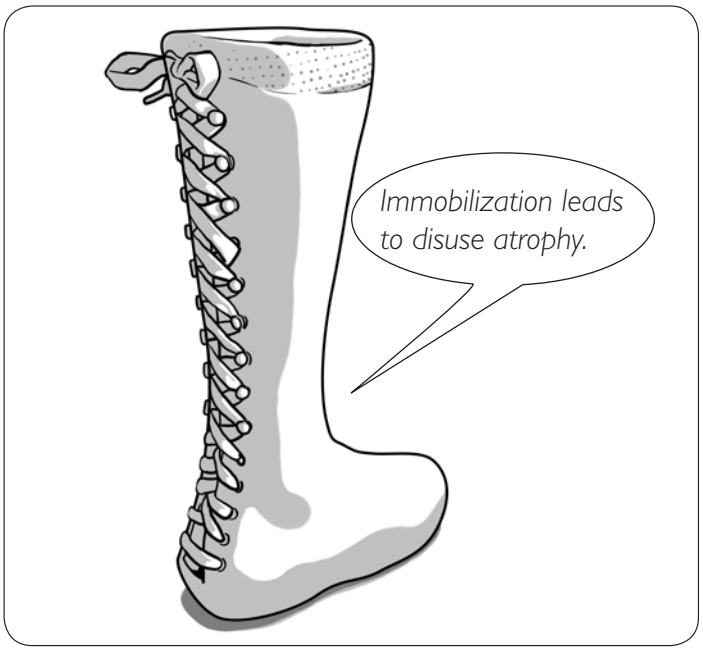
With amputation, muscles overpower the shortened lever arm, shearing connective tissue creating calluses.

OPTIONS

Foot Prosthesis or Short AFO

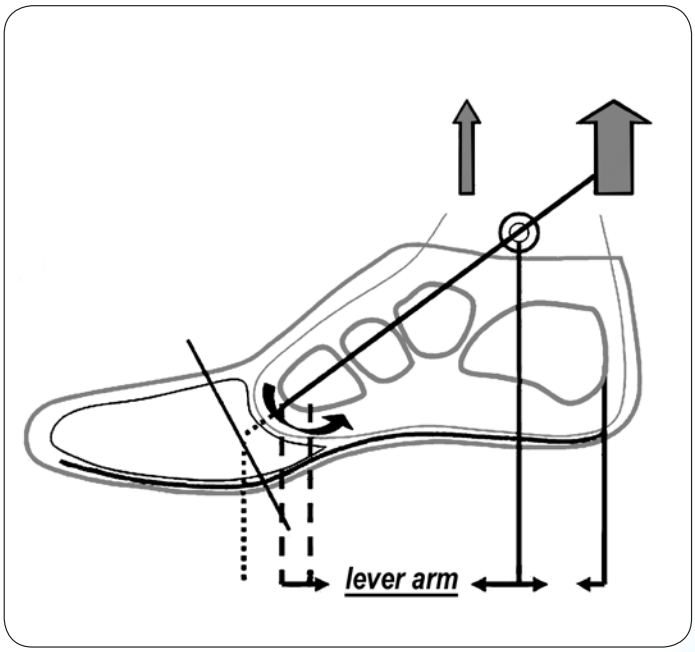
A foot prosthesis or short AFO with filler prosthesis cannot replace the lost propulsive lever arm.

Immobilization



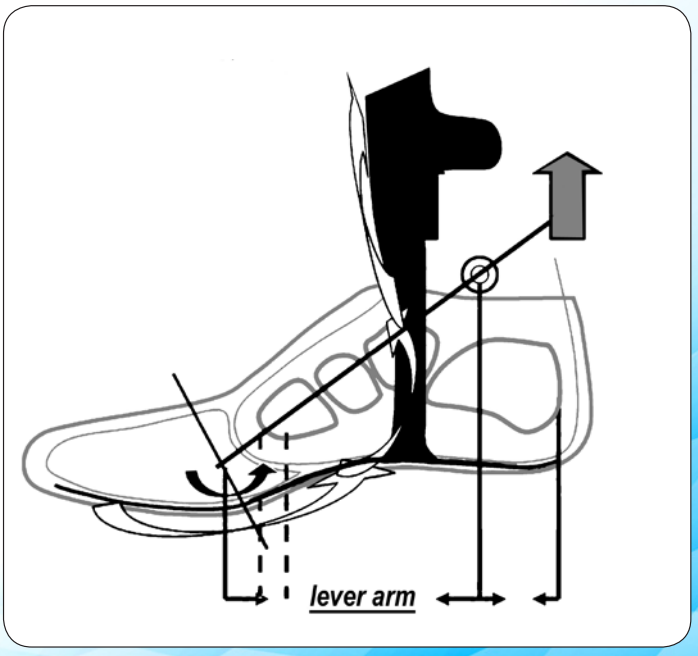
Immobilization can't help restore the propulsive lever arm and is proven to induce disuse atrophy.

Carbon Fiber Footplate



A carbon fiber footplate can only partially lengthen the propulsive lever arm, still allowing shearing leading to callus formation.

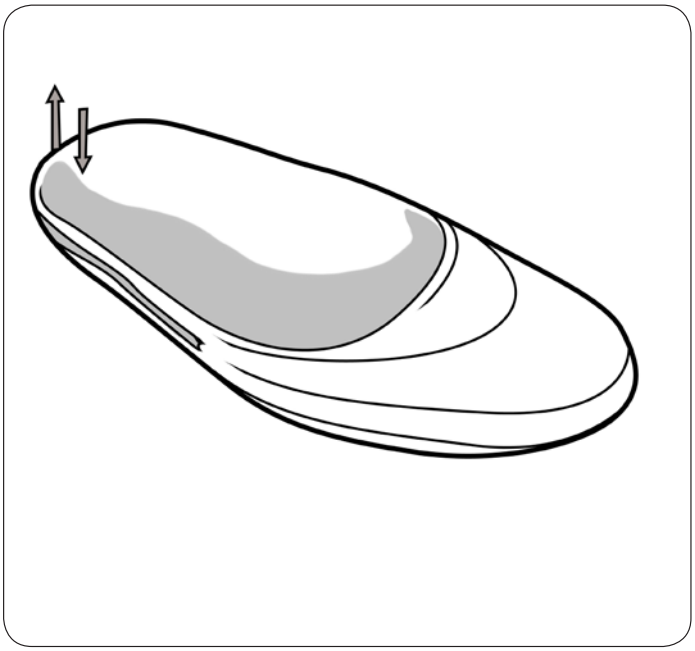
Carbon Fiber Footplate WITH a Lateral Strut



A footplate with a lateral strut leading into a tibial tubercle height pretibial shell can minimize or eliminate shearing forces by augmenting the shortened lever arm.

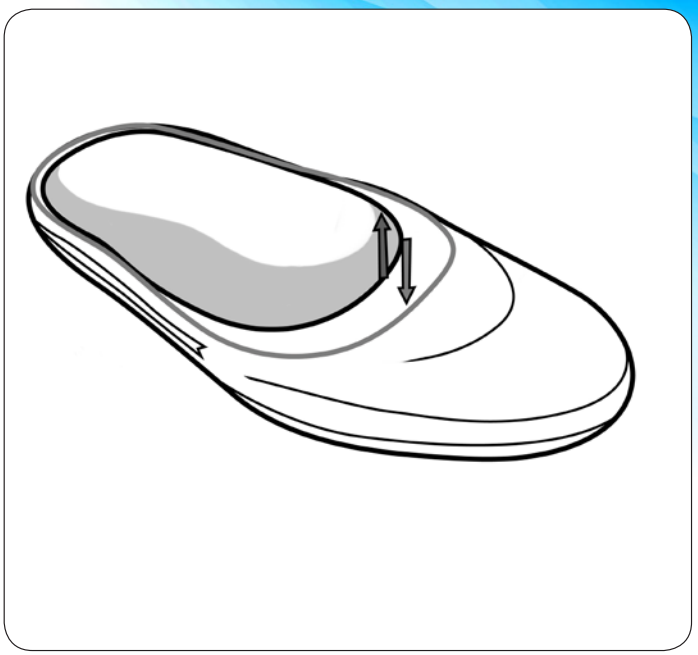
RESIDUAL FOOT PRESERVATION

Managing Friction



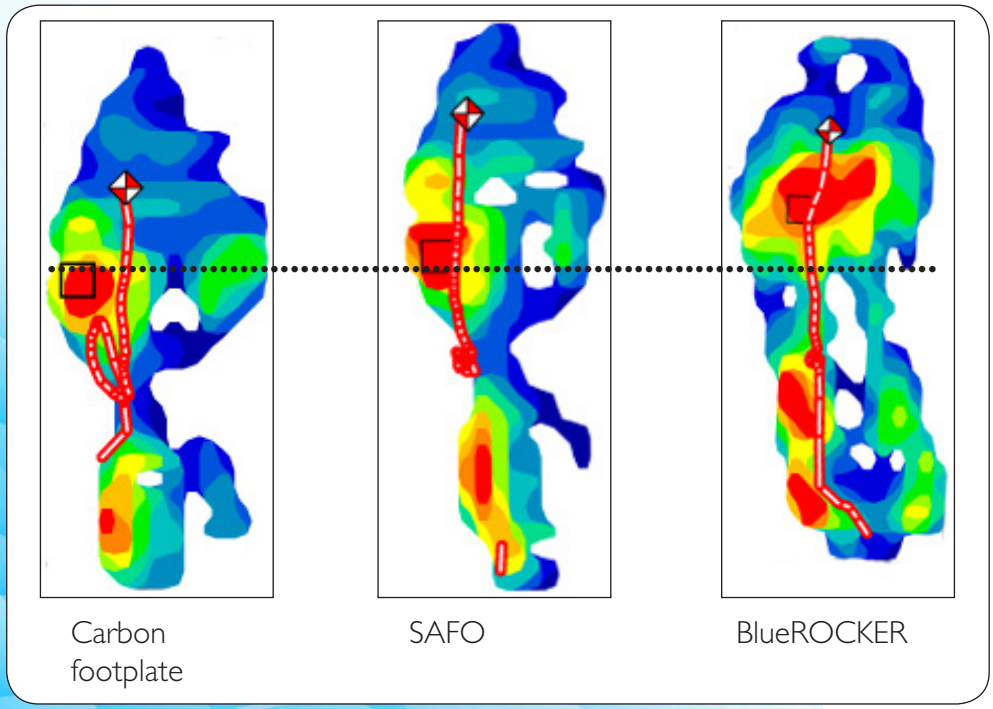
Friction can be managed by making sure the socket isn't too large and shoes aren't too big.

Managing Pressure



Pressure can be managed by making sure the socket isn't too small or shoes aren't too tight.

Residual Foot Preservation



Carbon footplate

SAFO

BlueROCKER

Studies have shown destructive forces are distal to the residuum using BlueROCKER, thereby preserving the residual foot.

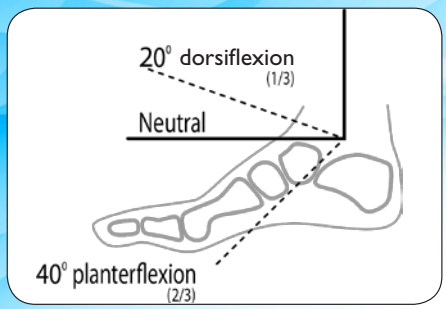
Foot Preservation Summary

To optimize residual foot soft tissue integrity it is important to make sure it is protected from:

- Friction
- Pressure
- Shearing forces

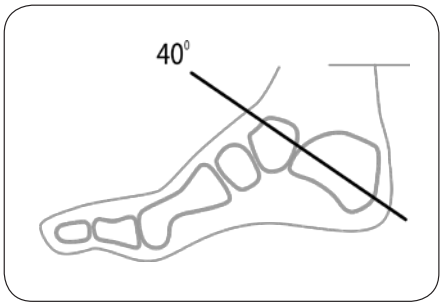
MANAGING LIMB LENGTH

Range of Motion



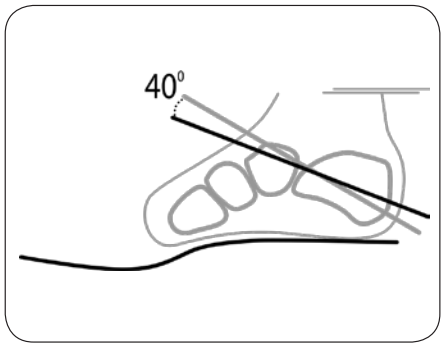
Nominal ROM at the ankle is 20° dorsiflexion and 40° plantarflexion.

Calcaneal Angle



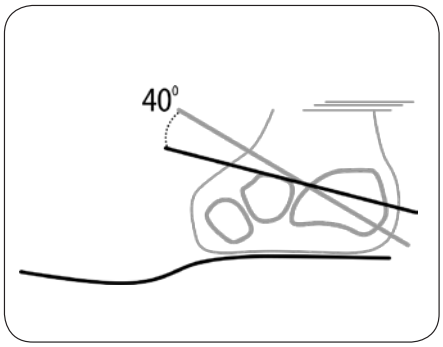
With the ankle at neutral, the normal calcaneal angle is 40°.

TMA



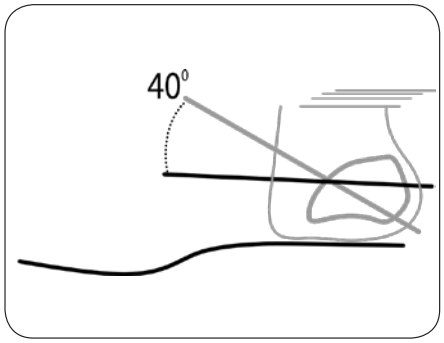
At TMA level amputation, expect 9,5 mm to 12,7 mm acquired limb length deficit.

LISFRANC



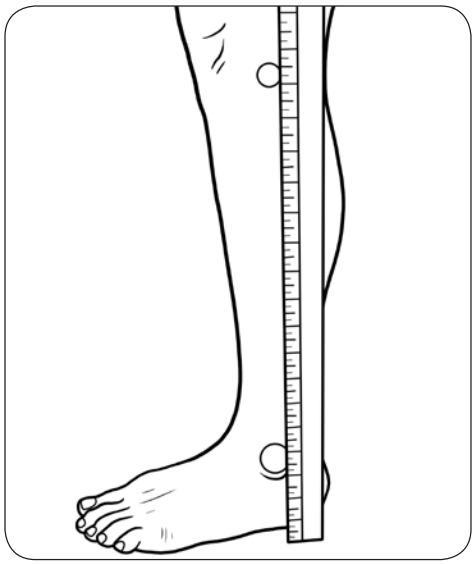
At Lisfranc level, expect 12 mm to 16 mm acquired limb length deficit.

CHOPART

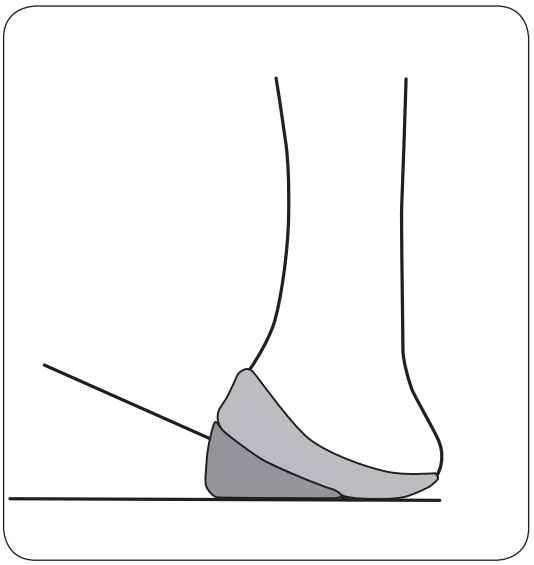


At Chopart level, expect 22 mm to 35 mm acquired LLD. Note acquired bulbous heel associated with ankle plantarflexion.

Determine leg length discrepancy



Measure limb length from fibular head to floor on both involved and uninvolved sides to determine acquired LLD.



Determine if restoring calcaneal angle can resolve LLD. Have patient stand on end of 1X4 board and lift the other end. Note/document calcaneal angle.

MANAGING LIMB LENGTH

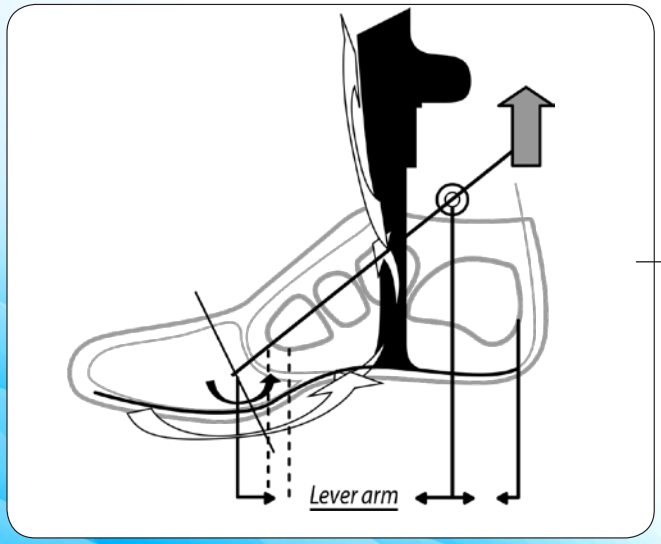
Adjust for leg length discrepancy

NOTE:
A calcaneal angle of 40° will return the ankle to neutral and should resolve any acquired LLD and eliminate or minimize an acquired bulbous heel.

Wedge anterior aspect of calcaneous to previous measurement. If LLD is not fully resolved, it will be necessary to post the heel section of the socket.
See page 8, step 5 for illustration.

GAIT RESTORATION

Restore Propulsion



Tibial tubercle height pre-tibial shell, lateral strut and kinetic return footplate help restore propulsion.

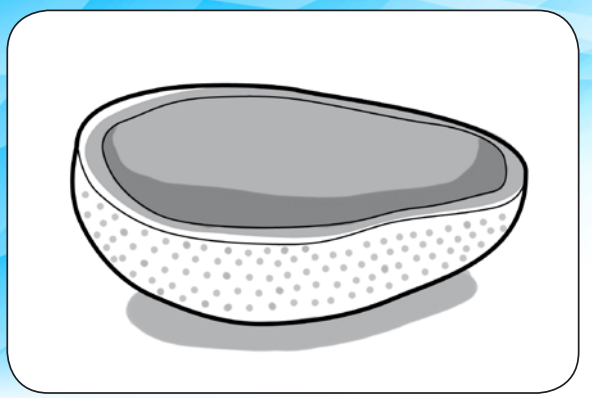
Data show that at TMA level, the ankle loses 85% of propulsive power. At Lisfranc and Chopart, the loss is 100% due to lack of a propulsive lever arm.

Compensations include hip-hiking, trunk lean, shorter sound side step length, and increased trunk torsion to advance the involved side limb through space.

Management of any partial foot amputation requires restoration of the propulsive lever arm.

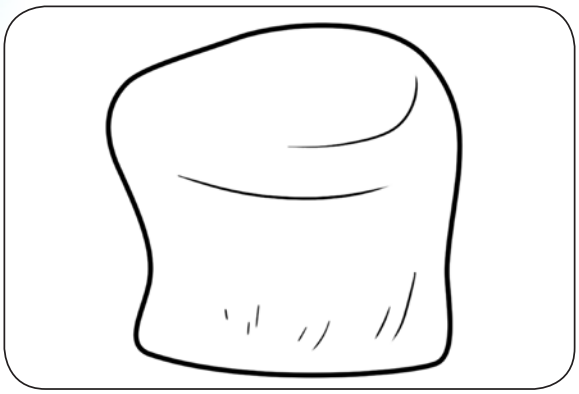
PROSTHESIS FABRICATION

1. Cast



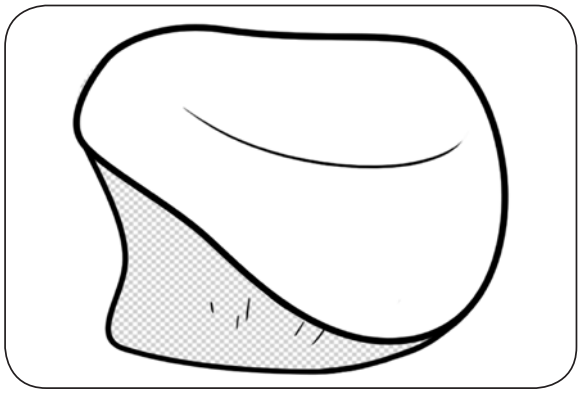
Cast residual foot. Also cast contralateral foot so the prosthesis can be built to match.

2. Positive Model



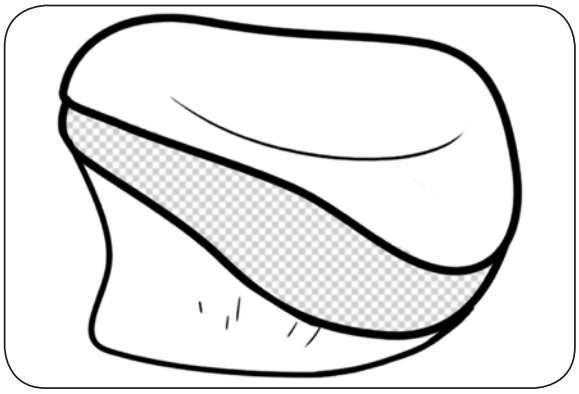
Make positive model of residual limb.

3. Distal Cushion



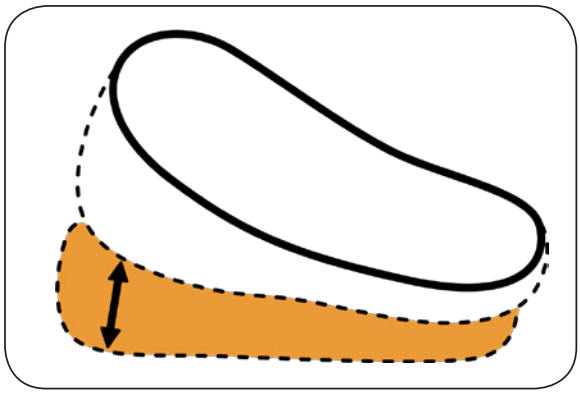
Mold 3,2 mm Impression Puff™ (25 Durometer Shore A EVA) for distal cushion.

4. Mold Socket



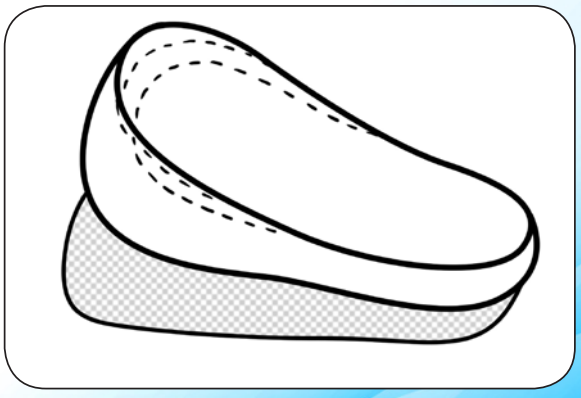
Mold 3,2 mm black co-polymer for the socket.

5. Post



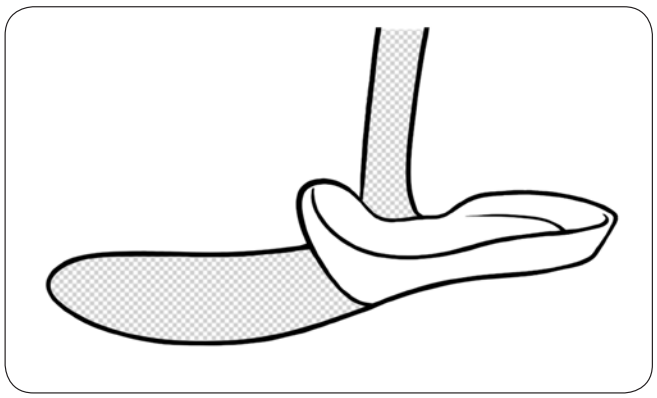
Post anterior aspect of socket to restore ankle neutral, and post posterior aspect if there is any residual LLD (see page 6).

6. Trim Lines



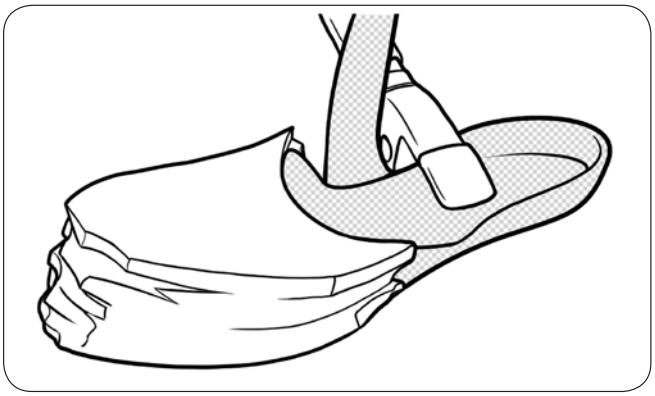
Trim anterior aspect of socket at start of filler prosthesis. Trim posterior aspect as a foot orthosis.

7. Align to BlueROCKER



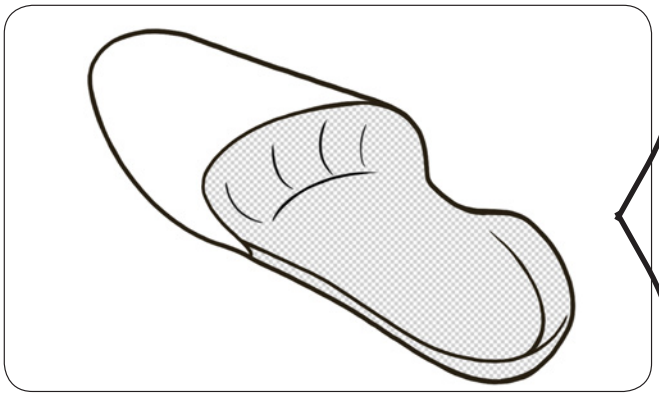
Align socket to BlueROCKER, trimming to accommodate lateral strut if necessary.

8. Laminate Layers of Microcell Puff®



Laminate 6,4 mm layers of Microcell Puff Lite to build the filler prosthesis, conforming it to the rocker footplate.

9. Shape Foot and Socket

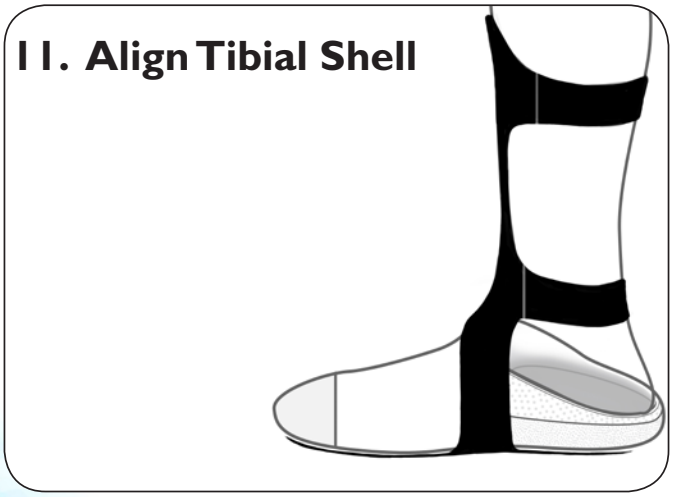


Shape to match the length, width and sagittal plane profile of the contralateral foot.

10. Add Interface

Line pretibial shell with SoftKIT, ComfortKIT, or Custom Interface to protect tibial crest.

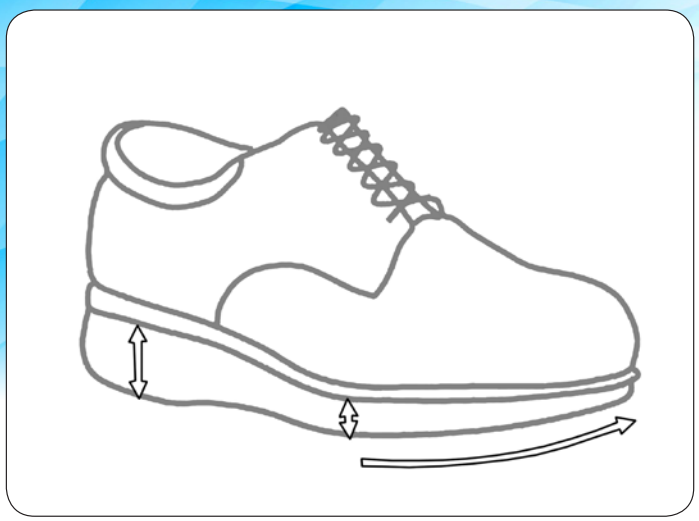
11. Align Tibial Shell



Align pretibial shell to tibial crest for equal top to bottom pressure distribution before securing prosthesis to footplate.

SHOE SELECTION & EXERCISES

Shoe Selection

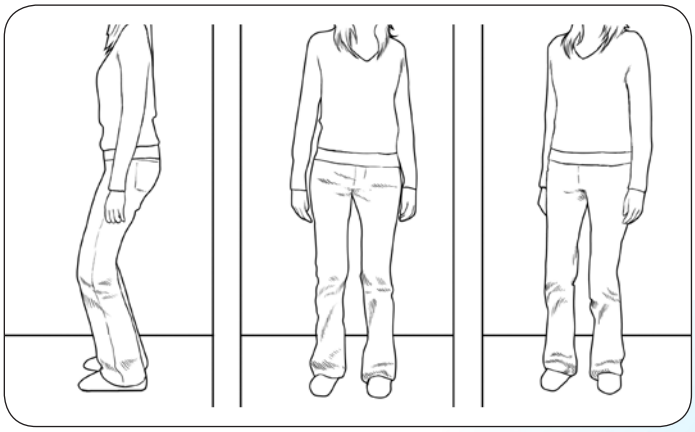


Footwear requirements include adequate heel/toe height differential, and toe rocker sole. A well constructed shoe (firm counter and shank) will produce better results. Flat-soled shoes (dress, court or deck shoes) are contraindicated.

Exercises

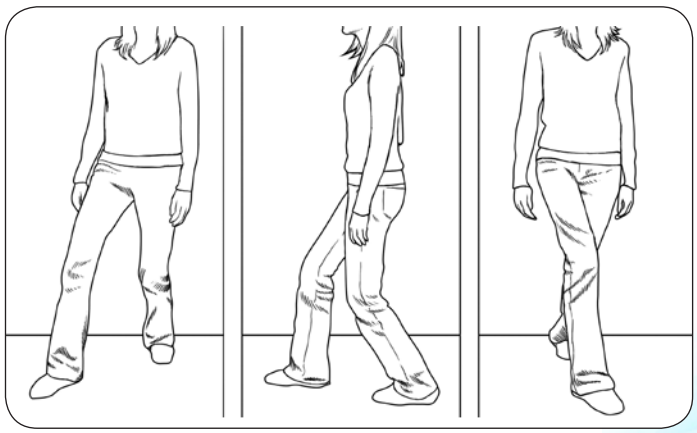
These exercises will help the wearer acclimate to their new environment by learning to take advantage of the energy return properties of the prosthesis. The importance of doing these exercises prior to walking cannot be overstated.

BABY SQUATS



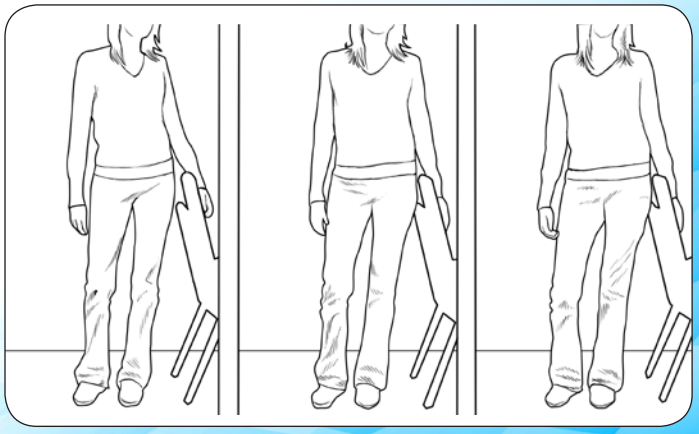
Baby squats (heels stay on the ground). Illustrated are sagittal, rotate right and rotate left squats.

TRI-PLANAR LUNGES



Step out, step ahead and cross-step, making sure both knees are flexed.

TRI-PLANAR HIP EXCURSION



Determine excursion distance frontal plane, and then rotating forward and rotating to the back .

ACKNOWLEDGEMENTS

***Robert H. Meier**, CO, BOCO whose dedication, contribution, and love of the O&P industry made this illustrative guide possible.*

***David Scurti**, CPO, for his early pioneering in partial foot prosthetic lever arm principles.*

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***Seamus Kennedy**, BEng (Mech), CPed, for his expertise in foot biomechanics relating to the windlass mechanism and loss of propulsion secondary to partial foot amputation.*

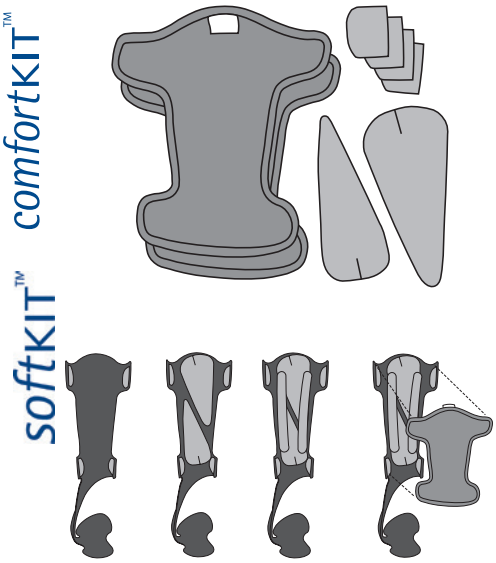
***Ryan Feltman** for the high quality professional illustrations.*

BLUEROCKER®

ToeOFF® 2.0

comfortKIT™

softKIT™



BlueROCKER is recommended for all PFA shorter than 1st ray.

For a stable ankle and no other proximal deficits, ToeOFF may be considered for 1st ray amputations.

AFO Selection

	ToeOFF 2.0 With D-Ring		ToeOFF 2.0 No D-Ring		BlueROCKER	
Size	Item No. Left	Item No. Right	Item No. Left	Item No. Right	Item No. Left	Item No. Right
X-Small	28922 1010	28922 2010	28920 1010	28920 2010	28405 1010	28405 2010
Small	28922 1011	28922 2011	28920 1011	28920 2011	28405 1011	28405 2011
Medium	28922 1012	28922 2012	28920 1012	28920 2012	28405 1012	28405 2012
Large	28922 1013	28922 2013	28920 1013	28920 2013	28405 1013	28405 2013
X-Large	28922 1014	28922 2014	28920 1014	28920 2014	28405 1014	28405 2014

Size	Footplate Length	Height
X-Small	210 mm	360 mm
Small	230 mm	380 mm
Medium	245 mm	405 mm
Large	270 mm	430 mm
X-Large	285 mm	BR = 430 mm 2.0 = 450 mm

Interface Selection

ToeOFF 2.0		
Size	SoftKIT	ComfortKIT
X-Small	28750 0010	28751 0010
Small	28750 0011	28751 0011
Medium	28750 0012	28751 0012
Large	28750 0013	28751 0013
X-Large	28750 0014	28751 0014

BlueROCKER		
Size	SoftKIT	ComfortKIT
X-Small	28390 0010	28398 0010
Small	28390 0011	28398 0011
Medium	28390 0012	28398 0012
Large/X-Large	28390 0013	28398 0013

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