

Total Contact Foot Orthoses

If podiatry has Root Theory biomechanics, at what altar does pedorthics worship?

- While there is not necessarily one canonical principle to which pedorthists and orthotists universally adhere, the generally accepted approach across OP&P is:
 - The mold, measurement or scan for any device should be made as close to the most functional position of the involved joint(s) of that individual patient. Ranging from *in situ* to, in some cases, dramatic *overcorrection*.
 - While modern OP&P education could easily be confused with a mechanical engineering think tank, real world pedorthics is rarely beholden to a rigid scientific formulaic approach to orthotic design.
 - The “One Size Fits All” approach simply does not work in practical OP&P.

The Total Contact Concept

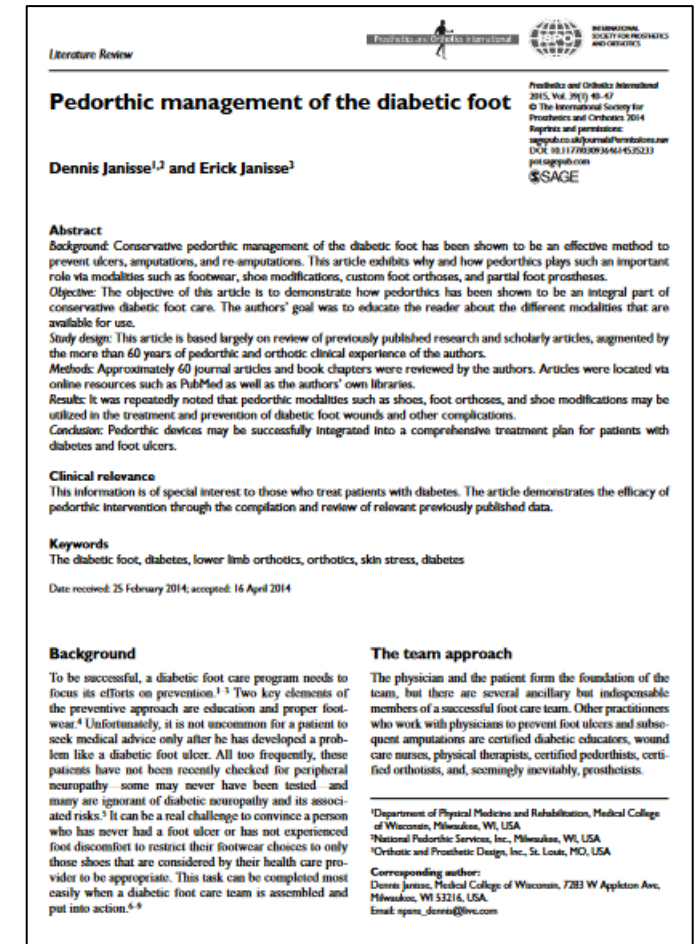
Unlike traditional functional foot orthoses, these devices achieve *total contact* with the plantar surface of the foot.

The top of the orthosis is a mirror image of the plantar surface of the foot.



The Total Contact Concept

- Total contact foot orthoses are widely used by the pedorthic community, just as conventional functional foot orthoses are customarily used by the podiatric community. However, comparatively less has been published (in research journals, trade publications and textbooks) about the design, use and efficacy of total contact inserts.
- That is not to say that *nothing* has been written, or that they haven't been studied; just that there is for more literature available on the topic of functional foot orthoses.
- Hopefully, this will change over the coming years.



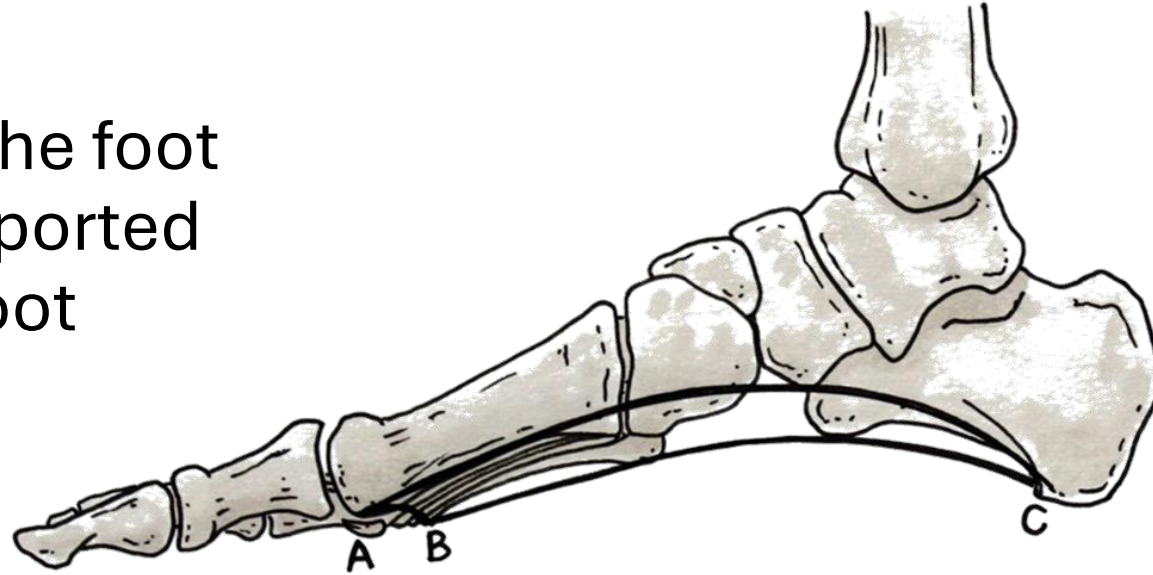
Total Contact Foot Orthoses

- Although TCOs are often referred to as “accommodative”, they are so much more.
- “Semi-rigid” is a much more appropriate descriptor.
- TCOs can be used to great effect to:
 - Support and splint the foot
 - Accommodate fixed deformities
 - Provide cushioning and shock attenuation
 - Correct flexible deformities
 - Correct forefoot and/or hindfoot alignment
 - Redistribute weightbearing plantar pressures more evenly
 - Decrease excess peak pressure over areas susceptible to ulceration
 - Reduce friction and shear forces on the foot

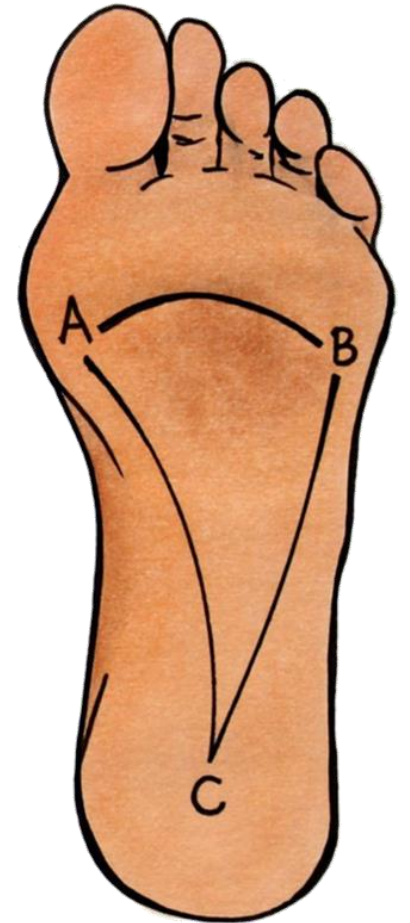


Total Contact Foot Orthoses

All three arches of the foot are “filled” and supported by a total contact foot orthosis.



A↔C MEDIAL LONGITUDINAL ARCH
B↔C LATERAL LONGITUDINAL ARCH
A↔B ANTERIOR TRANSVERSE ARCH



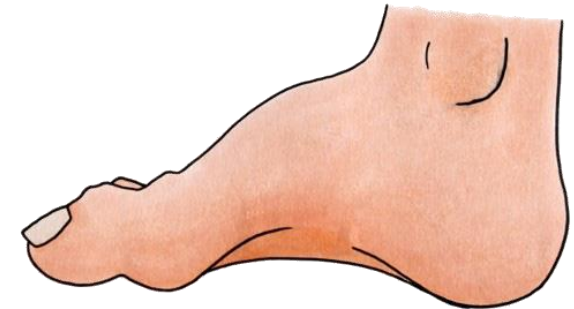
3 Types of Medial Longitudinal Arch

Pes Rectus—a foot with a normal arch; allows for shock absorbency



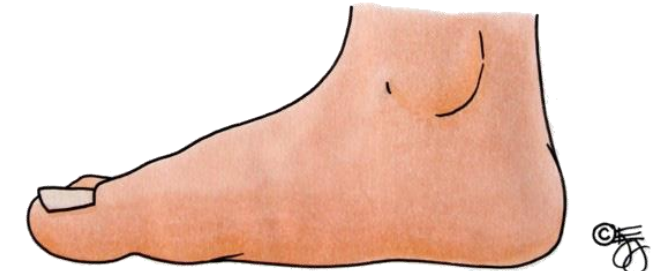
PES RECTUS

Pes Cavus—a foot with a high arch which does not flatten on weight bearing; weight is generally distributed to the lateral side of the foot



PES CAVUS

Pes Planus—flatfoot; a condition in which the arch has not developed normally and is flat



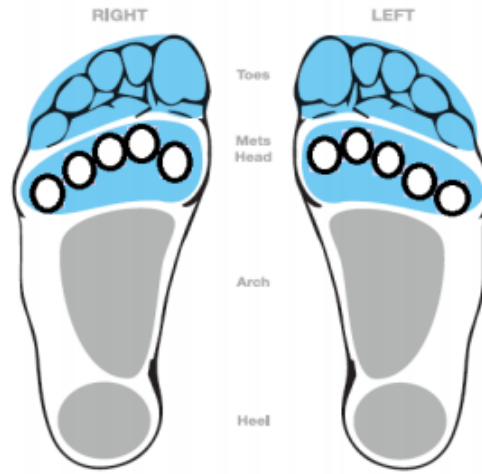
PES PLANUS

Intrinsic Vs Extrinsic Modifications/Corrections

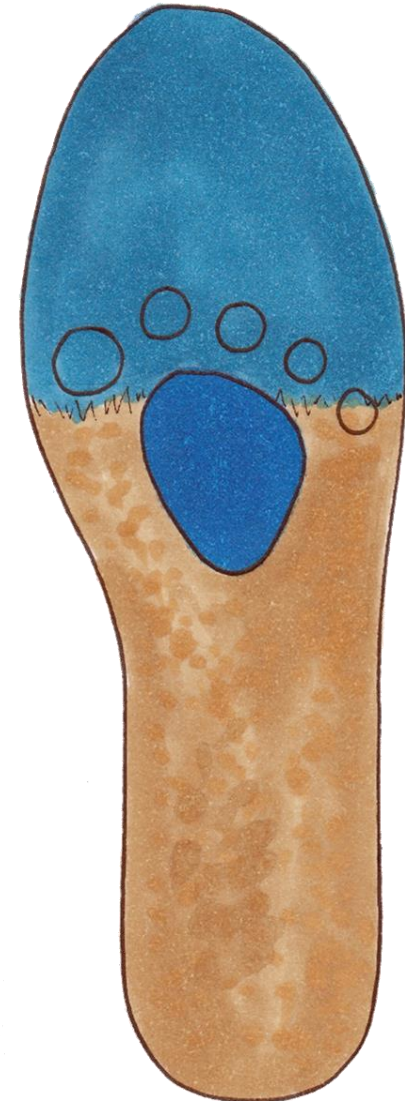
- Intrinsic = Built into either the positive model and/or the device itself. Typically refers to wedges, met pads and areas of relief.
- Not easily adjustable.
- Extrinsic = Added to the finished orthotic device. External wedges, met pads, etc.
- Simpler to adjust/correct.



STANDARD MODIFICATIONS		
R	Met Pad	L
R	Offloading*	L
Please indicate offloading on foot picture		
SPECIAL MODIFICATIONS		
R	Medial Heel Wedge	L
R	Lateral Heel Wedge	L
R	Met Bar	L
R	Heel Pad	L
R	High Heel Cup	L
R	High Medial Flange	L
R	High Lateral Flange	L
R	Heel Lift	L
Amount		
R	Sweet Spot*	L
R	Toe Plugs**	L
Please indicate toe plugs & sweet spots on foot picture		

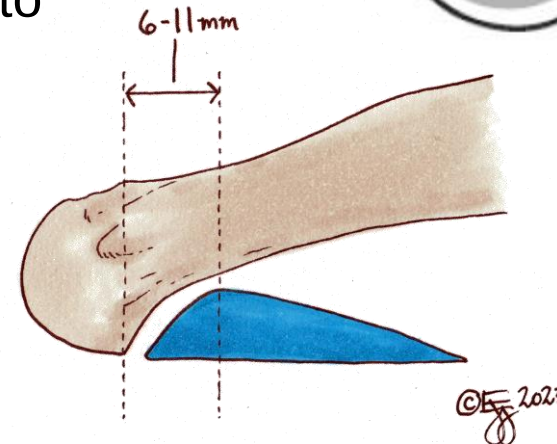


R L
R L
Charcot
Amputations
Please indicate amputations on foot picture



Met Pad

- Sits in the anterior transverse arch
- Optimal placement is 6.1mm – 10.6mm proximal to the apex of the metatarsal head
- Used for: metatarsal pain, ulcerations, callouses



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<i>Please indicate offloading on foot picture</i>		
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R	Lateral Heel Wedge	L
R	Met Bar	L
R	Heel Pad	L
R	High Heel Cup	L
R	High Medial Flange	L
R	High Lateral Flange	L
R	Heel Lift	L
R	Amount	L
R	Sweet Spot	L
R	Toe Plugs**	L
<i>Please indicate toe plugs & sweet spots on foot picture</i>		

RIGHT

R Charcot

R Amputations

Please indicate amputations on foot picture

LEFT

L Charcot

L Amputations



Met Bar

- Placed just proximal to the metatarsal heads
- Transferring the weight bearing surface to the shafts of metatarsals
- Creating a “shelf” like system to offload
- Used for: metatarsal pain, ulcerations, callouses
- Also called: “global” MTH relief/offloading

STANDARD MODIFICATIONS		
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R	Offloading*	L
Please indicate offloading on foot picture		
SPECIAL MODIFICATIONS		
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R	Lateral Heel Wedge	L
R	Met Bar	L
R	Heel Pad	L
R	High Heel Cup	L
R	High Medial Flange	L
R	High Lateral Flange	L
R	Heel Lift	L
Amount		
R	Sweet Spot*	L
R	Toe Plugs**	L
Please indicate toe plugs & sweet spots on foot picture		

RIGHT

R Charcot

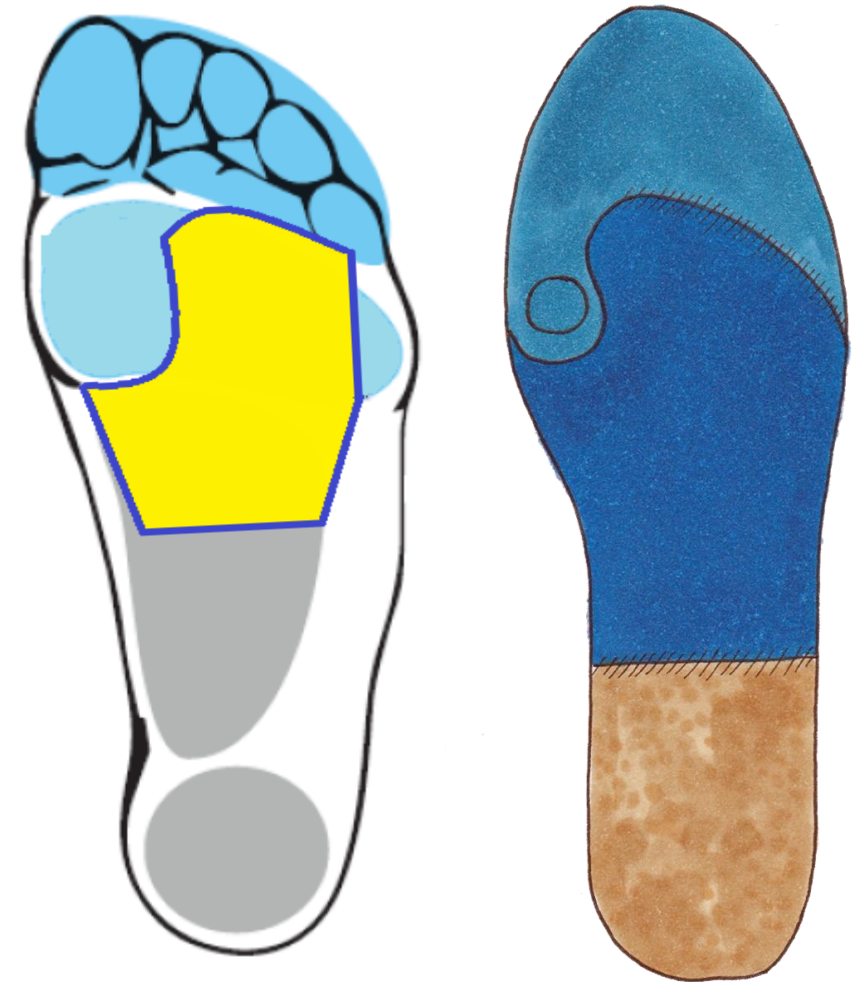
R Amputations

Please indicate amputations on foot picture

LEFT

L Charcot

L Amputations



1st MTH/sesamoid offloading - Dancer pad

- Transfers weightbearing pressure away from the affected area by *loading the lesser metatarsals*
- Used for: metatarsal pain, ulcerations, callouses
- Make sure it is safe to be – and that patient will tolerate – increasing the pressure under the lesser MTHs

STANDARD MODIFICATIONS		
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Please indicate offloading on foot picture		
SPECIAL MODIFICATIONS		
R	Medial Heel Wedge	L
R	Met Bar	L
R	Heel Pad	L
R	High Heel Cup	L
R	High Medial Flange	L
R	High Lateral Flange	L
R	Heel Lift	L
R	Amount	L
R	Sweet Spot*	L
R	Toe Plugs**	L
Please indicate toe plugs & sweet spots on foot picture		

RIGHT

TOES
META HEAD
ARCH
HEEL

LEFT

TOES
META HEAD
ARCH
HEEL

R

R

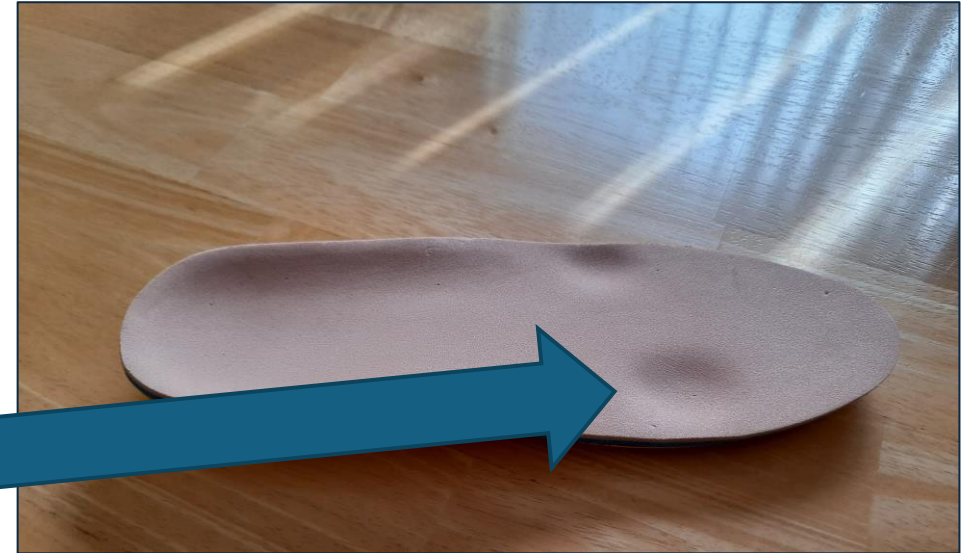
Charcot

Amputations

Please indicate amputations on foot picture

L

L

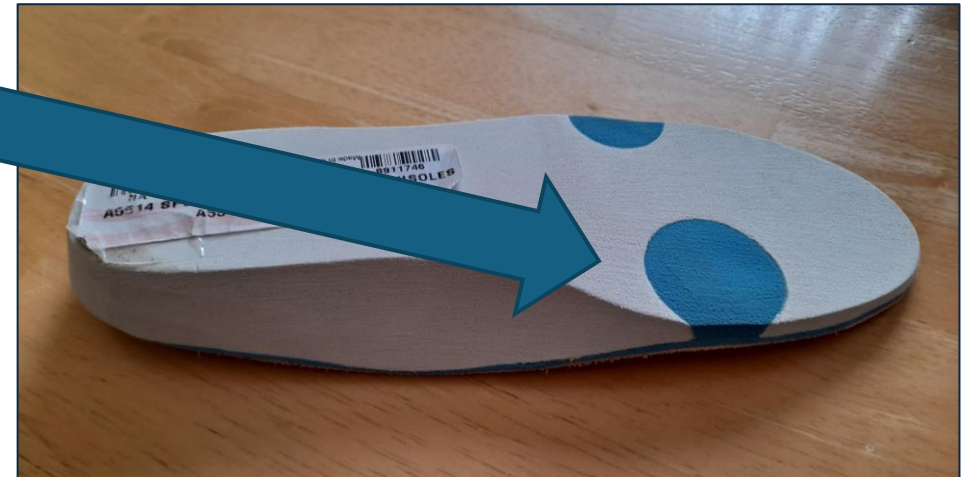


Offloading – Depression in the insert

“Sweet Spot” – Cutout in base backfilled with softer foam

Cushioning placed directly below the metatarsal heads (possibly slightly distal)
Transferring weight bearing away from the affected area

Used for: metatarsal pain, ulcerations, callouses



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R	Heel Lift	L
R	Amount	L
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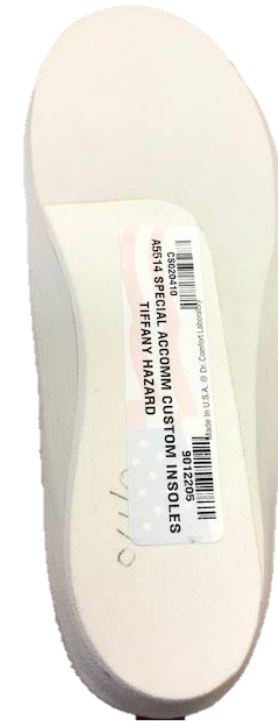
RIGHT

R

LEFT

L

Please indicate amputations on foot picture



Heel wedges/Posts

- Increase stability in the rear foot
- Correct flexible varus or valgus heel deformity
- Used to help reduce pronation and supination
- Wedges can also be applied in the midfoot and forefoot

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R	Lateral Heel Wedge	L
R	Met Bar	L
R	Heel Pad	L
R	High Heel Cup	L
R	High Medial Flange	L
R	High Lateral Flange	L
R	Heel Lift	L
	Amount	
R	Sweet Spot	L
R	Toe Plugs**	L
<i>Please indicate toe plugs & sweet spots on foot picture</i>		

RIGHT

R

R

LEFT

L

L

Please indicate amputations on foot picture



Heel Pad vs Heel Lift

Heel Lift: An addition to the orthosis to put the foot at a higher pitch than the shoe offers

- Used for: ROM limitations, tendonitis or a LLD

Heel Pad: Soft padding layer added between the base and top cover layers

- Used for: heel pain, plantar fasciitis

STANDARD MODIFICATIONS		
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R	Offloading*	L
<i>Please indicate offloading on foot picture</i>		
SPECIAL MODIFICATIONS		
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R	Lateral Heel Wedge	L
R	Met Bar	L
R	Heel Pad	L
R	High Heel Cup	L
R	High Medial Flange	L
R	High Lateral Flange	L
R	Heel Lift	L
	Amount	
R	Sweet Spot	L
R	Toe Plugs**	L
<i>Please indicate toe plugs & sweet spots on foot picture</i>		

RIGHT

R

LEFT

L

Please indicate amputations on foot picture



Higher or Extended Flanges/Heel Cup

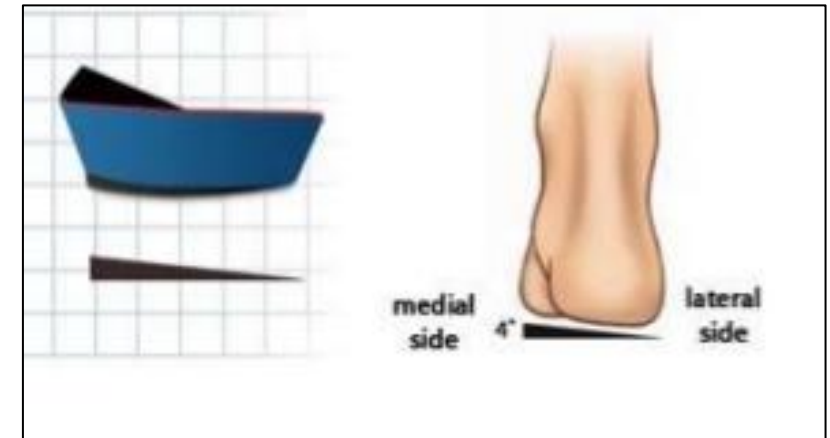
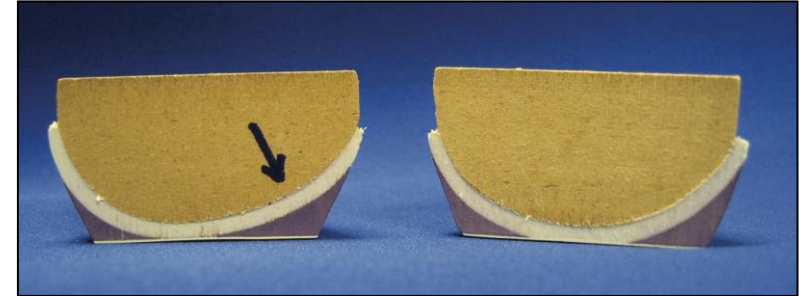
- The heel cup surrounds the sides and back of heel
- Flanges are the side “walls” of the total contact orthosis
- Used when more contact/control is desired and/or the patient requires cushion on the sides or posterior aspect of the foot.

Confusing Terminology

- Skive vs Wedge vs Post
 - OP&P community typically uses the term *wedge*.
 - Occasionally, they'll call it a *post* depending on their training.
 - The term *skive* is primarily used by the podiatric community.

Skive vs Wedge vs Post

- Skive:
 - The cast or positive model is modified.
 - Material is removed from the cast or positive 3D model under one side of the heel.
 - Ex: Medial heel skive = Material removed from underside of medial heel.
- Wedge:
 - The FO itself is modified.
 - Additional material added to the underside of the orthosis. May be external/extrinsic (readily apparent) or it may be built-in/intrinsic (not visible).
 - Ex: Medial heel wedge = Thickness under medial aspect of the heel is greater than the lateral aspect.
- Post: Another name for a wedge
- Functionally speaking, a wedge and a skive are two ways to skin the same cat. Just depends on your training/discipline.



Arch fill vs arch fill

- Arch fill on positive model

Is this a REORDER? ☐ Yes, ☐ No. ☐ Order 1 pair c

Customer Reminder: In support of federal requirements, yo

CAST CORRECTIONS				
Arch Fill				
R	Normal	L		
R	Increased	L	1	
R	No Fill	L	1	

REQUIRED DETAILS

Side: Right Left Bilateral

STANDARD SELECTIONS - comes with a

Casual

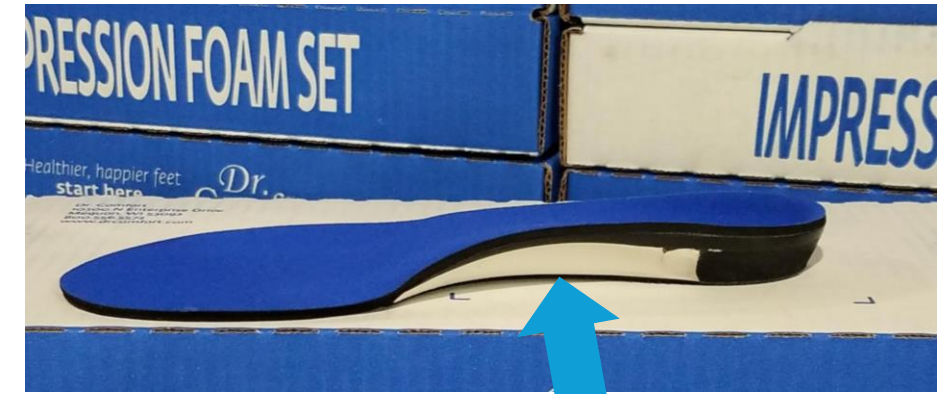
Poly pro shell - ball length
1/8" EVA top cover - full length

Dress

Poly pro shell - ball length



- Arch fill on orthosis



COLLECTION 3 - SPECIALTY FUNCTIONAL ORTHOSES

MARATHONER: Semi flexible Polypropylene shell, soft arch fill, dual density heel post, and neoprene top

Consider for:

Heel toe runners, Long distance runners, Greater dynamic response than standard functional orthotic

Material

- Top cover - 1/8" Neoprene Fabric
- Arch fill - Soft EVA
- Posting - Dual Density EVA
- Shell - Polypropylene - ball length
- Bottom - Sole Cap + Pseudo suede



Pros and Cons of TCOs

Pros

- Total contact function
- Can be supportive/corrective; can be accommodating; can be both at the same time.
- Endless material combinations
- Overall, easier to adjust
- Applicable for *all* conditions

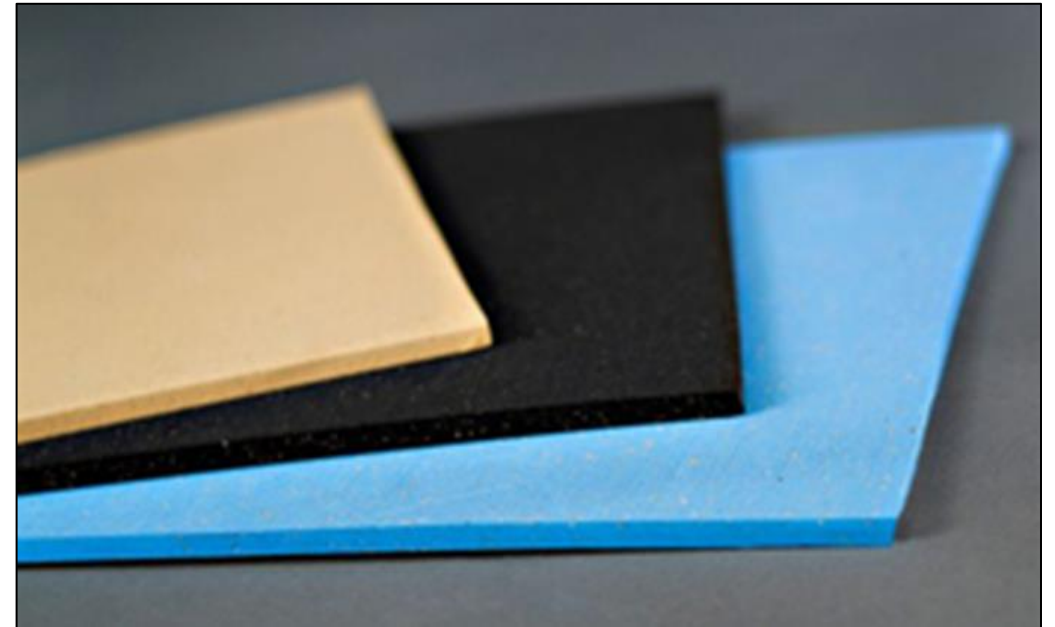
Cons

- Do not last as long as FFOs (12-16 mos.)
- Take up more room in shoe than FFOs



Materials

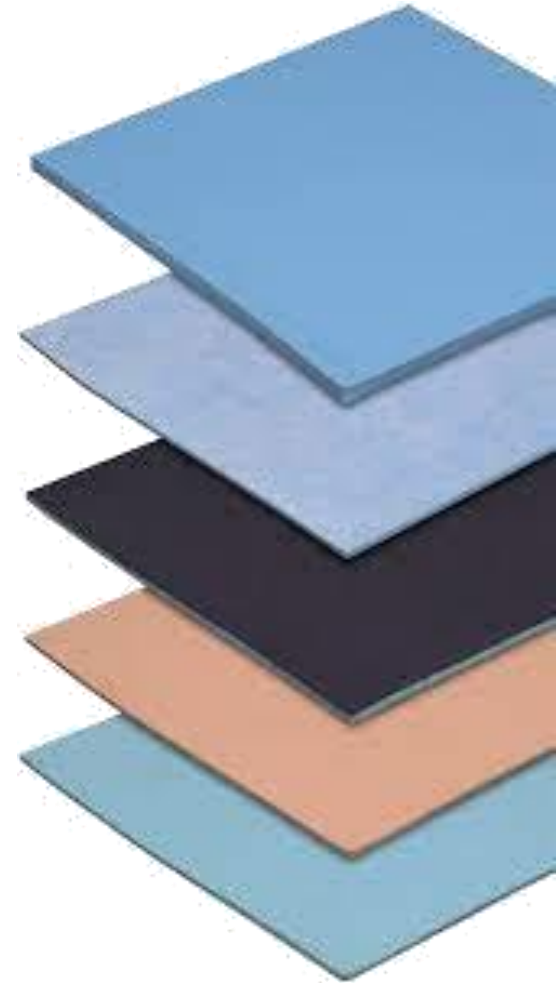
- Most, but not all, materials used for TCOs are thermomoldable.
 - Cork composites
 - Ethylene vinyl acetate foams
 - P-Cell™
 - Microcell Puff®
 - Cross-linked polyethylene foams
 - Plastazote®
 - PE-Lite™
 - Aliplast™
 - Nickelplast™
 - Polyurethane foams (not moldable)
 - PPT™
 - Poron®
- Various densities, durometers, colors and combinations are often used.



Shore a durometer

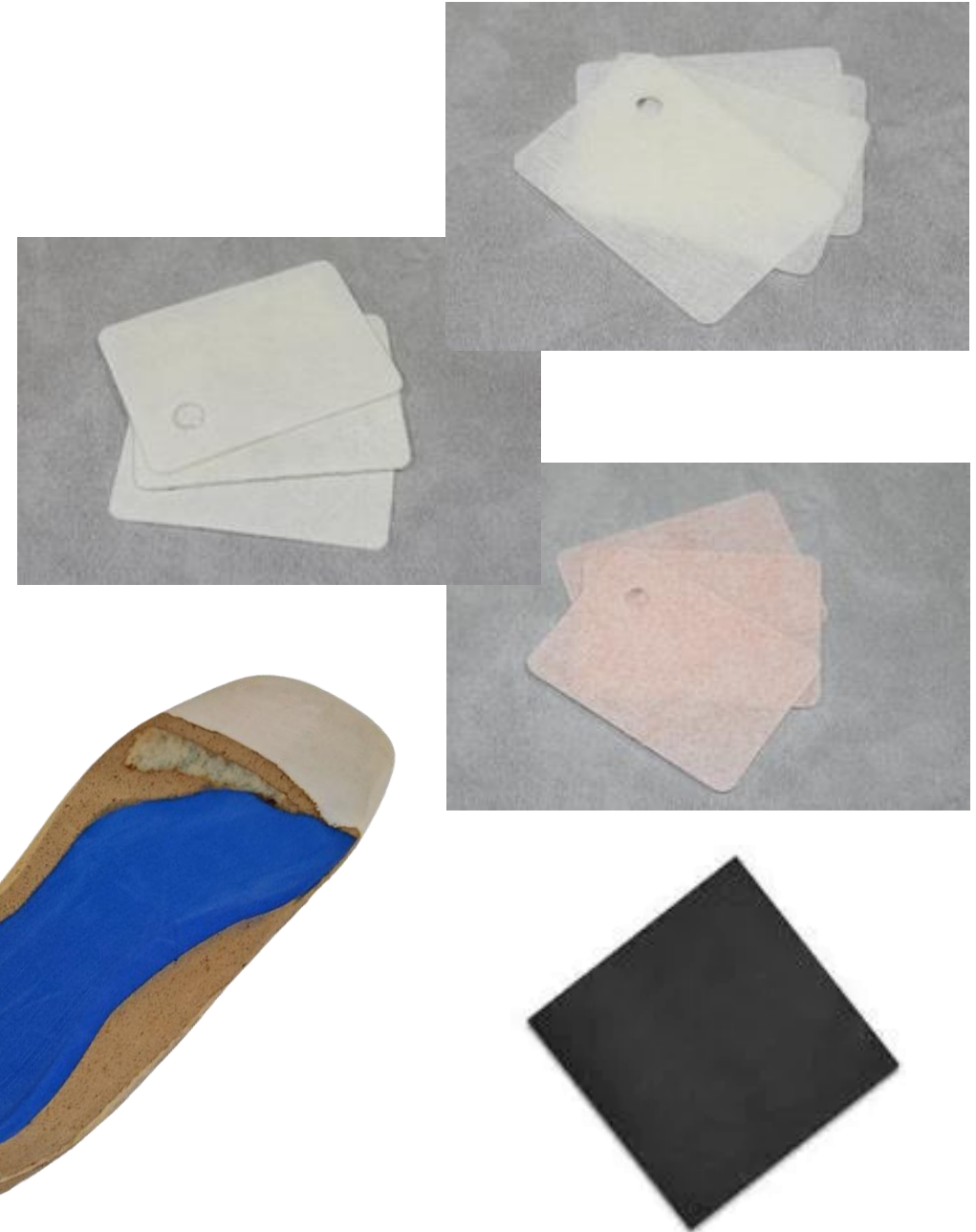


• Poron®	3	
• Plastazote® #1	15	
• AliPlast™	23	
• P-Cell™	20-25	
• Plastazote® #2	25	
• UcoLite™	35	
• Medium Pelite	37	
• EVA soling	45	
• Multicork	55-60	
• Plastazote® #3	60	
• Ripple soling		75



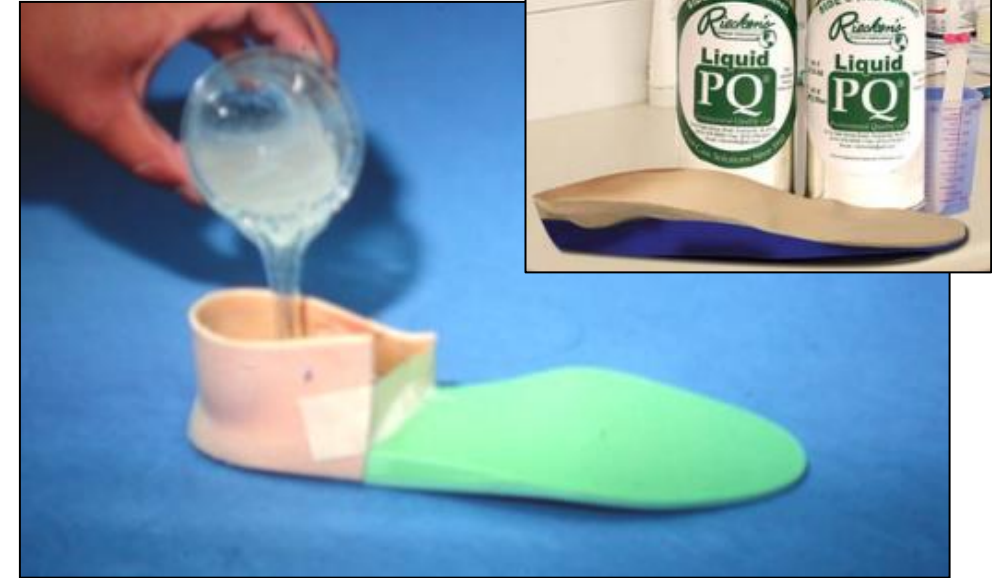
Materials

- Reinforcing semi-rigid materials
- Adding a layer of reinforcement to a TCO can be used to work toward the “best of both worlds” goal by combining the best attributes of traditional TCOs and conventional FFOs.
 - EFM™ - Firm EVA/SBR blend 75 Shore A durometer
 - THK-1 - Fibrous thermoplastic (UCO International)
 - Thermoflux – Resin-based reinforcement (UCO International)
 - Thermoknit – Woven, spun thermoplastic (UCO International)
 - Thermoplastics – polyethylene, polypropylene, etc.



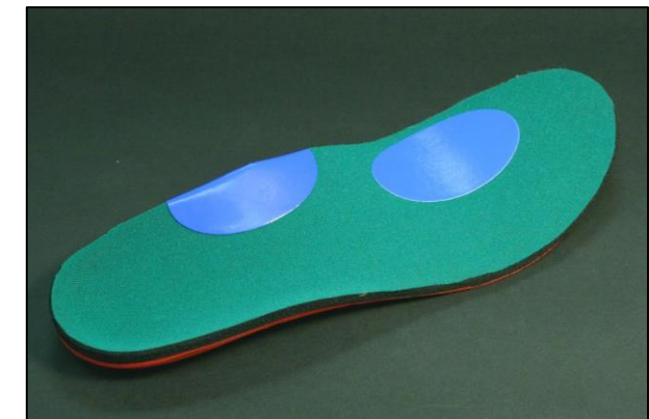
Materials

- Viscoelastic polymers
 - Cushion – Cushioning is the concept of adding a softer, less resistive material under a painful area of the foot.
 - Shock attenuation – Attenuation refers to the gradual loss of intensity or magnitude of a physical quantity as it propagates through a medium. Absorption is one factor of attenuation.
 - Viscoelastic polymers in a foot orthotic can be used to achieve both objectives.
 - P.Q.[®] - Riecken's – Variable durometer
 - Quick-Sil – Uco International – 2 Shore A durometer



Materials

- Low-friction Interface
 - ShearBan® – Tamarack Technologies
 - ShearBan® is a patented, self-adhesive, low friction interface that provides targeted protection from friction & shear forces that contribute to the formation of hot spots, blisters, calluses, and diabetic foot ulcers.
 - Reduces the friction/shear that cause skin breakdown
 - Enhances patients' comfort and improves function by reducing painful rubbing
 - Provides a greater margin of safety for individuals who are highly susceptible to skin breakdown; especially individuals with neuropathic foot conditions, amputations, or foot deformities
 - Maximizes orthopedic support and correction beyond what's possible with pressure offloading alone due to the reduction in tissue deformation where ShearBan® is used
 - Lasts many months before replacement may be necessary



Traditional Vacuum Forming

Subtractive Manufacturing

Traditional Vacuum Forming

- While many methods of manufacture are available and used prolifically throughout the industry, *traditional vacuum forming* is still the in-house manufacture method of choice for smaller, locally-owned podiatric or O,P&P facilities.
- The hardware and machinery required for *3-D printing* and *CNC routing* can be prohibitively expensive for a small practice. In many cases, these two methods don't make financial sense unless and until they are scaled to mass-production levels.
- All three methods of manufacture can, though, be used with great success to create total contact foot orthoses.



Traditional Vacuum Forming



Direct Molding

- Another way to fabricate a total contact foot orthosis is via direct molding.
- This can be achieved with a ½” piece of #1 Plastazote®, or it can be done with a prefabricated heat-moldable blank or multidensity insert (as in A5512).
- Given the material properties necessary to heat-and-mold directly, this device will be primarily accommodative in nature.



Indications and Examples

(for commonly encountered pedorthic patients)

Role in Management of the Diabetic Foot

- TCOs are much better suited to manage the diabetic foot than traditional FFOs.
 - Because they are total contact, they can more evenly distribute plantar pressure.
 - Typically, the materials from which they are made are much better suited to quick and easy in-office adjustment.
 - Because they are not made of rigid plastics, there is a decreased risk of a sharp edge of the device causing skin breakdown.
 - There is a wide variety of materials available to tailor the device the prescription, the patient and their foot.

Medicare's TSPD and TCOs

- By definition, A5513 and A5514 are custom *total contact* foot orthoses.
 - A5513 - For diabetics only, multiple density insert, custom molded from model of patient's foot, ***total contact with patient's foot***, including arch, base layer minimum of 3/16 inch material of shore a 35 durometer (or higher), includes arch filler and other shaping material, custom fabricated, each
 - A5514 - For diabetics only, multiple density insert, made by direct carving with cam technology from a rectified cad model created from a digitized scan of the patient, ***total contact with patient's foot***, including arch, base layer minimum of 3/16 inch material of shore a 35 durometer (or higher), includes arch filler and other shaping material, custom fabricated, each



Charcot Arthropathy

- Total contact foot orthosis
 - Multidensity
 - Accommodating top layer(s)
 - Firmer base to help redistribute pressure away from plantar prominence(s)
 - Intrinsic and/or extrinsic relief to further offload prominence(s)
 - Viscoelastic polymer?
 - Deep heel cup, high flanges
 - Low-friction interface under “hot spots”



Diabetes with Peripheral Neuropathy

- Remember, if foot structure is normal, the forefoot is the area of the foot most susceptible to skin breakdown or ulceration.
- Total contact foot orthoses
 - Multidensity
 - Accommodating top layer(s)
 - Firmer base to help redistribute pressure away from plantar prominence(s)
 - Intrinsic and/or extrinsic relief to further offload prominence(s)
 - Low-friction interface



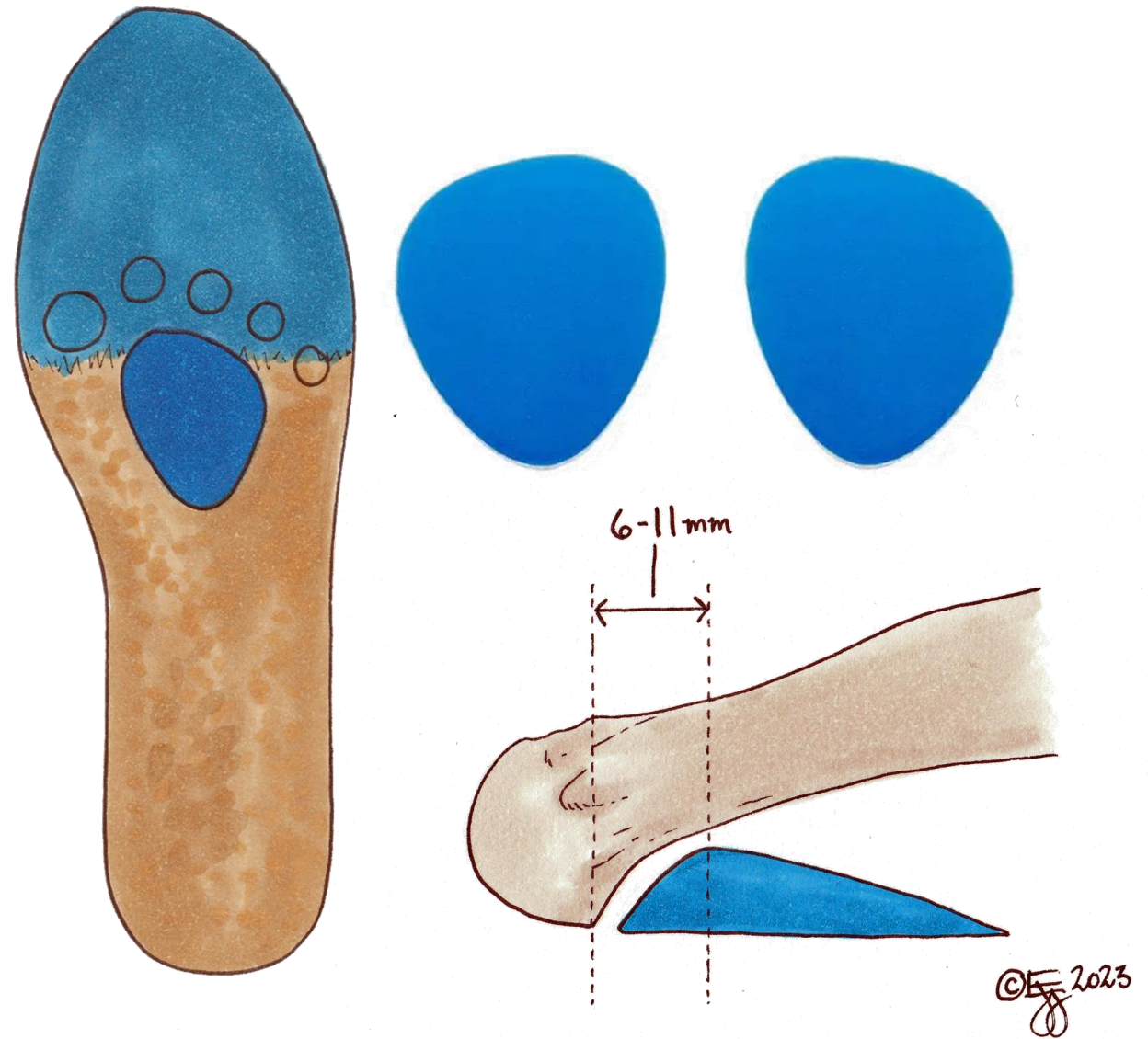
Diabetes with Peripheral Neuropathy

- Consider different add-ons or modifications to further protect the foot and offload established, or potential, problem spots.
- Intrinsic Vs. Extrinsic



Metatarsalgia

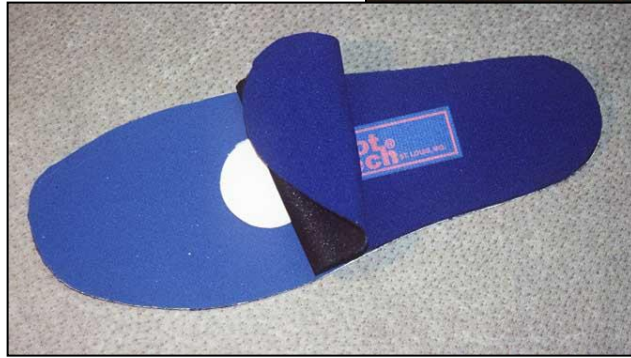
- Total contact foot orthoses
 - Reduce pressure under painful MTHs
 - Offload Vs. Cushion (or both)
 - Met pad, met bar, etc. will be used in some fashion by the pedorthist to treat most etiological causes of metatarsalgia



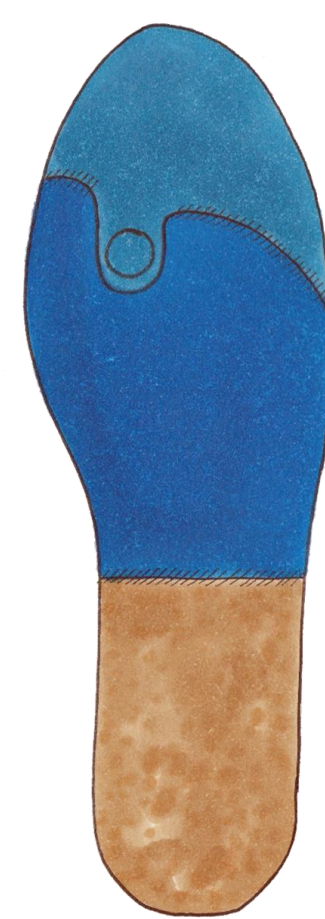
- Metatarsal pads...
 - Available in a wide variety of shapes, thickness, densities and materials
 - Self-adhesive
 - Easy to use
 - Don't stay in place for long



Metatarsalgia



Met Pad



Unload Single MTH



Met Bar

Sesamoiditis

- Total contact foot orthosis
 - FO should have posting to offload 1st MTH and transfer pressure to lesser MTHS.
 - Consider additional cushioning under 1st MTH, as well.
 - However, it is important to remember that the padding will necessarily counteract the offloading to at least some degree.
 - Trial of dancer pad?



Interdigital Neuroma

- For a true interdigital (or *Morton's*) neuroma, functional and total contact orthoses work equally as well. For that matter, prefabricated FOs with a properly placed metatarsal pad can be helpful.
- One of two key things to remember here is that the correct placement of the metatarsal pad is crucial. Too far proximal and it doesn't help. Placed too far distally, the met pad will cause more or worse pain. Sometimes, it is a matter of trial and error.
- The other key point to remember is that any time nerves are involved, there is a level of unpredictability in response to pedorthic intervention. The foot orthosis may help, it may do nothing, or – less commonly – it may exacerbate the condition. It is paramount that you proceed under that caveat and make sure you and your patient share the same (realistic) expectations.



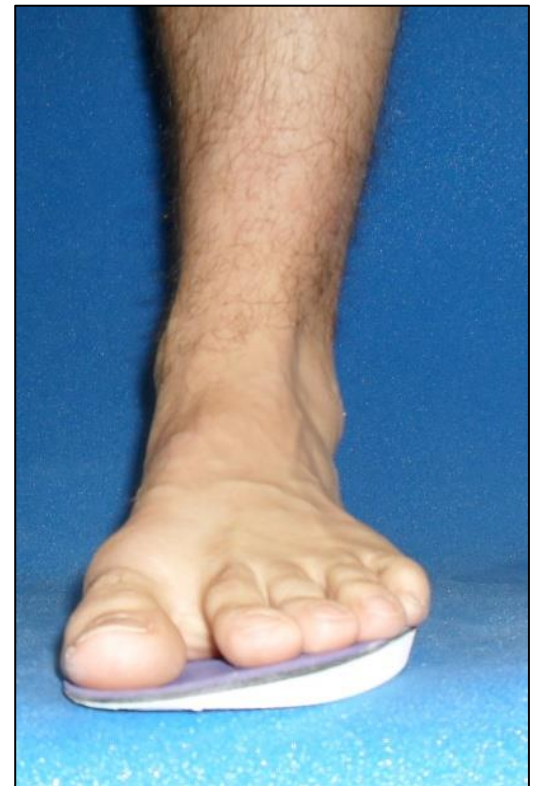
Flexible Pes Planovalgus

- There are different schools of thought of the best approach to foot orthotic management of the PPV foot.
- The most important criteria are:
 - Is the deformity passively correctable?
 - Is it a forefoot- or rearfoot-driven deformity?
- For a fixed deformity, the objective will be accommodation, support as possible, and comfort
- For a flexible deformity, the objective is to correct the foot alignment and hold it in that corrected position throughout the gait cycle.
- If possible, mold should be taken with foot in a corrected neutral position.



Flexible Flatfoot Deformity

- Consider TCO with medial hindfoot post and lateral forefoot post

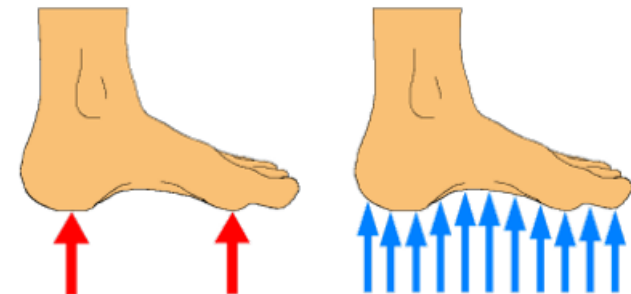


Posterior Tibial Tendinopathy

- Very similar approach to treatment of flexible PPV
- Total contact foot orthosis
 - Deep heel cup
 - Long medial flange
 - Medial heel wedge
 - +/- forefoot post
 - Lateral if there is underlying forefoot varus
 - Medial otherwise

Cavovarus Foot Deformity

- Tend to be moderately to severely rigid; not good shock absorbing feet.
- Problem areas include the ball of the foot and the base of the 5th metatarsal.
- Perfect example of the benefit of the total contact approach. In the cavus foot, the body's weight is borne mostly in the MTHs, lateral border of the foot and the heel.



Cavovarus Foot Deformity

- Total contact foot orthoses
 - Multidensity
 - Softer, accommodating topcover
 - Consider midlayer of polyurethane foam (PPT®, Poron®)
 - Firmer, but still shock attenuating base material
 - Offloading for ball of foot and/or base of 5th MT
 - Low-friction interface under areas of friction/callus
 - Lateral posting if deformity is passively correctable



Peroneal Tendinopathy

- The goal of orthotic treatment is to relieve stress and strain on the peroneal tendons to reduce inflammation.
- Total contact foot orthoses
 - Deep heel cup, high lateral flange
 - Lateral heel wedge (+/- midfoot and forefoot wedge)



Plantar Fasciitis

- Research demonstrates fairly conclusively that a great many types, styles and designs of foot orthoses are equally effective in the treatment of plantar fasciitis.
- Is this because all FOs are truly effective for plantar fasciitis? Or is this because plantar fasciitis is a self-limiting pathology?
- The theory behind use of a total contact foot orthosis for plantar fasciitis is that by filling in the medial longitudinal arch with a firm base, it reduces the downward flex of the midfoot during late stance and early toe-off phases of gait thereby reducing stress and strain on the plantar aponeurosis. That does sound logical.

Plantar Fasciitis

- Total contact foot orthoses
 - Medium density topcover
 - +/- softer midlayer (PU foam?)
 - Firmer, but shock absorbing base like cork composite
 - Some literature suggests medial heel post/wedge
 - Additional heel cushion, while merely palliative in this case, may help the patient feel more immediate pain relief.
 - Poron®, PPT®
 - Viscoelastic polymer



Tarsal Tunnel Syndrome

- The main objective in treating tarsal tunnel syndrome is to correct hindfoot and midfoot alignment and prevent overpronation to decrease pressure and strain on the medial branch of the tibial nerve as it passes through the tarsal tunnel.
- The main challenge is that filling in the medial longitudinal arch in order to achieve that objective often exacerbates the neuritis by creating additional pressure.
- The device pictured here is a total contact insert that was molded with the foot in a corrected, neutral position, is made with a relatively firm cork substrate base, and features a viscoelastic polymer-filled cutout under the route of nerve inferior to the tarsal tunnel.
- As with the FO for interdigital neuroma discussed earlier, it is key to remember that any time nerves are involved, there is a level of unpredictability in response to pedorthic intervention. The foot orthosis may help, it may do nothing, or – less commonly – it may exacerbate the condition. It is paramount that you proceed under that caveat and make sure you and your patient share the same (realistic) expectations.



Shin Splints

- Total contact foot orthoses
 - Multidensity composition
 - Shock attenuating material under heel to decrease the heel-strike forces that translate up the tibia
 - Must be used in an activity-appropriate shoe



Arthritis

- Foot orthotic treatment for an arthritic foot can take many forms. However, the primary goal is the same – restrict painful motion.
- The secondary goal, in many cases, is to provide cushion and comfort.
- Rarely, if ever, is the pedorthist looking to dramatically alter foot position or alignment in an arthritic foot.
- Total contact foot orthoses
 - Trilaminar toplayer - #1 or #2 Plastazote® (P-Cell, etc.)/PU foam/EVA
 - Firmer, but not rigid base – softer cork substrates, medium to firm EVA
 - Intrinsic depressions or extrinsic offloading for painful MTHs, etc.
 - Viscoelastic polymer as needed



The End