

Rocker Soles

In this session...

- What is a rocker sole?
- Types of rocker soles
- Rocker sole research
- Indications
- Contraindications

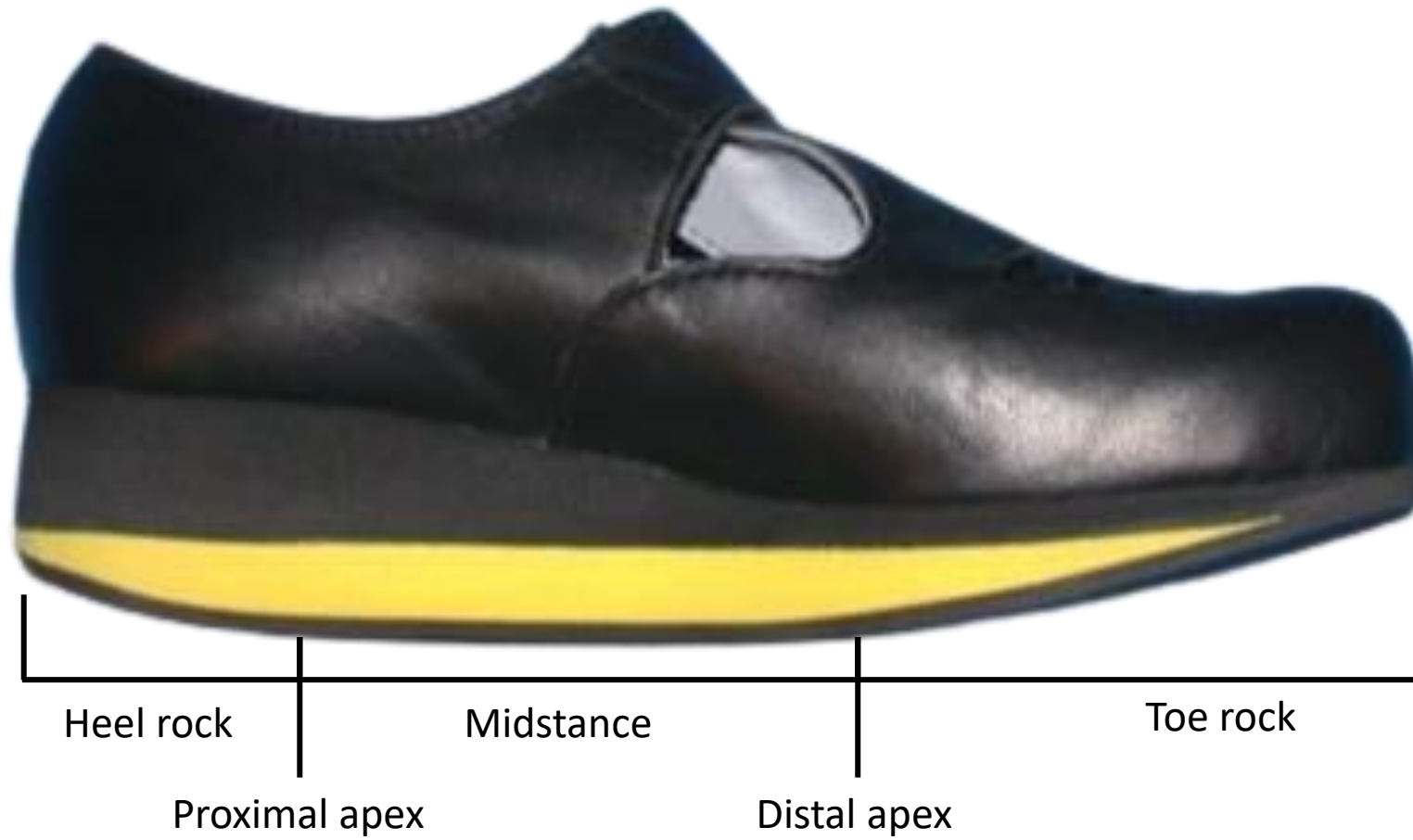
What exactly is a rocker sole?

Rocker Sole

- It is just what it sounds like. The sole of the shoe is contoured like the rockers on a rocking chair or rocking horse.



Parts of a Rocker Sole



Four things rocker soles do well...

1. Unload problematic areas of the plantar foot – especially the forefoot
2. Replace motion lost due to fusion or use of solid ankle AFO
3. Decrease bending forces through the foot – especially the forefoot
4. Assist in restoring efficient and normal gait



Three things rocker soles don't do well...

- Improve balance
- Improve proprioception
- Make shoes lighter in weight



Types of Rocker Soles

Rigid Vs. Flexible

- Adding the material to shape the rocker sole inevitably stiffens the sole of the shoe.
- This is not a bad thing. In the overwhelming majority of cases, the goal is a rigid rocker sole.
- A rocker sole that is very flexible works in opposition to the most common goals of treatment with a rocker:
 - Replace lost motion
 - Transfer forces
 - Offload forefoot
 - Rigid lever arm for toe-off

Factory Rocker Sole

- Running shoes have varying degrees of rocker built-in to the design as it serves to propel the foot forward into the next gait cycle.
- Like running shoes, several styles of commercially available walking and/or “comfort” shoes will have a rocker sole.
- Many shoes that fall under the “diabetic shoe” umbrella also have rocker soles incorporated into the design as the rockers reduce plantar pressure under the balls of the feet.



- **The use of running shoes to reduce plantar pressures in patients who have diabetes.** Perry JE1, Ulbrecht JS, Derr JA, Cavanagh PR. *J Bone Joint Surg Am.* 1995 Dec;77(12):1819-28.
- We compared the plantar pressures generated by walking in leather-soled Oxford-style shoes and by walking in inexpensive running shoes with those generated by walking in thin socks on a hard surface for 39 individuals.
- [T]he plantar pressure associated with the Oxford-style shoes were not different from those associated with walking without shoes.
- In comparison, the inexpensive running shoes relieved plantar pressure in the forefoot and heel...with the most relief occurring in the feet that had the highest pressures when they were unshod.
- Individuals who have insensate feet should be discouraged from wearing leather-soled Oxford-style shoes because of the risk of ulceration due to elevated plantar pressures.
- Inexpensive running shoes should be viewed as the very minimally acceptable choice for footwear for these individuals if the feet are free of deformity.

Mild Rocker

- Intended to augment or accentuate the factory rocker; or to add a functional rocker to a shoe sole that had none to begin with.
- Relatively safe for patients with mild instability/balance issues.
- Will provide some offloading for the MTHs and make walking easier.
- Commonly used to slightly reduce forefoot pressures or to help restore lost motion.
- The rocker sole is tapered proximal to the ball of the foot to toe and will have a slight heel rock.
- Typically, less material is added but also less rocking motion is achieved.



Toe-Only Rocker

- Best option for patient who needs a rocker sole but has instability and/or balance problems.
- Also called a *forefoot rocker*.
- Used most commonly to reduce forefoot pressures to the foot but can also help with toe-off.
- The rocker sole is tapered more aggressively proximal to the ball of the foot to toe and will have a slight heel rock.
- More material may need to be added to accomplish this goal.



toe-only rocker sole

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Heel-to-Toe Rocker

- Rocker sole in the truest sense of the word.
- Also called a *midfoot rocker* because of the aggressive nature of this rocker sole.
- Most of the weight-bearing load is borne primarily by the midfoot.
- This rocker sole has a very aggressive heel to toe rocker, tapered proximal to the ball of the foot to the toe.
- Substantial added material is needed to accomplish this aggressive rock.
- It is used primarily to restore lost motion due to different ankle pathologies but may also be very effective for reducing harmful pressures to the heel and forefoot.
- Caution: Reduced midstance contributes to instability



heel-to-toe rocker sole

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Double Rocker Sole

- Perfect option to address midfoot plantar pressure issues.
- This rocker is modified with a concave portion in the midfoot.
- Used most often in the reduce midfoot pressure on the plantar prominence of a so-called *rocker bottom foot* deformity arising from Charcot arthropathy.
- It is also useful to unload the base of the 5th metatarsal in patients with cavus foot, Charcot-Marie-Tooth disease, or a Jones fracture.
- Should be used in conjunction with a steel shank.



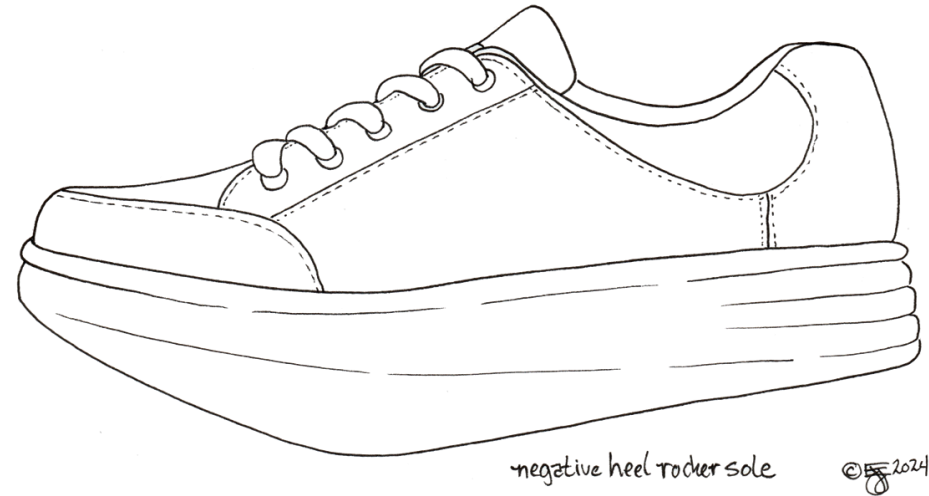
double rocker sole

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Negative Heel Rocker

- Patient must have adequate DF ROM at ankle and no balance/proprioception issues
- This rocker sole design is focused heavily on reducing forefoot pressures on the foot.
- The rocker sole is constructed similarly to the forefoot rocker except that the heel portion is dropped into a negative height position.
- This transfers the bulk of weight-bearing load to the rear foot of the shoe.
- Much like the “Earth Shoes” of the 60’s.



Severe Angle Rocker

- Developed by Dr. Paul Brand at the Hansen's Disease Center in Carville, LA.
- This rocker has a severe cut angle more so than a traditional "rock".
- It is used for more aggressive forefoot off-loading.
- Patient may require gait training to learn how to walk safely as attempting to walk normally in a rolling heel-to-toe step could cause the patient to fall.



Severe angle (Carville) rocker sole

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Rocker Sole Research

Risk factors for plantar foot ulcer recurrence in neuropathic diabetic patients.

- [Waijman R¹](#), [de Haart M¹](#), [Arts ML¹](#), [Wever D²](#), [Verlouw AJ³](#), [Nollet F¹](#), [Bus SA⁴](#). [Diabetes Care](#). 2014 Jun;37(6):1697-705. doi: 10.2337/dc13-2470. Epub 2014 Apr 4.
- **Abstract**
- **OBJECTIVE:** Recurrence of plantar foot ulcers is a common and major problem in diabetes but not well understood. Foot biomechanics and patient behavior may be important. The aim was to identify risk factors for ulcer recurrence and to establish targets for ulcer prevention.
- **RESEARCH DESIGN AND METHODS:** As part of a footwear trial, 171 neuropathic diabetic patients with a recently healed plantar foot ulcer and custom-made footwear were followed for 18 months or until ulceration. Demographic data, disease-related parameters, presence of minor lesions, barefoot and in-shoe plantar peak pressures, footwear adherence, and daily stride count were entered in a multivariate multilevel logistic regression model of plantar foot ulcer recurrence.
- **RESULTS:** A total of 71 patients had a recurrent ulcer. Significant independent predictors were presence of minor lesions (odds ratio 9.06 [95% CI 2.98-27.57]), day-to-day variation in stride count (0.93 [0.89-0.99]), and cumulative duration of past foot ulcers (1.03 [1.00-1.06]). Significant independent predictors for those 41 recurrences suggested to be the result of unrecognized repetitive trauma were presence of minor lesions (10.95 [5.01-23.96]), in-shoe peak pressure <200 kPa with footwear adherence >80% (0.43 [0.20-0.94]), barefoot peak pressure (1.11 [1.00-1.22]), and day-to-day variation in stride count (0.91 [0.86-0.96]).
- **CONCLUSIONS:** The presence of a minor lesion was clearly the strongest predictor, while recommended use of adequately offloading footwear was a strong protector against ulcer recurrence from unrecognized repetitive trauma. These outcomes define clear targets for diabetic foot screening and ulcer prevention.

Data-driven directions for effective footwear provision for the high-risk diabetic foot.

- [Arts ML¹](#), [de Haart M¹](#), [Waaijman R¹](#), [Dahmen R²](#), [Berendsen H³](#), [Nollet F¹](#), [Bus SA¹](#). [Diabet Med.](#) 2015 Jun;32(6):790-7. doi: 10.1111/dme.12741. Epub 2015 Mar 28.
- **AIMS:** Custom-made footwear is used to offload the diabetic foot to prevent plantar foot ulcers. This prospective study evaluates the offloading effects of modifying custom-made footwear and aims to provide data-driven directions for the provision of effectively offloading footwear in clinical practice.
- **METHODS:** Eighty-five people with diabetic neuropathy and a recently healed plantar foot ulcer, who participated in a clinical trial on footwear effectiveness, had their custom-made footwear evaluated with in-shoe plantar pressure measurements at three-monthly intervals. Footwear was modified when peak pressure was ≥ 200 kPa. The effect of single and combined footwear modifications on in-shoe peak pressure at these high-pressure target locations was assessed.
- **RESULTS:** All footwear modifications significantly reduced peak pressure at the target locations compared with pre-modification levels (range -6.7% to -24.0%, $P < 0.001$). The metatarsal heads were most frequently targeted. Repositioning an existing (trans-)metatarsal pad in the shoe insole (-15.9% peak pressure relief), applying local cushioning to the insole (-15.0%) and replacing the insole top cover with Plastazote (-14.2%) were the most effective single modifications. Combining a new Plastazote top cover with a trans-metatarsal bar (-24.0% peak pressure relief) or with local cushioning (-22.0%) were the most effective combined modifications.
- **CONCLUSIONS:** In people with diabetic neuropathy and a recently healed plantar foot ulcer, significant offloading can be achieved at high-risk foot regions by modifying custom-made footwear. These results provide data-driven directions for the design and evaluation of custom-made footwear for high-risk people with diabetes, and essentially mean that each shoe prescribed should incorporate those design features that effectively offload the foot.

Orthopaedic footwear against foot ulcers in diabetes.

- [Bus SA¹. Ned Tijdschr Geneeskd. 2014;158:A7497.](#)
- In people with diabetes mellitus, foot ulcers are a major problem because they increase the risk of a foot infection and amputation and reduce quality of life. After a foot ulcer has healed, the risk of recurrence is high. Orthopaedic shoes and orthotics are often prescribed to high risk patients and aim to reduce the mechanical pressure on the plantar surface of the foot.
- Orthopaedic footwear that is modified to reduce pressure is not much more effective in preventing foot ulcer recurrence than orthopaedic footwear that did not undergo such modification, unless the shoes are worn as recommended. In that case, the risk of ulcer recurrence is reduced by 46%.
- In patients with a history of ulceration, compliance in wearing orthopaedic shoes at home is low, while these patients walk more inside the house than outside the house

Which shoe is best?

- The influence of shoe design on plantar pressures in neuropathic feet.
- Praet SF, Louwerens JW in Diabetes Care. 2003 Feb;26(2):441-5.
- CONCLUSIONS: The most effective way to offload the forefoot of patients with neuropathic feet is through the use of the rocker sole principle. In general, the effect of an insole depends on the design characteristics of a shoe.



Do Rocker Soles Work?

- **Effect of rocker soles on plantar pressures.**

- Brown D, Wertsch JJ, Harris GF, Klein J, Janisse D. Arch Phys Med Rehabil. 2004 Jan;85(1):81-6.
- **OBJECTIVE:** To examine the effect of different types of rocker soles on plantar pressures.
- **DESIGN:** In-shoe plantar pressures were measured in subjects without deformity with baseline shoes and 3 types of rockers: toe-only, negative heel, and double.
- **PARTICIPANTS:** Forty healthy patients (20 men, 20 women) without foot deformity.
- **INTERVENTIONS:** Plantar pressures were recorded over a 2 1/2-hour test period with over 400 steps analyzed for each type of rocker sole. Peak pressures, pressure-time integral (PTI), and sensor contact duration were computed for each step.
- **MAIN OUTCOME MEASURES:** Peak plantar pressure PTI, and contact duration were compared for each rocker with a baseline shoe.
- **RESULTS:** Significant reduction ($P < .01$) in peak pressure and PTI were recorded across the forefoot for all 3 rockers. The reduction of pressure at the forefoot was balanced by shifting pressure to the midfoot with the negative heel and toe-only rockers.
- **CONCLUSION:** This study lends scientific credence to the prescription of rocker soles for patients who need forefoot pressure reduction, such as in diabetic neuropathy and possible ulceration.

Toe Only Results

- 1st metatarsal head, 10% reduction
- Hallux, 89% reduction
- 2nd metatarsal head, 42% reduction
- 3rd -4th metatarsal heads, 43% reduction
- 5th metatarsal head, 18% reduction
- Base of 5th metatarsal, 48% increase
- Heel, 36% reduction

Results

- Toe Only
 - Effectively reduce pressure in the forefoot, especially the medial column
 - Best forefoot relief
 - Increase midstance time in hindfoot and midfoot
 - Increase loading of midfoot
 - Decreased heel strike and heel pressure
 - Best all around except midfoot

Negative Heel Results

- 1st metatarsal head, 7% reduction
- Hallux, 44% reduction
- 2nd metatarsal head, 36% reduction
- 3rd -4th metatarsal heads, 36% reduction
- 5th metatarsal head, 5% reduction
- Base of 5th metatarsal, 23% increase
- Heel 34%, reduction

Results

- Negative Heel
 - Decreased forefoot pressure, increased midfoot pressure
 - Less overall height to the shoe, subjects reported feeling more stable
 - Despite built-in dorsiflexion, decrease in heel pressure, 34%
 - Not recommended for those who cannot handle the dorsiflexion

Double Results

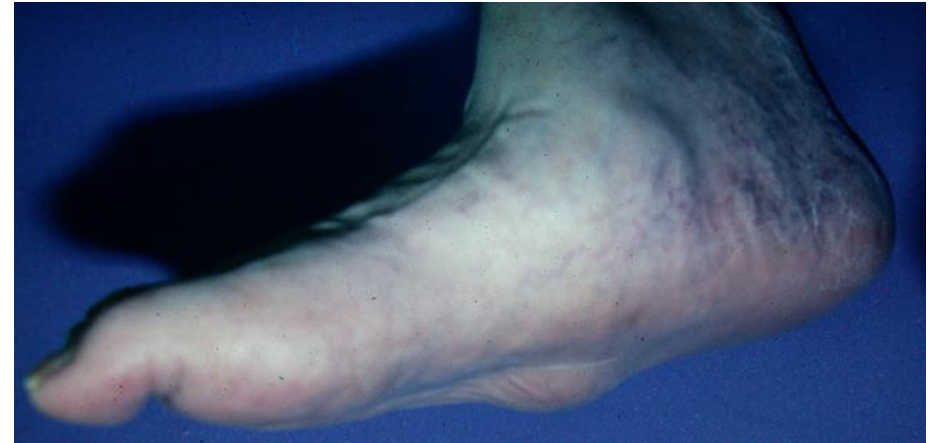
- 1st metatarsal head, 7% reduction
- Hallux, 87% reduction
- 2nd metatarsal head, 30% reduction
- 3rd -4th metatarsal heads, 24% reduction
- 5th metatarsal head, 7% reduction
- Base of 5th metatarsal, 4% reduction
- Heel, 25% reduction

Results

- Double Rocker
 - Decreased forefoot pressure
 - Decreased heel pressure
 - Some decrease at base of 5th MT
 - Other rocker designs, as well as unmodified shoe, all increased pressure under base of 5th MT

Summary

- Therapeutic Footwear/Rocker Soles
 - All three rockers studied reduced forefoot and heel plantar pressure
 - Double rocker sole did not load midfoot
 - Negative and toe only significantly loaded midfoot
 - Double-4%
 - Negative -4/+23=27%
 - Toe only-4/+48=52%
 - Double rock may have been more effective w/o 1" steel shank



Are Rocker Soles Safe?

- **Rocker outsole shoe is not a threat to postural stability in patients with diabetic neuropathy.**
 - Ghomian B, Kamyab M, Jafari H, Khamseh M, Healy A. Prosthet Orthot Int. 2016 Apr;40(2):224-30.
- **BACKGROUND:** Rocker outsole shoes are commonly prescribed to patients with diabetic neuropathy to offload a particular area of the foot sole, thereby decreasing the risk of foot ulceration. Contrary to this, some evidence has reported a postural destabilizing effect of these shoes in healthy adults.
- **OBJECTIVE:** To explore the postural stability of patients with diabetic neuropathy who wear a rocker outsole shoe.
- **METHOD:** In total, 17 patients with diabetic neuropathy (aged 49.29 ± 7.48 years; 7 female, 10 males) participated in this study. A Motor Control Test measuring center of force displacement, response strength scale and response latency in medium and large perturbations was conducted using the EquiTest system to evaluate postural stability while wearing a baseline shoe (without a rocker outsole) or a rocker outsole shoe (with a toe-only rocker sole).
- **RESULTS:** No significant difference was observed between the shoe conditions in center of force displacement and response latency of the participants ($p > 0.05$). The results indicated a significant increase in the response strength scale of participants by the rocker outsole, for medium forward and backward and large forward perturbations ($p = 0.014$, $p = 0.001$ and $p = 0.027$, respectively).
- **CONCLUSION:** When the immediate effect is a concern, the rocker outsole shoe did not negatively affect postural stability in patients with diabetic neuropathy.

Indications and Suggested Use

Indications and Suggested Use

Forefoot diabetic ulcerations

- Objective: Offload forefoot
- Most commonly used
 - Mild rocker
 - Toe-only rocker
 - Heel-to-Toe rocker
- In specific extreme circumstances
 - Negative heel rocker
 - Severe angle rocker
- Used in conjunction with an extended steel shank (not required, but more effective with shank)

Charcot “rocker bottom” foot

- Objectives: Offload prominence(s)
Reduce bending stresses through midfoot
- Patient may be using AFO attached to shoe
- Most commonly used:
 - Heel-to-Toe (If primary objective is to reduce bending forces)
 - Double rocker (If primary objective is offloading midfoot)
- In both cases, would be used with an extended steel shank

Indications and Suggested Use

Midfoot Arthritis

- Objective: Reduce bending forces through midfoot
- Primary shoe modification is the addition of an extended steel shank
- Rocker is then required to replace motion lost due to addition of shank so patient can walk safely and normally
- Most commonly used:
 - Heel-to-Toe Rocker

Hallux limitus/rigidus

- Objective: Reduce bending forces through forefoot
- Primary shoe modification is the addition of an extended steel shank
- Rocker is then required to replace motion lost due to addition of shank so patient can walk safely and normally
- Most commonly used:
 - Mild rocker
 - Toe-only rocker
 - Heel-to-Toe rocker

Indications and Suggested Use

Loss of ankle ROM due to fusion or solid ankle AFO

- Objective: Replace lost motion to restore safe, energy-efficient, as-close-to-normal-as-possible gait.
- Steel shank not required, but it will perform better with one.
- Most commonly used:
 - Heel-to-Toe
- Toe-only rocker can be used if patient cannot tolerate or is not a good candidate for a heel-to-toe, but it will not be as effective



Indications and Suggested Use

Severe/chronic metatarsalgia

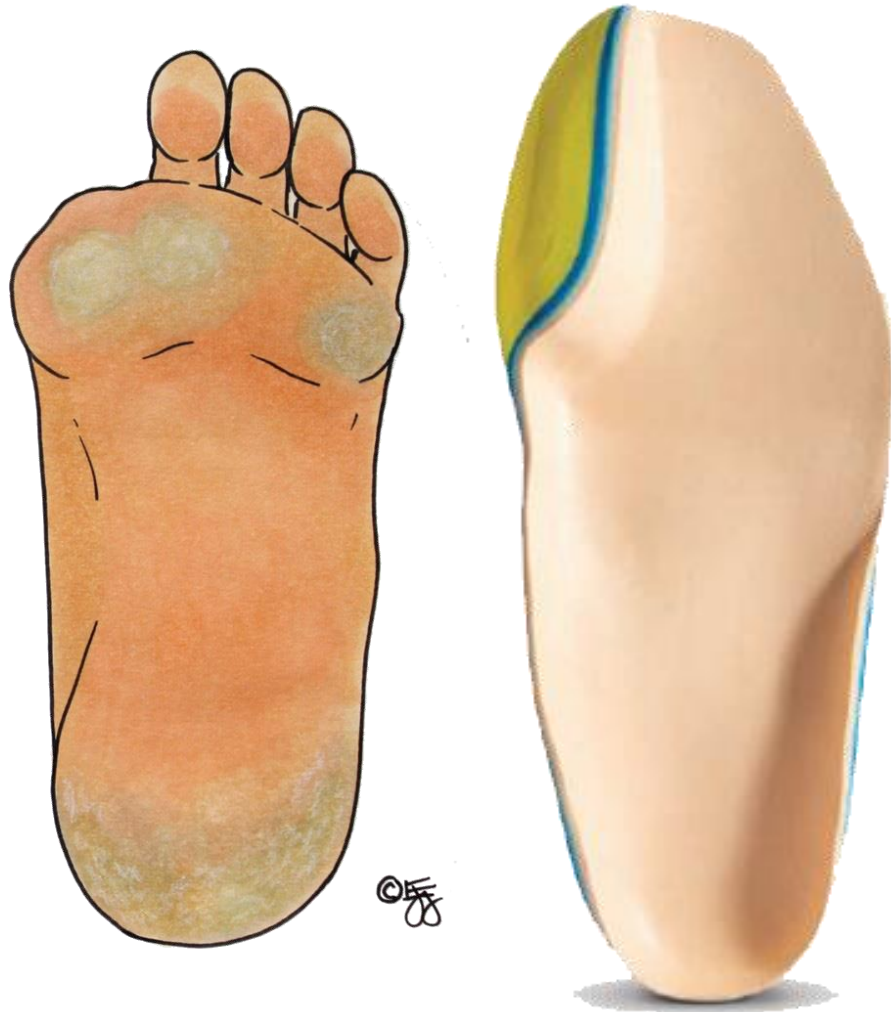
Pre-ulcerative calluses

- Objective: Offload forefoot
- Most commonly used
 - Mild rocker
 - Toe-only rocker
 - Heel-to-Toe rocker
- Used in conjunction with an extended steel shank (not required, but more effective with shank)

Neuromuscular cavovarus foot with painful base of fifth metatarsal

- Objective: Reduce stress on base of 5th MT
- Double rocker with ext steel shank is really the only option for a rocker sole.
- Consider additional/alternative modifications
 - Internal excavation under site of greatest pain
 - Lateral flare

Indications and Suggested Use



Partial foot s/p amputation

- Objective: Normalize gait by replacing the toe-off function lost due to amputation of great toe/forefoot.
- Most commonly used
 - Heel-to-Toe rocker
 - Mild rocker
- Necessarily used in conjunction with an extended steel shank

Contraindications

Contraindications

- In general
 - Balance and/or proprioception concerns
 - History of falls
 - Ataxic conditions (poor muscle control that causes clumsy movements)
- Negative heel
 - Patient does not have necessary dorsiflexion at ankle to be able to use rocker comfortably and safely
- Severe angle
 - While not a contraindication, keep in mind that the severe angle rocker often necessitates gait training with a physical therapist

The End