

Pressure Redistribution and Offloading

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Learning Outcomes

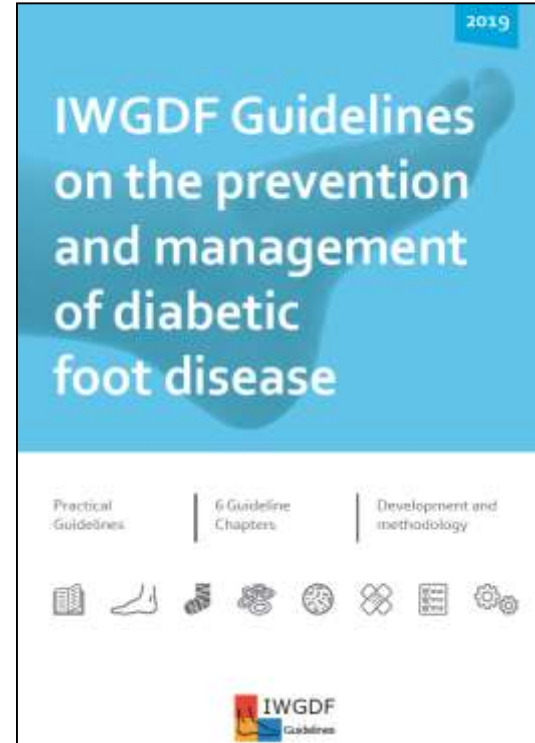
- Understand what pressure redistribution and offloading is
- Understand why these are important for the foot in diabetes
- What is the role of an orthotist and podiatrist in this area
- Understand what products and devices can be available to your patients and how to access these
- Understand the significance of the correct redistribution / offloading of pressure
- When to refer on and how you would find out to whom to refer to

IWGDF Guidelines

- 6 guideline chapters
- Focussing on
 - Prevention



- Offloading Foot Ulcers in Persons with Diabetes



Cornerstones of Foot Ulcer Prevention

There are five key elements that underpin efforts to prevent foot ulcers:

1. Identifying the at-risk foot
2. Regularly inspecting and examining the at-risk foot
3. Educating the patient, family and healthcare professionals
4. Ensuring routine wearing of appropriate footwear
5. Treating risk factors for ulceration

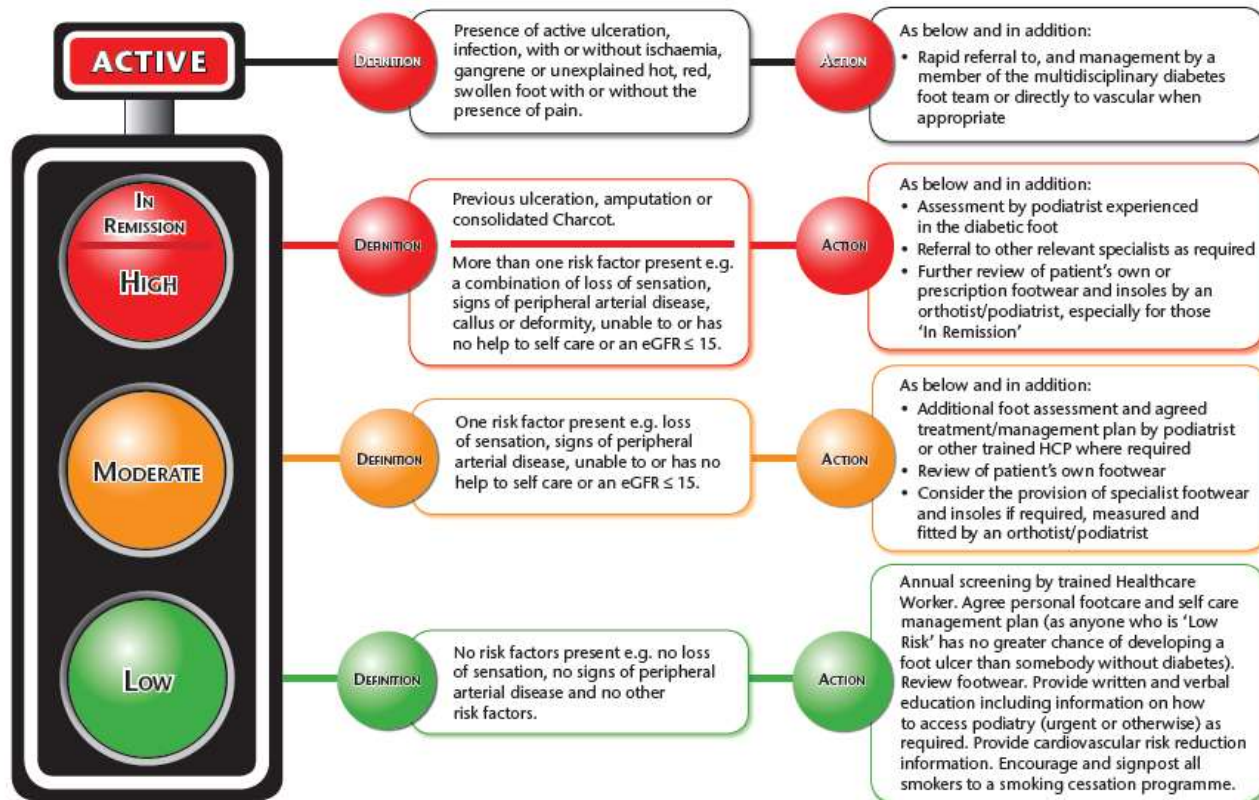
IWGDF, 2019

Table 1. The IWGDF 2019 Risk Stratification System and corresponding foot screening frequency

Category	Ulcer risk	Characteristics	Frequency*
0	Very low	No LOPS and No PAD	Once a year
1	Low	LOPS or PAD	Once every 6-12 months
2	Moderate	LOPS + PAD, or LOPS + foot deformity or PAD + foot deformity	Once every 3-6 months
3	High	LOPS or PAD, <i>and</i> one or more of the following: - history of a foot ulcer - a lower-extremity amputation (minor or major) - end-stage renal disease	Once every 1-3 months

* Screening frequency is based on expert opinion, since there is no published evidence to support these intervals.

DIABETIC FOOT RISK STRATIFICATION AND TRIAGE



Produced by the Scottish Diabetes Group - Foot Action Group
November 2016

These risk categories relate to the use of the SCI-Diabetes foot risk stratification tool

CCP/BBT/116, 005/14

IWGDF Recommendations

Regarding Footwear in Prevention

- Instruct a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3) to protect their feet by not walking barefoot, in socks without shoes, or in thin-soled slippers, whether indoors or outdoors
- Instruct a person with diabetes who is at moderate risk for foot ulceration (IWGDF risk 2) or who has healed from a non-plantar foot ulcer (IWGDF risk 3) to wear therapeutic footwear that accommodates the shape of the feet and that fits properly, to reduce plantar pressure and help prevent a foot ulcer. When a foot deformity or a pre-ulcerative sign is present, consider prescribing custom-made footwear, custom-made insoles, or toe orthoses
- Consider prescribing orthotic interventions, such as toe silicone or (semi-)rigid orthotic devices, to help reduce abundant callus in a person with diabetes who is at risk for foot ulceration (IWGDF risk 1-3)
- In a person with diabetes who has a healed plantar foot ulcer (IWGDF risk 3), prescribe therapeutic footwear that has a demonstrated plantar pressure relieving effect during walking, to help prevent a recurrent plantar foot ulcer; furthermore, encourage the patient to consistently wear this footwear

IWGDF Recommendations

Regarding Footwear in Prevention

(Cont'd)

- Consider advising a person with diabetes who is at low or moderate risk for foot ulceration (IWGDF risk 1 or 2) to perform foot and mobility-related exercises with the aim of reducing risk factors of ulceration, i.e., decreasing peak pressure and increasing foot and ankle range of motion, and with the aim of improving neuropathy symptoms
- Consider communicating to a person with diabetes who is at low or moderate risk for foot ulceration (IWGDF risk 1 or 2) that a moderate increase in the level of walking-related weightbearing daily activity (i.e. an extra 1.000 steps/day) is likely to be safe. Advise this person to wear appropriate footwear when undertaking weight-bearing activities, and to frequently monitor the skin for pre-ulcerative signs or breakdown

Functions of Footwear

- Provide shock absorption
- Protect at risk skin
- Accommodate an insole to provide pressure distribution over the plantar surface
- Accommodate foot deformities without undue pressure (thereby reducing high pressure areas)
- Increase stability in weightbearing/gait
- Limit pathological joint movement
- Reduce Pain
- Be cosmetically appealing
- Provide mechanical control

Types of Footwear

- 5 types of footwear:
 - Shop-bought
 - Temporary / Therapeutic
 - Stock
 - Modular
 - Bespoke

Types of Footwear

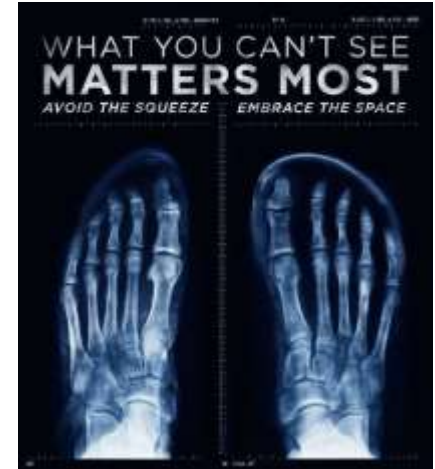
- 5 types of footwear:
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Footwear Features

Features of Good Footwear

- Deep toe box
- Stable construction at heel quarter
- A modest heel pitch
- Seamless construction/lining
- Fastening section
- Avoid slip-on shoes and slippers
- Correct size, shape and width
- Padded collars



- Image source: Reed Medical, <https://www.altrarunning.com/run-better>

Temporary/Therapeutic Footwear

- Accommodative of localised oedema
- Accommodative of heavy dressings
- Provide protection of the foot from the environment
- Provide stable base of support
- Facilitate gait

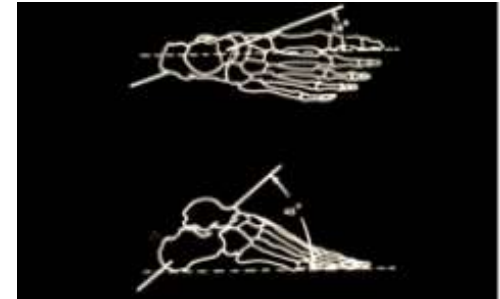
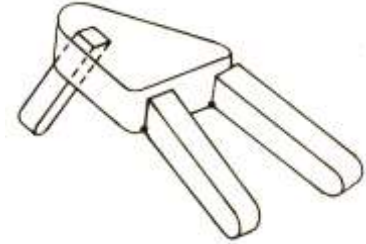


Footwear Prescription

- Presence and degree of neuropathy and ischaemia
- Biomechanical and musculoskeletal analysis (stability about joints and ROM available)
- Nature and severity of any deformity
- Position of osteoarthropathy, fracture, subluxation or ulceration
- Ambulatory status of patient
- Patient desires and expectations

Biomechanical Considerations

- Range of motion available
- Deformity
- Flexibility
- Rigidity
- Proprioception



Images: Courtesy of Willie Munro, Sauseng & Kastenbauer

- Unopposed intrinsic muscle pull
- Limited joint mobility
- Migration of plantar fat pads due to excessive bony pressures
- Callus formation
- Footwear challenges

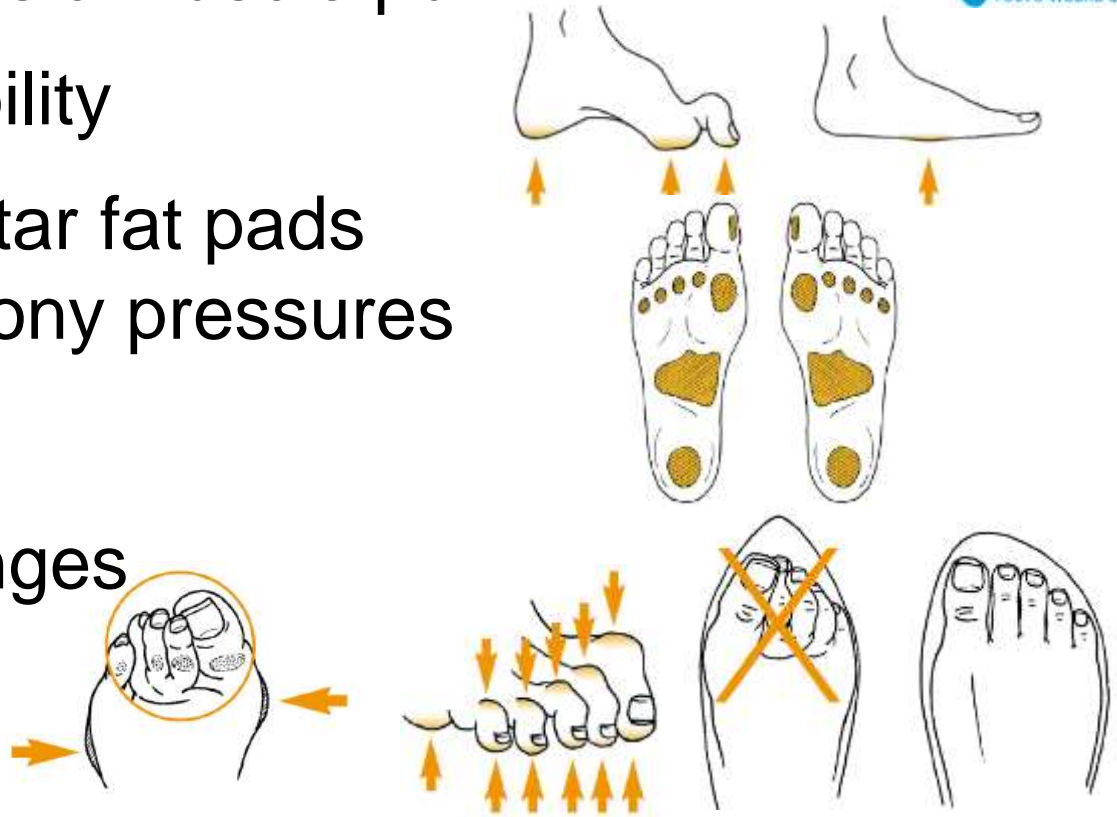


Image source: IWGDF Practical Guidelines, 2019

Footwear Selection

- **Stock**
 - Increased width and depth
 - Accommodates minimal deformity
- **Modular**
 - Accommodates mild anatomical abnormalities
- **Bespoke**
 - Accommodates significant structural / biomechanical deformities
 - Provide the exact fit needed to adequately protect and stabilise the foot.

- All designs must ensure adequate control of the hindfoot, midfoot, accommodate the forefoot and total contact insoles. This goes toward the re-distribution plantar pressures and off-load bony prominences which will remain at risk of ulceration.
- Shoes, boots and trainers are available in a wide range of colours, materials and designs. Often high street designs can be duplicated if appropriate

Stock Footwear

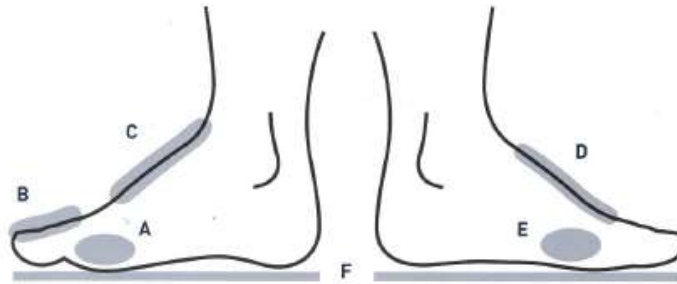
- Increased width and depth
- Accommodates minimal deformity



• Image source: Ken Hall Footwear

Modular Footwear

- Accommodates mild anatomical deformities



Medial

- A Medial ball pocket
- B Additional toe box depth
- C Additional lacing section depth

Lateral

- D Additional forefoot depth
- E Lateral fifth joint pocket
- F Additional through depth

NB: Wide and deep specification gives a further increased 6mm forefoot and firm instep depth on wide model lasts only

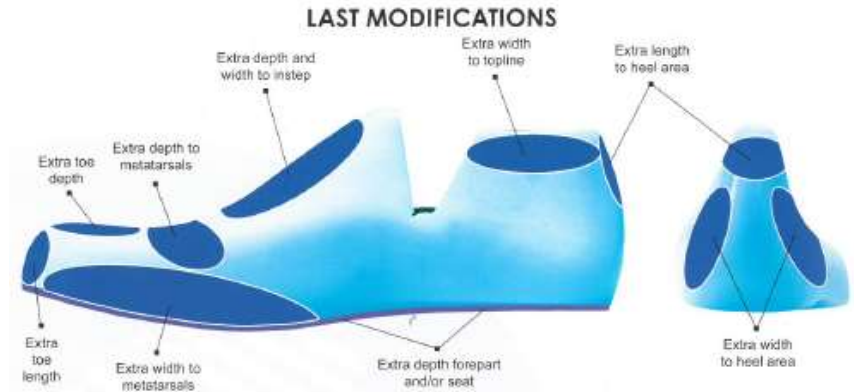


Image Sources: Reed Medical, Ken Hall Footwear

Bespoke Footwear

- Accommodates significant structural / biomechanical deformities
- Provides the exact fit needed to adequately protect and stabilise the foot



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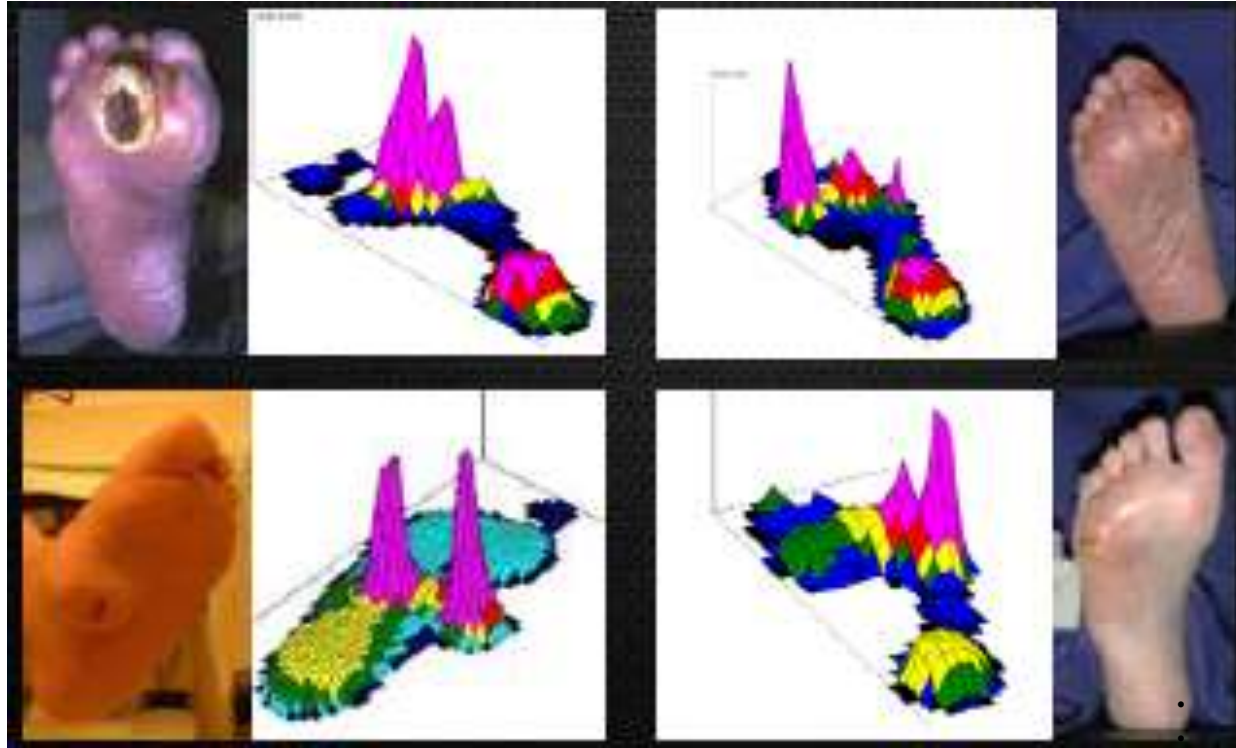


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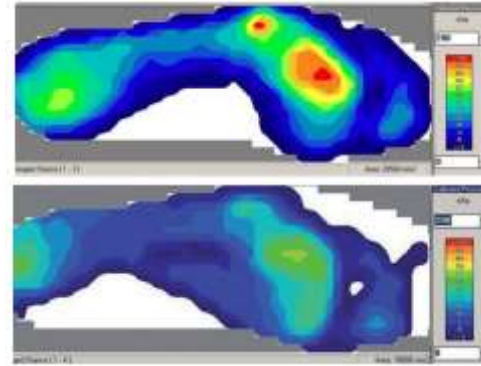


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Elevated Plantar Pressure



- Bus et al, 2011;
- Diabetes Care 34: 1595-1600



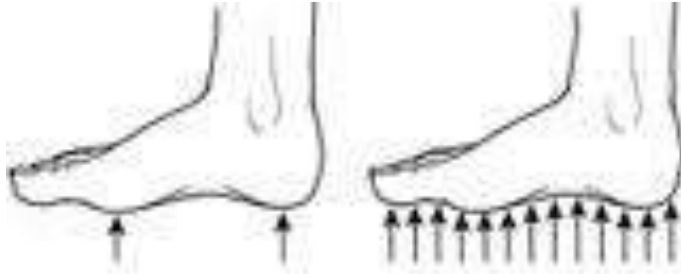
- Image source: <http://www.liqua-care.co.uk/index.asp>, Stang D, Munro W, The Diabetic Foot Journal Vol 18 No 1 2015. 20-24

Total Contact Insoles

- Total contact insoles are fabricated from a combination of materials, with different properties, to effectively re-distribute high plantar pressures and offload areas at risk of ulceration or re-ulceration.
- Improved alignment of the foot and ankle complex can be achieved by incorporating hind and forefoot postings to the total contact insole, this involves careful biomechanical assessment to correct any mobile deformity and accommodate fixed deformities between the hindfoot and forefoot.

Moulded total contact insole (TCI)

- Intimate contoured fit
- Variable material choices



Pressure reduces when spread over larger areas



• Image Source: BAPO, www.podotherapie.nl/pages/sitepage.asp?articleid=48169:48173&token=



Biomechanical: Moving a joint



Biomechanical: Stabilising a joint



Toe Spacer

External Modifications

- Used to control the foot and during stance phase
- Alter the ground reaction forces and the effects on the joints of the lower limb
- Have an affect on the pelvis and spine



Mild Rocker

Heel-Too Rocker



Toe Only Rocker

Severe Angle Rocker



Negative Heel Rocker

Double Rocker

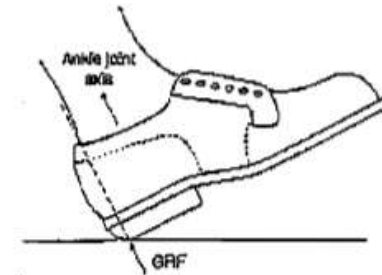


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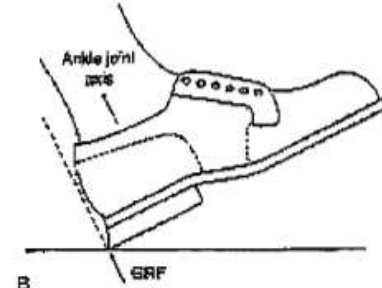


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Rocker Soles

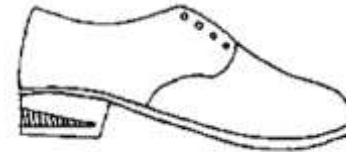


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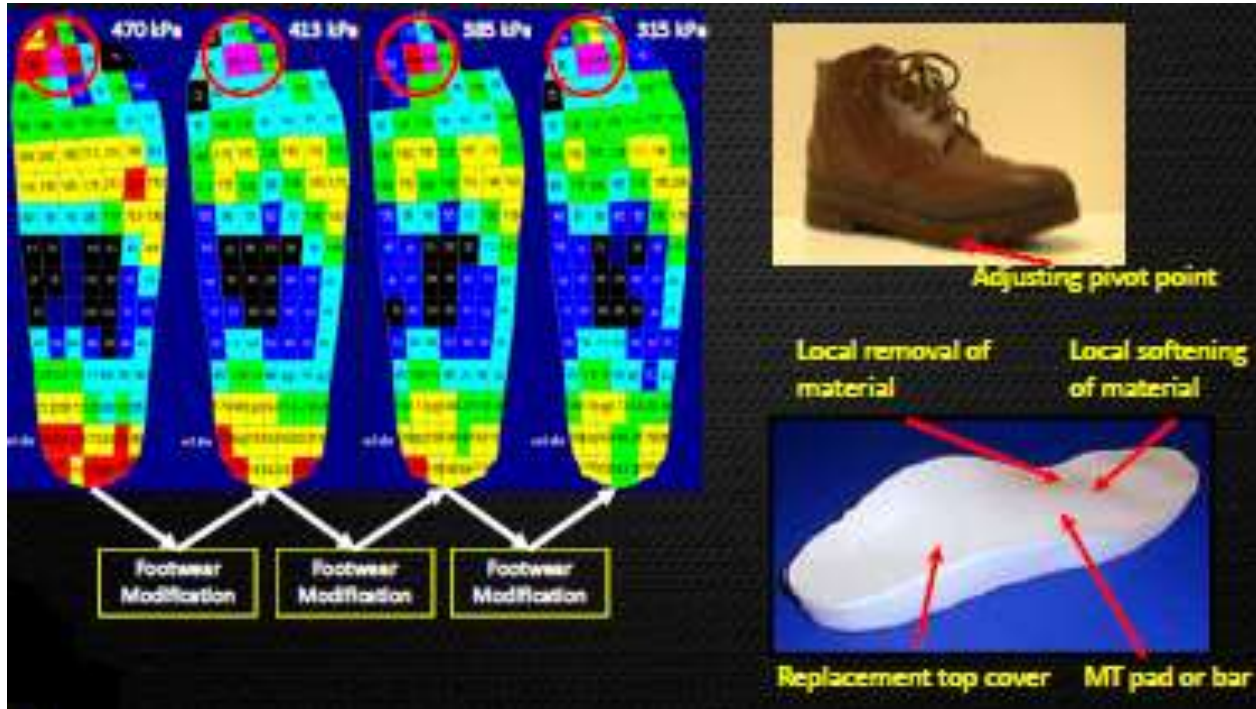
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Negative and Positive Heel Flares



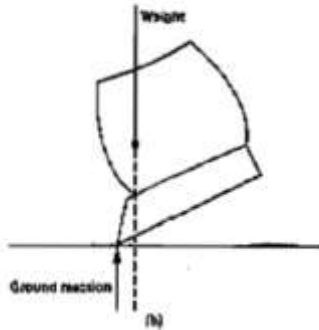
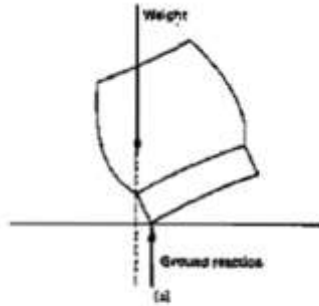
- Images courtesy of Salford University

Footwear Modifications

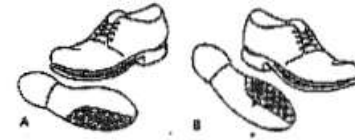
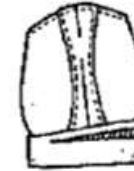
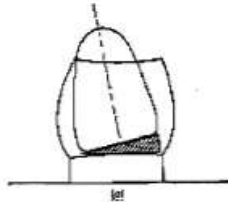
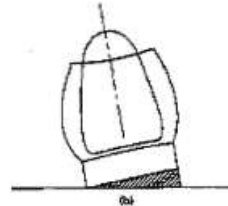
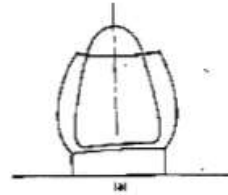


- Bus et al, 2011; Diabetes Care 34: 1595-1600

Flares/Floats and Posts/Wedging



Flares/Floats



Posting/Wedging

- Images courtesy of Salford University

What is 'Offloading'?

- The relief of mechanical stress (pressure) from a specific region of the foot

(IWGDF, 2019)

- Reduction, redistribution or removal of detrimental forces applied to the foot

(Baker N, Osman S. DFJ Vol 19, No 4. 2016)

- Deleterious force management

(Baker N, Cundell J. DFJ Vol 20 No 1. 2017)

- Load redistribution/sharing/transfer and axial offloading

(Munro W. DFJ Vol 21 No 3. 2018)

IWGDF Offloading Recommendations

1. a) In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, use a non-removable knee-high offloading device with an appropriate foot-device interface as the first-choice of offloading treatment to promote healing of the ulcer
b) When using a non-removable knee-high offloading device to heal a neuropathic plantar forefoot or midfoot ulcer in a person with diabetes, use either a total contact cast or non-removable knee-high walker, with the choice dependent on the resources available, technician skills, patient preferences and extent of foot deformity present
2. In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer for whom a non-removable knee-high offloading device is contraindicated or not tolerated, consider using a removable knee-high offloading device with an appropriate foot-device interface as the second choice of offloading treatment to promote healing of the ulcer. Additionally, encourage the patient to consistently wear the device
3. In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer for whom a knee-high offloading device is contraindicated or not tolerated, use a removable ankle-high offloading device as the third-choice of offloading treatment to promote healing of the ulcer. Additionally, encourage the patient to consistently wear the device

4. a) In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, do not use, and instruct the patient not to use, conventional or standard therapeutic footwear as offloading treatment to promote healing of the ulcer, unless none of the above-mentioned offloading devices is available

b) In that case, consider using felted foam in combination with appropriately fitting conventional or standard therapeutic footwear as the fourth choice of offloading treatment to promote healing of the ulcer

5. In a person with diabetes and a neuropathic plantar metatarsal head ulcer, consider using Achilles tendon lengthening, metatarsal head resection(s), or joint arthroplasty to promote healing of the ulcer, if non-surgical offloading treatment fails

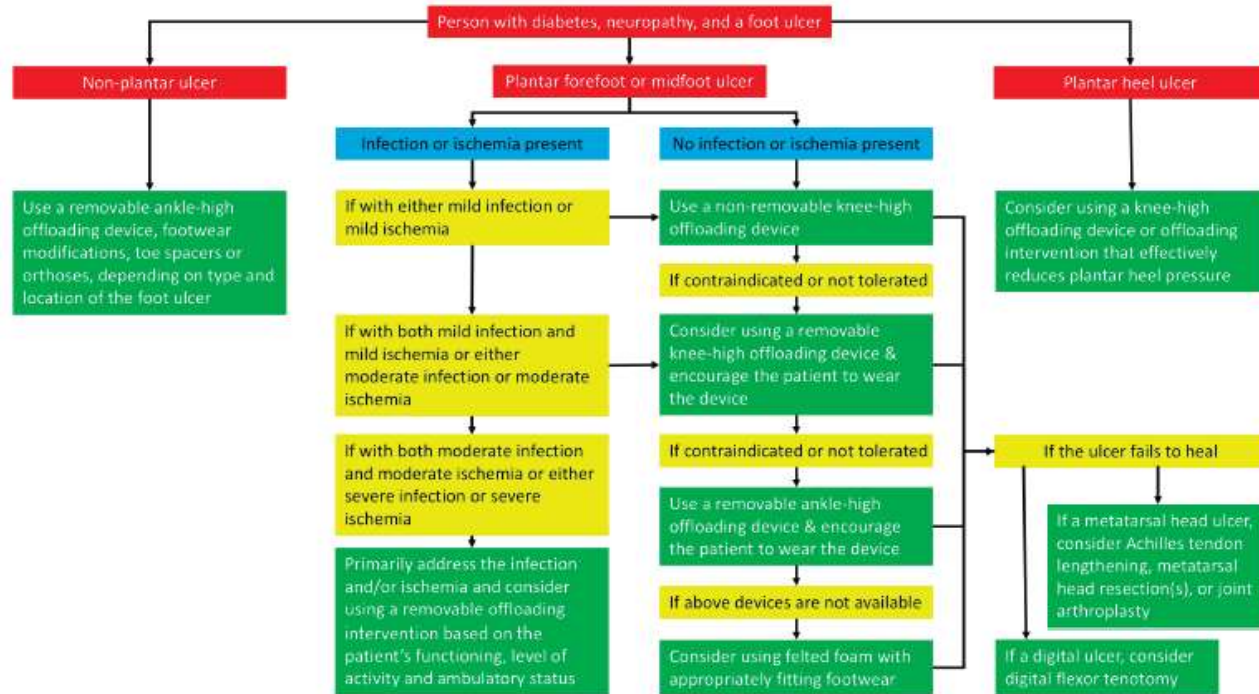
6. In a person with diabetes and a neuropathic plantar digital ulcer, consider using digital flexor tenotomy to promote healing of the ulcer, if non-surgical offloading treatment fails

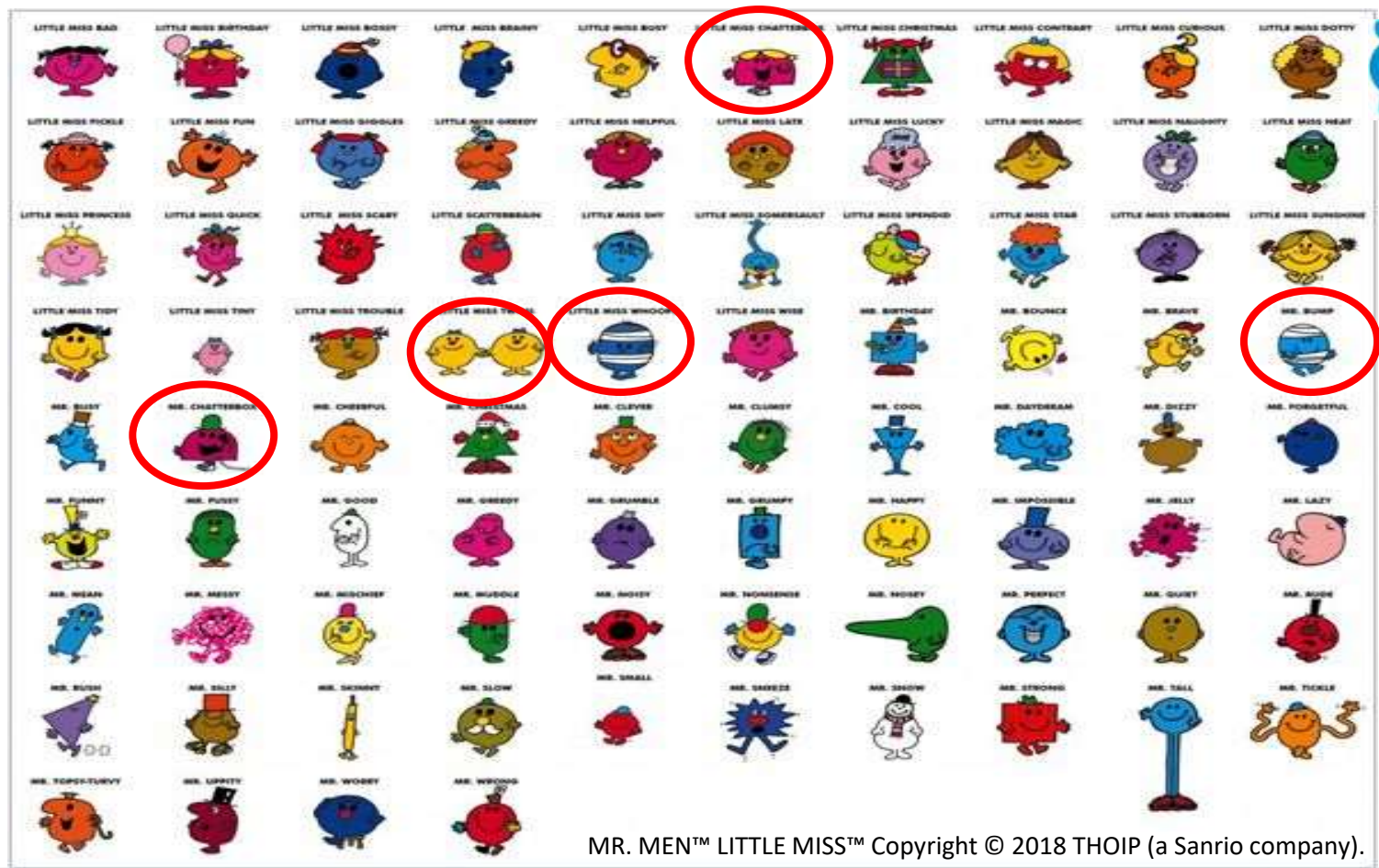
7. a) In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer with either mild infection or mild ischemia, consider using a non-removable knee-high offloading device to promote healing of the ulcer

b) In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer with both mild infection and mild ischemia, or with either moderate infection or moderate ischaemia, consider using a removable knee-high offloading device to promote healing of the ulcer

7. c) In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer with both moderate infection and moderate ischaemia, or with either severe infection or severe ischemia, primarily address the infection and/or ischemia, and consider using a removable offloading intervention based on the patient's functioning, ambulatory status and activity level, to promote healing of the ulcer
8. In a person with diabetes and a neuropathic plantar heel ulcer, consider using a knee-high offloading device or other offloading intervention that effectively reduces plantar pressure on the heel and is tolerated by the patient, to promote healing of the ulcer
9. In a person with diabetes and a non-plantar foot ulcer, use a removable ankle-high offloading device, footwear modifications, toe spacers, or orthoses, depending on the type and location of the foot ulcer, to promote healing of the ulcer

Flow diagram on the recommended offloading treatment for a person with diabetes and a foot ulcer.





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Non-Removable Devices



- Image Source: O&P Library, Tanmeet Kaur

• Böhler Walker

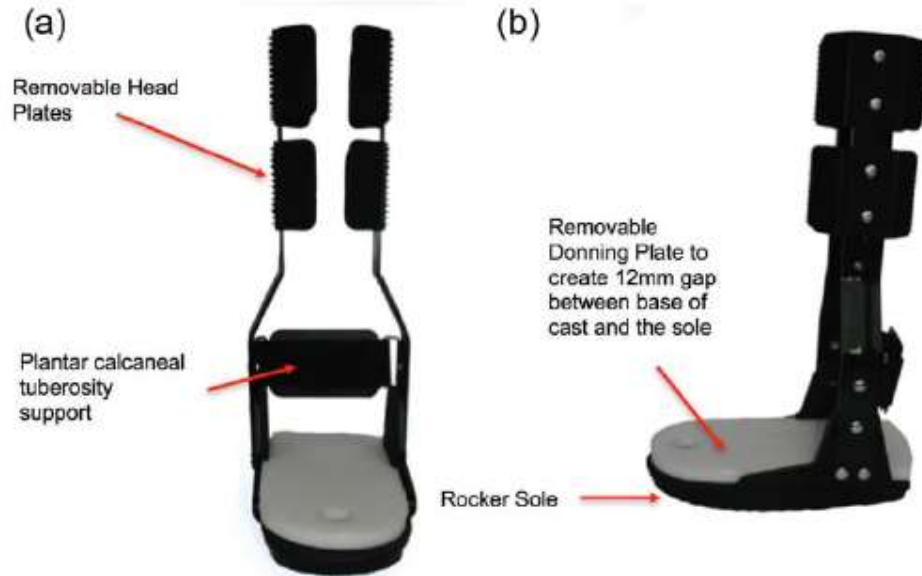


Image Source:

- Beagle Orthopaedic,
- Berwon JT et al, Foot Ankle Int. 2015 Jun;36(6):722-9

Contraindications to TCC

- Infected ulceration
- Severe cardiac problems
- Extensive necrosis
- End stage renal failure
- Iatrogenic lesion
- Patient is uncooperative and will not accept treatment
- Mental health issues
- Knee, hip and spine pains due to leg length discrepancy

Removable Devices



Image Source: DJO Global, <http://foot.oped-uk.com/vacoped-diabetic/>

Charcot Restraint Orthotic Walker (CROW)



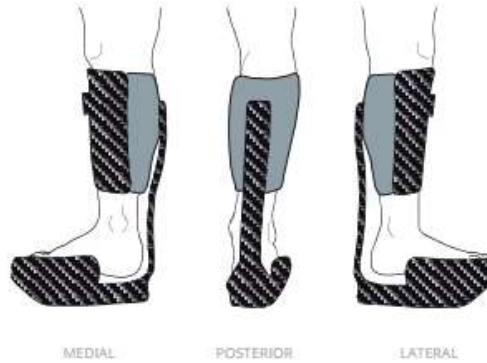


Patellar-Tendon-Bearing (PTB) AFO and Bespoke Boots



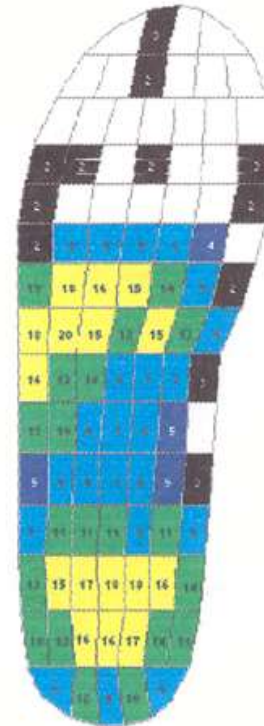
- Images source:
www.atazaorthopros.wordpress.com,
<http://rehabitech.sakura.ne.jp/products/article/12>

Axial Offload AFO



- Images courtesy of Orthotic Composites

Ground Reaction AFO (GRAFO)



Ankle-Foot Orthosis (AFO) and Bespoke Boots





Removable Ankle-High Devices

- Scotchcast™ Boot/
Leicester Boot
- Temporary footwear



Image Source:

- Raspovic et al. 2016. Diabetes Research and Clinical Practice. Vol 121. 166-172, www.rnursingschool.biz, Beagle Orthopaedic, OrthoEurope,



Image Source: DJO Global

Also consider...

- Consider the contralateral side and overall skeletal alignment – Is a raise required?



- Image Source: Evenupcorp.com, DARCO Europe

- Semi-compressed felt



- Footwear and insole adaption

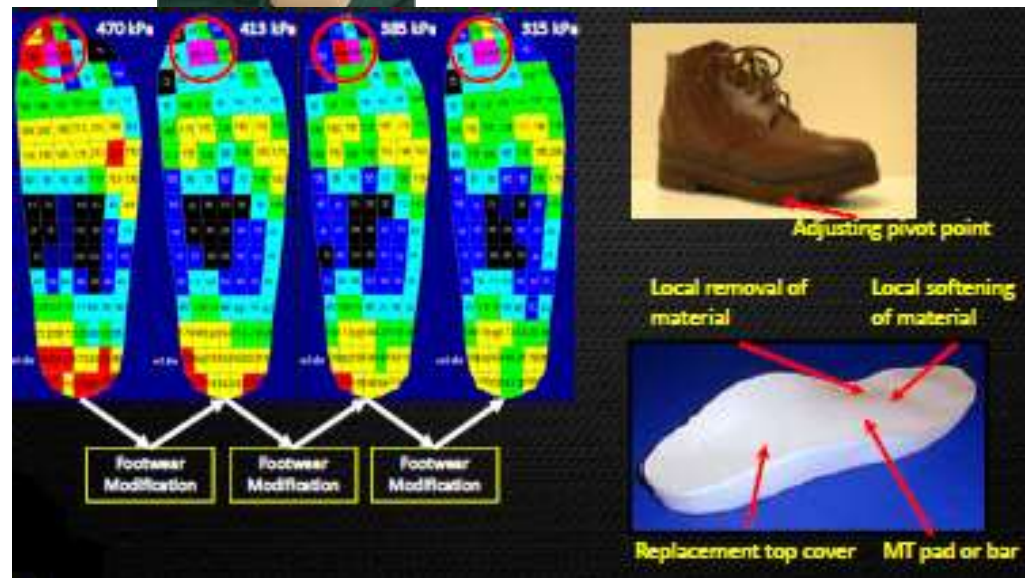


Image Source:

- Raspovic et al. 2016. Diabetes Research and Clinical Practice. Vol 121. 166-172,
- Bus et al, 2011; Diabetes Care 34: 1595-1600

Mobility Devices

- iWalk
- Knee Scooter



Image Source:

- <http://keystonemobility.com/product/iwalk/>
- lwalk-free.com
- Abc4mobility.com

Heels for Inpatients



- Image source: www.anatomicalconcepts.com/65oskt-1/ , www.promedics.co.uk/products/ankle-contracture-afo <https://www.promedics.co.uk/products/podus-boot> , www.sage-products.co.uk/product-heel-skin-injury/ , <http://www.talarmade.com/products/567-heelpro-heel-protector.aspx> , V&M Marketing

Factors to Consider

- Mechanical alignment and protection and accommodation of any deformity present
- The functional/mechanical role of the foot and ankle complex
- Acknowledge the biomechanical and physiological changes which occur to the diabetic foot over time and after an ulceration.
- Maintain skin integrity through redistribution of pressure and protecting from shear and peak forces.

Factors to Consider (Cont'd)

- What are the patient's expectations
- The change in biomechanical forces on the contra-lateral limb and the implications on the rest of the body
- Compliance due to ease of application and durability, cosmesis and comfort
- Education
- Support (family/social care)
- Psychological support

Conclusion

- Prompt diagnosis, treatment and management is essential to reduce complications associated with Charcot and ulceration
- Always consider the patient and what they can or cannot cope with
- Always keep the patient informed of their progress

Problems External to Mechanics and Medicine

- Patient's expectations and concerns
 - Discuss the Orthotic requirements
 - Discuss solutions
 - Compromise (if necessary)
 - Provide education

PATIENT ACCEPTANCE AND COMPLIANCE
IS PARAMOUNT.

Any Questions?

Thank you

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- www.footindiabetes.org.uk
- www.londonscn.nhs.uk
- www.bapo.com