Ancient German Proverb

For want of a nail the shoe was lost,
for want of a shoe the horse was lost,
for want of a horse the knight was lost,
for want of a knight the battle was lost,
for want of a battle the kingdom was lost.
So a kingdom was lost—all for want of a nail.

Diabetic Foot Management

For want of a Nail a toe was lost (Toe Amputation)
For want of Toe a foot was lost(TMA/MFA)
For want of Foot a leg was lost(BK)
For want of a Leg a limb was lost(AK)
For want of Limb a life was lost
So a Life was lost all for want of a nail

-the rhyme of a podiatric surgeon

10 commmandemants

1) **DO NOT** walk barefoot
2) **INSPECT** the feet daily for blisters ,wounds,bleeding,smell,increased temperature,pressure points of feet and edema
3) **DO NOT** apply hot fomentation/cold compresses/electric heating pads strong counter irritants or pumis stone to rub the legs and feet
4) **USE** correct foot wear .Choose your foot wear after consulting your doctor.Always wear footwear with socks with loose elastic .

- 5)**DO NOT** walk bearing weight on an affected /ulcerated foot or after a surgery on the foot.
- 6)**DO NOT** sit cross legged for long time
- 7)**DO NOT** remove footwear during travel and expose your feet to a hot or cold surface

- 8)**CUT** the nails regularly ,trimmed square
- 9)**DO NOT** cut corns /calluses with a blade or a knife .Home surgery is dangerous
- 10)**CLEAN** the feet twice daily with soap and water .Wipe the web spaces dry and apply softening agents


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RIP

The Problem: every 30 seconds a limb is lost to diabetes

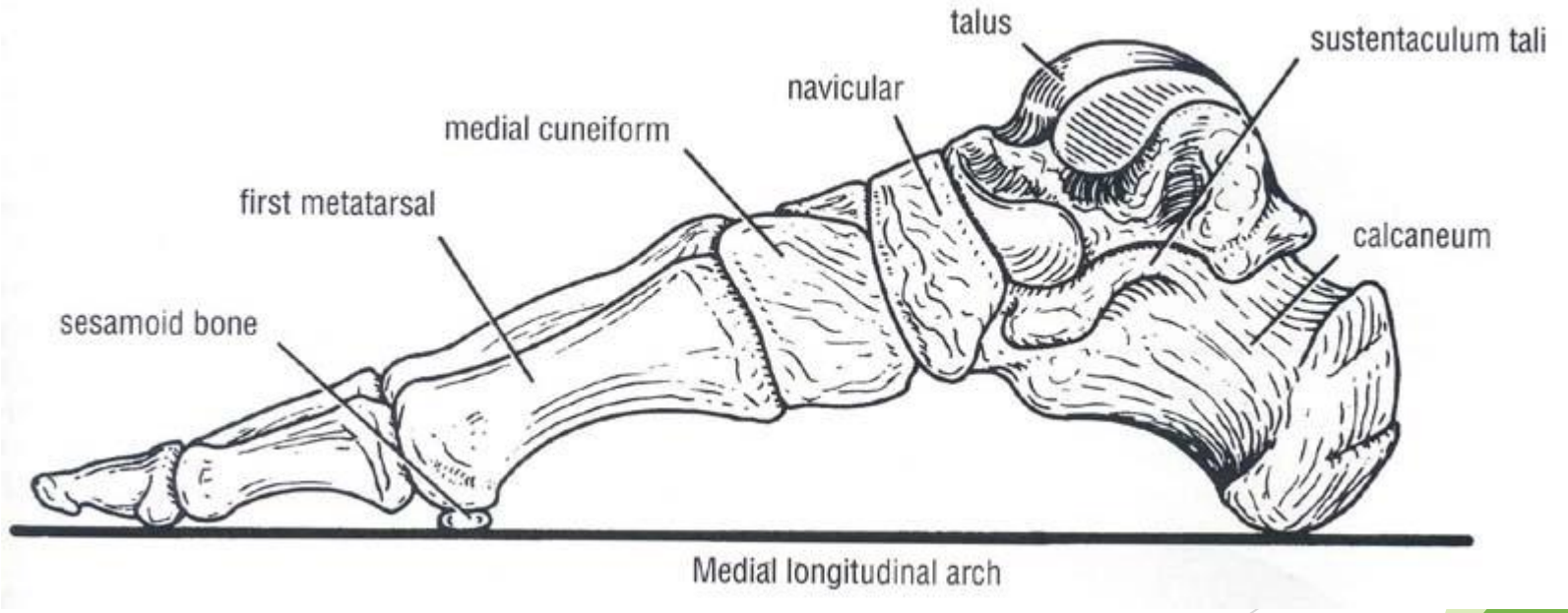
- The solution does not lie in reconstruction but prevention


Photo courtesy of Peter Blume, DPM

Biomechanics,Surgical Anatomy and Overview of Neuropathy

- (*The human foot is a strong and complex mechanical structure containing **26** bones, 33 joints (20 of which are actively articulated), and more than a hundred muscles, tendons, and ligaments*)

- Area of foot 175 sq cms
- Area of contact 100sq cms
- Pressure 0.6kg /sq cm

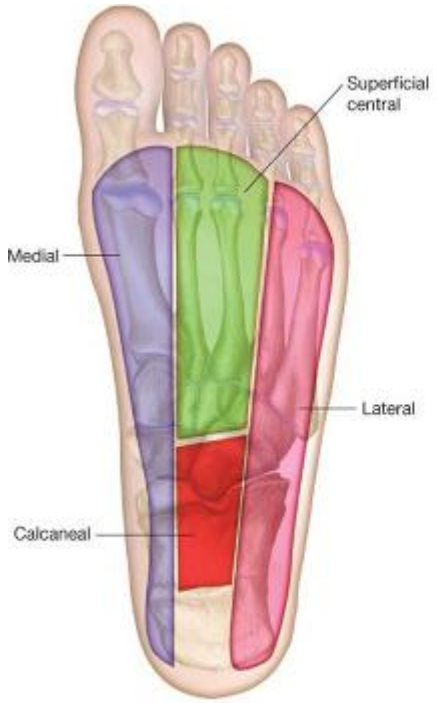


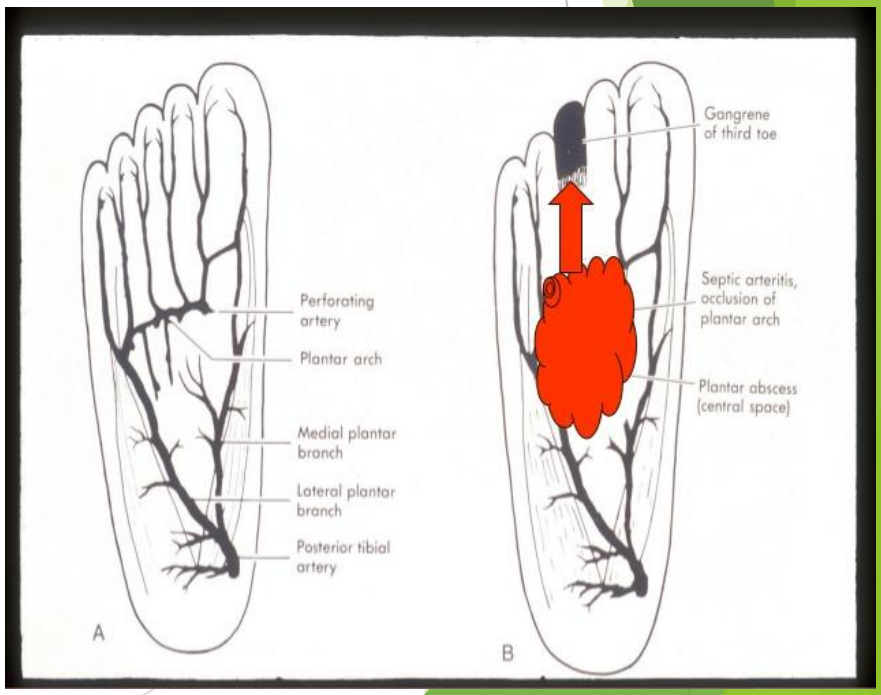
1250 Kilopascals

- 6 KPA -Capillary flow obliterated
- 15 KPA -Arterial flow obliterated
- Momentary so usually harmless but
- In diabetics more contact time and sympathetic degeneration results in prolongation of ischemia time
- Increased local pressure due to
- Hallux rigidus
- Neuropathy
- Liimited Joint Mobility (Glycosylation)

Surgical Anatomy of Diabetic foot

- 9 compartments
- Spread is through tendons





Clinical assesment of Neuropathy and Diabetic ulcers ,with preliminary concerns

Neuropathy

- Prevalence depends on modality used to detect it
- Can be present at diagnosis of type 2
- Starts within 5 years in 50% cases
- Usually feet ,may be associated with CTS
- Associated with MI /diarrhoea/hypo or hyperhydrosis

Myths and facts

- Myth -DPN is a result of long standing diabetes
- Fact -can be as high
- 49% in people IGT
- 50% in newly detected diabetes

- Myth :DPN is progressive and irreversible
- Fact: not always,can be reversed to considerable extent by intensive medical and surgical treatment
- Myth : DPN is symmetrical with anesthesia ,parasthesias as the principal symptoms
- Fact :DPN starts unilaterally and will become bilaterally symmetrical much later

Risk factors in foot of Diabetic

- Barefoot walking-Indoor/Outdoor
- Paresthesia,Allodynia,Hyperesthesia
- Pruritis/Itching
- Injurious practices
- Self Footcare
- Claudication

- End Of day Edema
- Injury
- Other causes leading to ulceration-
- Varicose veins,Eczema,Burns

Clinical examination risk factors

- Prominent dorsal veins.bounding pulses ?charcot
- Evidence of excessive pressures-callosity,corns,
- Abnormal shape
- Deformed nails
- Crowding of toes,
- Hammer toes,Hallux valgus, Hallux rigidus,Clawing,

.Narrow toe boxes

.Ischemic foot

- Web space for fungal infection

- LJM

- Temperature Warmth /cold
- Colour
- Crepitus
- Monofilament testing hallux,metatarsal heads and heel.3/5 foot at risk.

- LOV 128 Mhz on 1st toe and medial malleolus

Ulcer examination

PTB test

Wagner classification

Grade 0	Intact skin
Grade 1	Superficial ulcer
Grade 2	Deep ulcer
Grade 3	Ulcer with bone involvement
Grade 4	Forefoot gangrene
Grade 5	Full-foot gangrene

Foot wear inspection

Diagnostic Equipment For Diabetic foot

Neuropathy assesment

- SWN Monofilament-2 out of 3 answers incorrect-protective sensation absent
- Identifies foot at risk but no quantification

- Biothesiometer-Vibration Perception Threshhold-
- >25 V-abnormal
- 25-33 V-4 fold
- >42V-42 fold

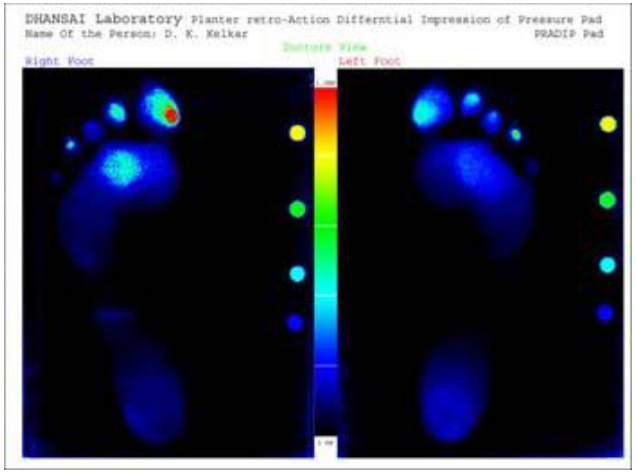
- Heat and cold sensation /Pain sensitometer
- EMG and NCV

Others

- Infrared temperature sensor of skin
- Corneal Confocal Microscopy

Pressure Assesment

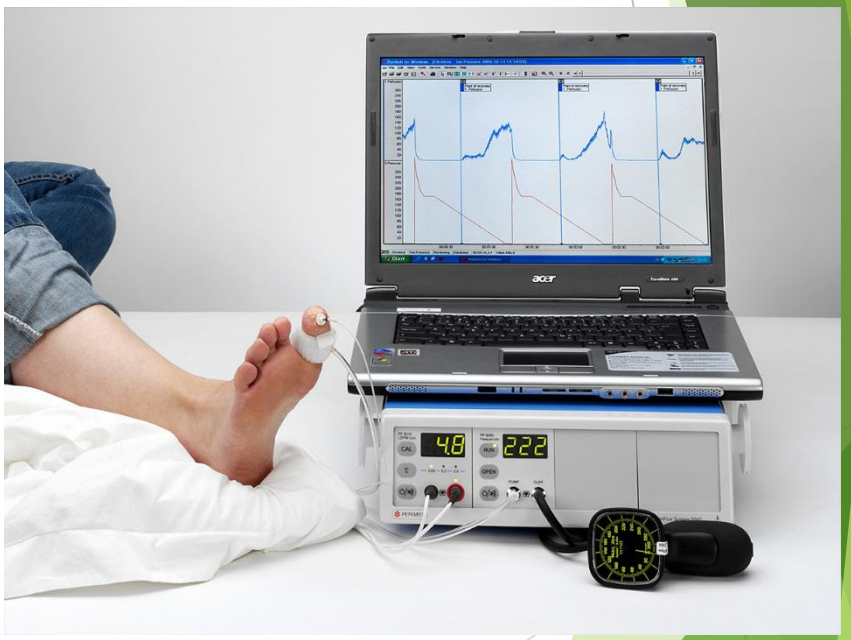
- Computer assisted Platform based foot scans
- Optical pedobarograph
- Inshoe pressure sensor system
- PRADIP-Plan-tar Retro Action Differential Impression of Pressure Pad



- Ankle brachial Index ,
- Normal 0.9 -1.4
- ABI <0.9 PAD 98% overall accuracy
- < 0.8 in pts with claudication
- <0.5 with rest pain
- all these patients are high risks for sytemic cardiovascular events and have double 5 year mortality

- Toe pressure Index and Tcpo2 more accurate
- TBI>75 wnl,<70-PAD

Tcpo2<30-low chance of healing



Approach to Peripheral Arterial Disease in patients with Diabetes

Diabetic PAD

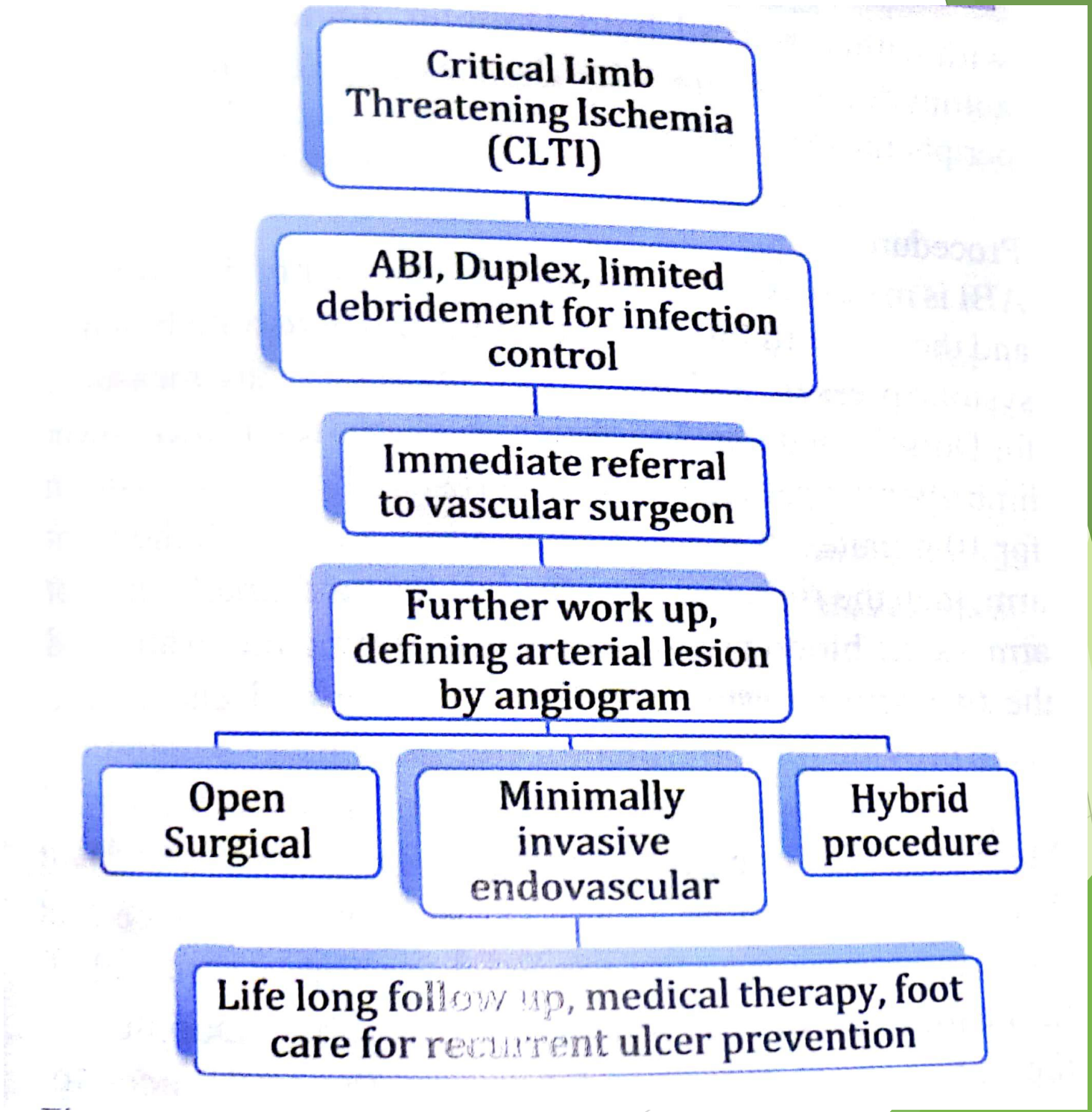
- More aggressive disease and occurs in younger patient
- More rapid progression of early critical limb ischemia to gangrene
- Multilevel disease is more common in persons with diabetes with higher predilection infrapopliteal arteries
- Tissue loss not necessarily preceded by claudication

- Higher risk potential for sudden progession from intermittent claudication to limb threatening ischemia
- Reflects systemic atherosclerosis more than CAD and CVA

Stage	Presentation	Invasive diagnostic and therapeutic intervention
0	No signs or symptoms	Never justified
1	Intermittent claudication>300mts,no physical changes	Usually unjustified
2	Severe claudication <150 mts,dependent rubor:decreased temperature	Sometimes justified,not always necessary,mostly remain stable
3	Rest pain,atrophy,cyanosis ,dependent rubor	Mostly indicated but may do well for long periods without revascularisation
4	Non healing ulcer or gangrene	Nearly always indicated

- Medical management is not beneficial in Critical limb Ischemia
- i.e PAD and rest pain
- or Tissue loss like NHU(2 weeks)
- or gangrene
- Other criteria which are supportive but not indicative in isolation
- ABI<0.5
- TBI<30
- Tcpo2 <30

- Surgical Bypass
- Endovascular Interventions
- Hybrid procedures


Critical Limb Threatening Ischemia (CLTI)
ABI, Duplex, limited debridement for infection control
Immediate referral to vascular surgeon
Further work up, defining arterial lesion by angiogram
Open Surgical
Minimally invasive endovascular
Hybrid procedure
Life long follow up, medical therapy, foot care for recurrent ulcer prevention

- PAD has a significant negative impact on diabetic foot
- All persons with diabetes should undergo vascular examination once in 6 months with good clinical examination and ABI.More frequent examinations are determined by patient symptoms
- Asymptomatic PAD does not require any invasive testing or intervention

Diagnosis and Medical Management of Diabetic foot infections

- Starts as a seemingly minor problem but progresses too often to culminate in amputation if not recognised early
- Requires Multi Disciplinary approach
- Includes initial wound assessment debridement offloading and wound dressing
- Wound to be assessed atleast every week,Wound area reduction 10-15 %per week more than 50 % reduction in 4 weeks increased likelihood of healing

When surgeon should be involved?

- From the earliest,joint rounds are the best where patient systemic and local conditions are discussed and non contradictory clear decisions are taken.
- In moderate to severe DFI when an aggressive incision ,drainage ,debridement of non viable soft tissue and bone and foot exploration is required
- Sharp debridement during first visit and maintainence debridement

How to recognise infections with or without an ulcer in diabetic foot?

- Obvious purulent discharge and 2 /more signs of inflamation
- Sometimes primary signs absent then 2ndary signs-foul odour ,serous exudates ,undermined wound edge and discoloured or friable wound edges .
- Suspected if wound size > 2cm,depth >3mm,duration more than 2 weeks ,renal insufficiency,loss of protective sensation h/0 prior amputation /ulcer or walking barefoot.

Microbiological assessment

- Deep tissue cultures should be taken after cleaning and debriding wound
- Ulcer swabs should not be sent
- Pus aerobic and anaerobic cultures
- Osteomyelitis -bone biopsy and culture..dont treat OM based on soft tissue culture.

General Guidelines

- Non limb Threatening Infections

- Amoxicillin+Clavulanic Acid+Metronidazole
- Ofloxacin + Metronidazole
- Cephalosporins +Metronidazole

- **Limb threatening infections**
- Tazobactam+piperacillin with Amikacin +metronidazole
- Ceftriaxone +amikacin+metronidazole
- Ofloxacin + amikacin+metronidazole
- Amoxicillin -clavulanic acid +amikacin+metronidazole
- Cefoperazone and sulbactam+amikacin and metronidazole

Life threatening

- Tazobactam+piperazillinand amikacin+Metronidazole
- Meropenem+Amikacin +metronidazole
- Ceftazidime +amoxicillin-clavunate+metronidazole

Newer antibiotics

- Ertapenem -aerobic and facultative gram positive and gram negative microrganisms or anerobic microorganisms in diabetic foot infections
- MRSA -Vancomycin
- Pseudomonas -Ceftazidime and Amibact and Aztreonam

How long to treat

- Moderate and severe DFI 2 to 4 weeks (initially IV followed by oral)
- Mild to moderate skin and soft tissue infection-1-2 weeks
- Osteomyelitis 6 weeks
- Bio-availailbility,Bone penetration,renal impairment ,fungal infection

Classification of DFI

- Wagner and Megitt
- University Of Texas
- IDSA-
- mild < 2cm erythema
- Moderate > 2cm erythema
- Severe-systemic and metabolic instability

Lab investigations

- Cbc
- RFT,Blood glucose level
- HbA1c
- ESR >70 mm/hr ? OM>cellulitis
- CRP,>3.2mg/dl increase risk of OM (costly)
- Procalcitonin rise sepsis(costly)

OM?

- Ulcer over bony prominence
- Bone visible at base of ulcer
- ulcer does not heal despite offloading
- Sausage toe
- PTB + 57 %Ppv
- PTB – 98% absence of OM (stronger predictor of absence of bone infection)

Radiological Investigations

- X-ray
- MRI
- Tc 99
- FDG -PET

Foot salvage Surgery

- A deformed foot is better than an amputated one
- Early conservative Amputation or a foot salvage procedure is neither a contraindication nor a paradox
- A limited amputation early enough should and can be the treatment of choice for most diabetic foot infections which may complicate further.

- Principle is hto create a mobile soft tissue envelope with biomechanically correct contour of the cut bones to absorb or reduce shear and direct forces which occur at the interface between foot and footwear.
- Remove the septic focus at the earliest
- Toes are like caps on the pus filled plantar spaces
- Pus spreads along the tendons

- First toe amputation distal to FHL tendon
- Ray amputation
- Lesser toe amputation
- Transmetatarsal amputation
- Midfoot amputation

Foot wear Specifications

Foot wear specifications

- To help ulcers heal once they are rendered free of infections
- To prevent recurrences of the ulcers
- To stabilize the diabetic foot and reduce plantar pressures below the skin breaking level
- Presently majority of manufacturers of Diabetic foot wear are selling suboptimal products

Objectives

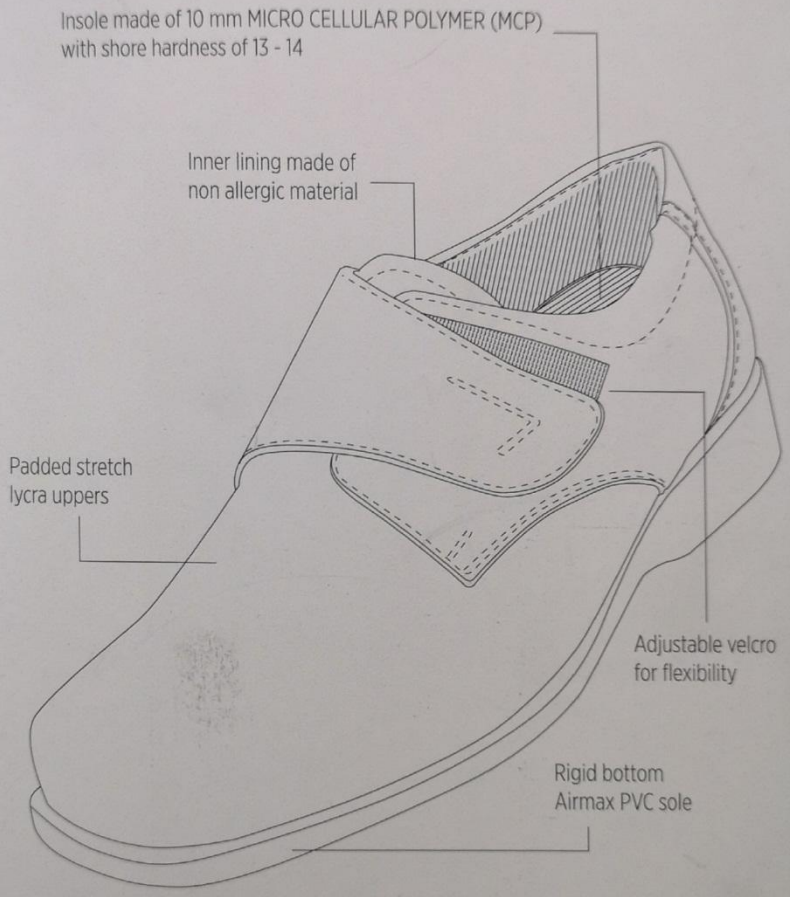
- Reduction of shock
- Reduction of shear
- Accomadation of minimal deformity by use of adaptable quality of insoles and using orthotic supports
- Stabilisation of deformity of the grossly deformed foot using the moulded customised footwear
- Preventing recurrence of ulcer by protecting insensate feet from trauma and reducing abnormally high pressures

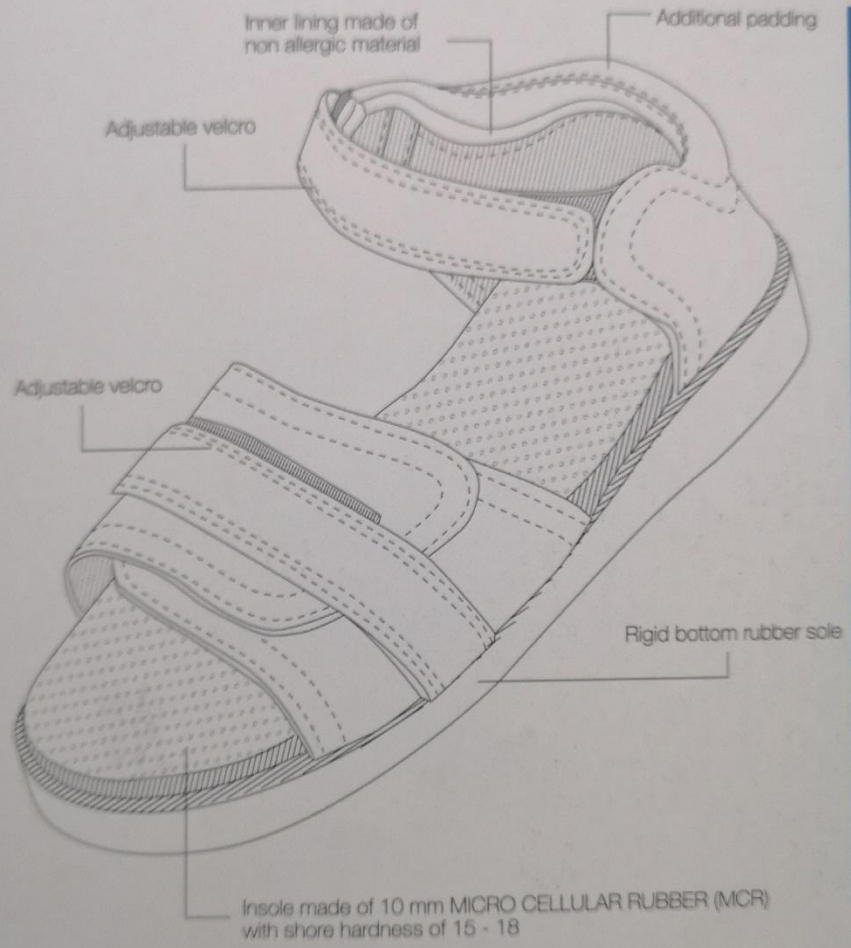
Charachteristics of diabetic footwear

3 types

- Regular shoe
- Sandal
- Long Boot

- Shoes should be tried on in evening when pedal edema is maximum


Insole made of 10 mm MICRO CELLULAR POLYMER (MCP)
with shore hardness of 13 - 14
Inner lining made of
non allergic material
Padded stretch
lycra uppers
Adjustable velcro
for flexibility
Rigid bottom
Airmax PVC sole


Inner lining made of
non allergic material
Additional padding
Adjustable velcro
Adjustable velcro
Rigid bottom rubber sole
Insole made of 10 mm MICRO CELLULAR RUBBER (MCR)
with shore hardness of 15 - 18

Shoes for people with Diabetes

- A wide toe box
- Shoe length -allow half an inch more
- Extra depth
- Outsole should be rigid
- No metals to be used
- All pasted not stiched
- Ankle high leather boots
- Sandals should have heel counters and velcro straps

Types of shoes

- Pressure reducing foot wear
- Prophylactic walking footwear
- Custom molded footwear
- Rigid rocker bottom shoe
- Roller bottoms
- Orthowedge footwear

- Normal response to monofilament -sandals or closed shoes with insole of either MCR or EVA 8-10 mm thickness
- Positive monofilament test-sandals with velcro straps
- Partially healed or non healing plantar ulcer-TCC/orthowedge insole with wing pad to offload ulcer: felt
- Foot deformity :total contact cradle insole like polyethylene ,plastazote and cork rubber

- Partially amputated forefoot -front filler of soft material in shores with wide toe box and extra depth
- To relieve metatarsal pressure -Mid Rocker Sole
- Fixed Claw toes,Hammer toes ,Calcaneal ulcers,MidFoot amputations -Heel to toe rocker sole
- For Ulcers over Metatarsal heads -Toe only rocker sole
- Hallux Rigidus,Ulcer on Distal Part of Toe ,Hammer Toe ,Ulcer Metatarsal heads-Severe angle rocker sole

- Fixed ankle ,Dorsiflexion -Negative Heel rocker Sole
- Charcot foot -Double rocker Sole

Materials used

- Upper shoe.good quality calf leather with flexibility
- Heel counter-rigid to retain shape
- Topline and tongue padding-compressible foam with thickness
- Laces velcro quality should not affect dimensional stabilty by becoming lax

- Insole-MCR shore A hardness: 22 thickness :12 mm
- EVA Shore A: 15-22
- Greater the shore hardness longer lasting but costlier
- Others polyurethrane foam,silicon,polyethylene
- Outsoles should be made of hard rubber PVC or leathers which can withstand -
- heat ,cold,water,insults ,chemical ,moisture ,Good tensile tear strength and resilience antiskid properties with sufficient longeivity;hysteresis retain shape and toughness after repeated compression

- Encourage patients to wear footwear both indoor and outdoor and discourage from using slippers
- Encourage the patient to regularly inspect footwear to detect areas of increasing pressures indicated by bottoming out of insoles
- Any new areas of pressure will require appropriate changes in insoles
- Work pattern,travel distance for the work,socioeconomic and cultural environment should be considered before finalising the footwear and offloading

Why choose SUT pattom?

- It is a multidisciplinary approach involving almost all specialities
- Plastic/ Podiatric surgeon and department committed to treatment of diabetic foot
- Diabetologists
- Radiologists
- Nephrologists
- Cardiologists
- Vascular surgeon
- Intensivists
- Infectious disease specialist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Reconstruction Clinic
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BR LIFE
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THANK YOU

HAPPY NEW YEAR