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The diabetic foot

from a orthopaedic surgeons perspective

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- Foot complications is the most common reason for admission to hospital and contact to the healthcare system (US) (diabetics)

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- Diabetes most importent reason for amputation in peacetime
- Type 1 and 2 similar when it comes to foot complications

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Treatment goals

- Avoid amputation
  - Prevent and treat diabetic foot ulcers
- Best possible function during treatment

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Risk of amputation :

- Norway : 4/1000 diabetics per year
- Europe : 2,5/1000 diabetics per year
- Risk is 33 times higher then for non-diabetics

- Kapelrud, H Underekstremitetsamputasjoner og diabetes, TNLF 7, p 2262, 2006
- Chaturvedi N, Stevens LK, Fuller JH et al. Risk facors, ethnic differences and mortality associated with lowe extremity gangrene and amputation in diabetes. The WHO multinational study of vascular disease in diabet Diabetologia Suppl 2001; 44 (suppl 2): S65 – 71.

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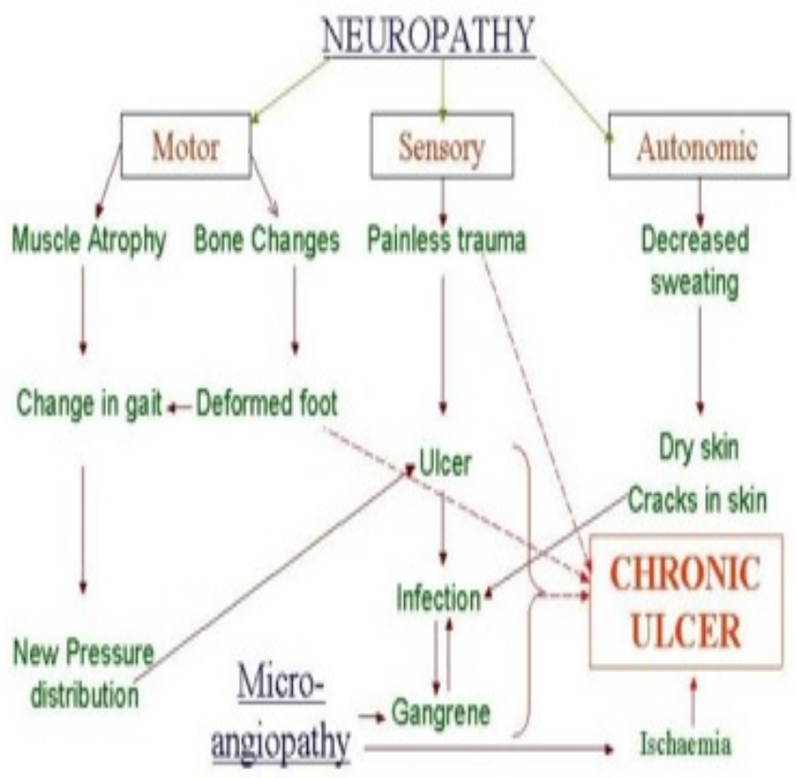
Why does ulcers develop in the diabetic patient ?

- **The key to understanding is the neuropathy which gives :**



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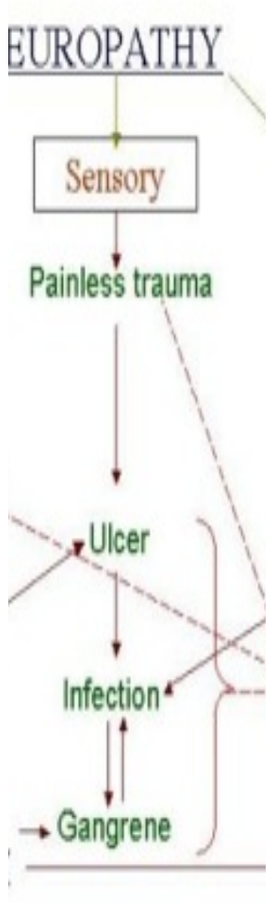
Sensory neuropathy :

- Weakened protective sensibility



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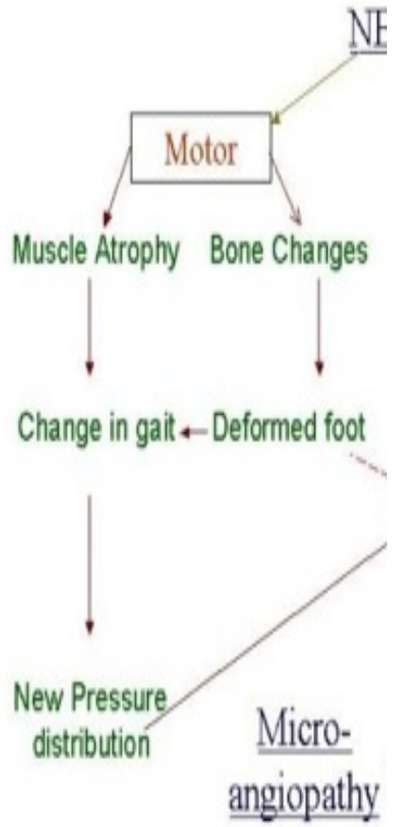
Motor neuropathy :

- Weakened intrinsic muscles of the foot
  - Claw toes



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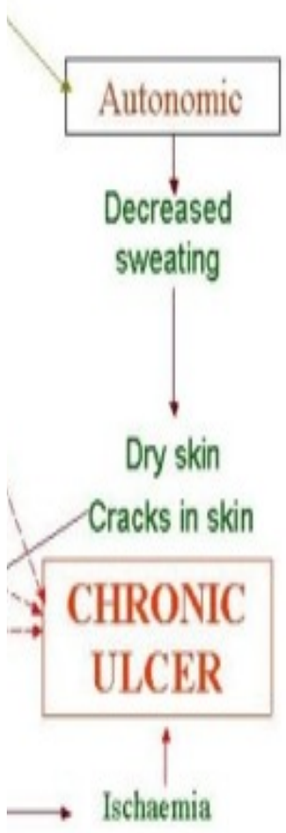
Autonomic neuropathy :

- Skin problems following autonomous sudomotor (sweat) dysfunction
- Angiopathy (micro/macro)
- Charcot neuroarthropathy



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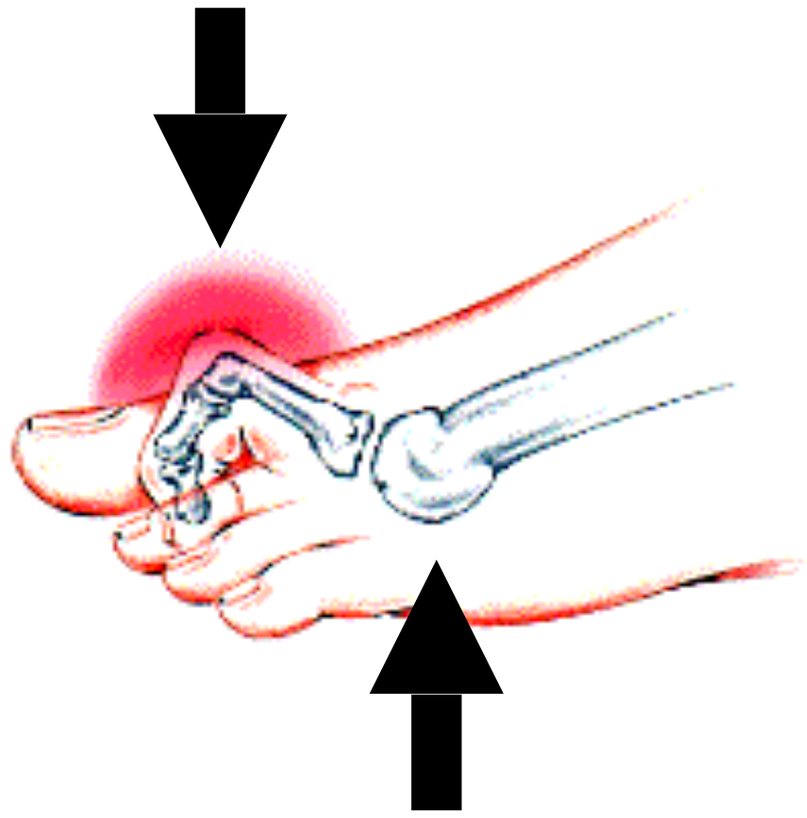
Neuropathy = pressure ulcers



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- Incidens ulcers = 2% per year
- Main reason neuropathy, but vascular disease is also present in a large proportion of diabetics

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Wound classification (Wagner):

Grade	Characteristics	Treatment
0	Intact skin	
1	Superficial wound	TAFO/CROW or TCC
2	Exposed tendon, bone or joint	
3	Abcess/osteomyelitis	Revision of focus, conservative resection as needed
4-5	Gangrene	(Partiell) amputation

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Everyday life in the diabetic outpatient clinic

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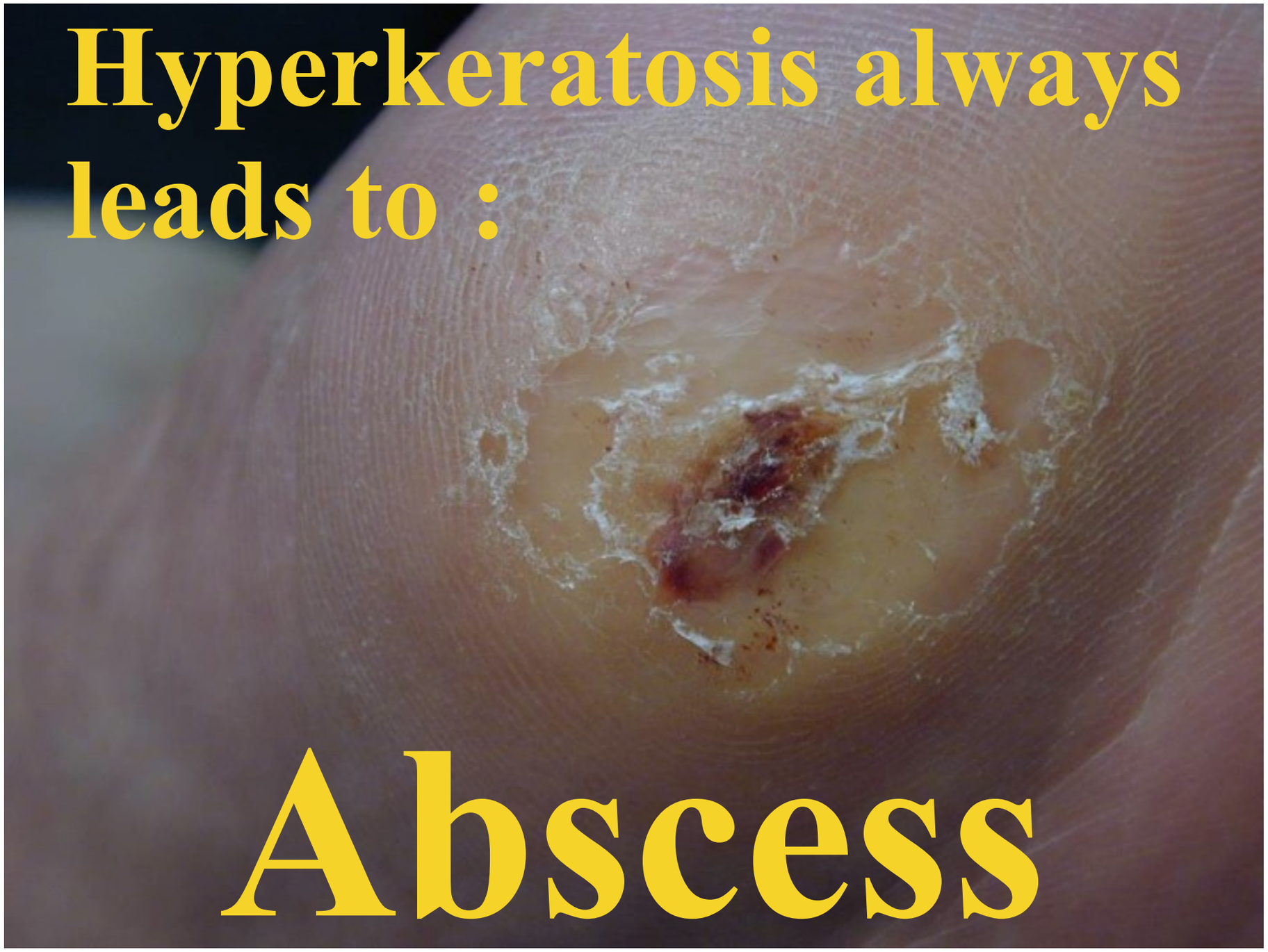
Hyperkeratosis always leads to :



Abscess

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Fixed equinus and/or intrinsic weakening with clawtoes

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Hallux valgus in diabetic patient

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Ulcer with risk of amputation

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Metatarsalgia - plantar callus can give abcess in diabetics

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After one day
with a stone
in his shoe

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Treatment of diabetic ulcers from an orthopedic surgeons view :

- Evaluate mechanical abnormalities and unloading using orthopedic aids
- Optimize circulation -> Evaluation by vascular surgeon!

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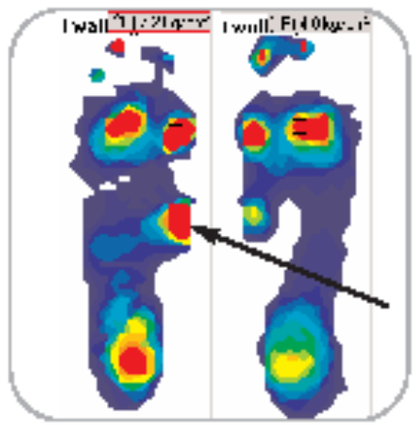
A diabetic patient with a long term (15 months) non-healing ulcer under the left midfoot (Charcot Joint) was presented to private practice. The *F-Scan*® In-Shoe Pressure Analysis System and the *F-Mat*™ floor mat were used to assist the podiatrist and the patient to achieve optimal treatment outcomes. The ulcer site healed within one month of orthotic modification with the assistance of the *F-Scan*. More importantly, the patient was significantly more compliant with recommended treatments once he could visualize the extremely high and abnormal pressures that his ulcer site was generating while walking barefoot on the *F-Mat*. The *F-Scan*'s ability to demonstrate to the patient the importance of footwear and orthotic therapy in this case perhaps outweighs the assistance that it gave to the podiatrist in maximizing treatment outcomes.

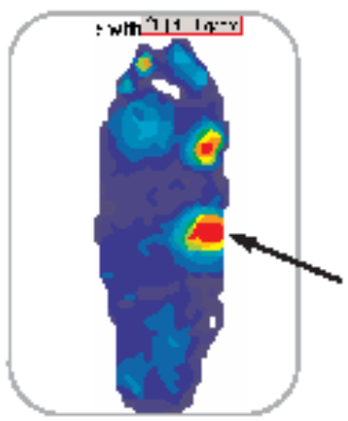
F-Mat™ of barefoot walking showing peak pressure over ulcer site, and F-Scan® showing reduction in pressure with orthotic and footwear

BEFORE



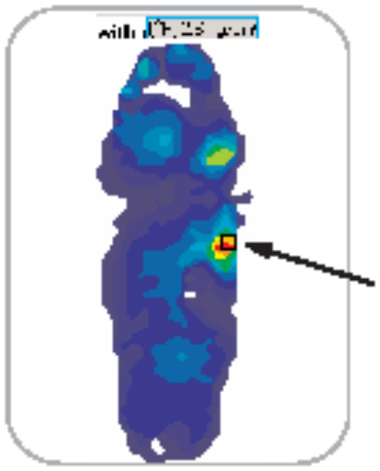
Above is a barefoot *F-Mat* pressure profile showing peak pressures over the ulcer site (arrow) and the 1st MTPJ of the left foot. The peak pressure over the ulcer site is 6.8kg/cm² (102 PSI).

BEFORE



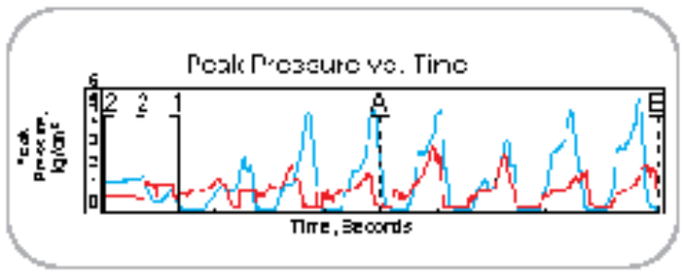
Above is the left pressure profile for in-shoe with orthotic before modifications. The pressure over the ulcer site is reduced compared with barefoot; however, the ulcer is still present. The peak pressure has reduced to 4.2kg/cm² (60 PSI).

AFTER



Above is the left pressure profile for in-shoe with modified orthotic. The pressure over the ulcer site is reduced even further to 2.6 kg/cm² (37 PSI) and after 3 weeks of wear, the ulcer has healed completely. The orthotic was modified "on-the-spot" with the assistance of the *F-Scan* to allow for immediate feedback on the suitability of the modification.

AFTER



The blue curve shows the peak pressure versus time before the orthotic was modified. The red curve shows peak pressure versus time for in-shoe with modified orthotic. Clearly the magnitude of peak pressure with the new modified orthotic is much lower than before the orthotic was modified. This significant reduc
assisted in the healing of the ul

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Tekscan, Inc. 307 West First Street South Boston, MA 02127-1309 USA tel: 617.464.4500/800.248.3669
e-mail: marketing@tekscan.com website: www.tekscan.com

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TAFO/CROW
(boot) or
TCC(cast)

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Shoe with roller sole

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Debride hyperkeratosis

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- Wound biology
  - Choice of wound products
  - **ALWAYS ANTIBIOTICS**

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FLOWCHART :

Infected, normal bloodflow

Dysvacular +/- infection

ULCER

Foot pulse /Doppler

MRI, CT, X-ray

OM — Excition — **Partial amp.**

Abscess — Drain/ debride — **Partial amp. for coverage**

Cellulitis — IV abx

Evaluation by vascular surgeon

Intervention possible — Intervention

- **Infection** — **debridement**
- **No infection** — **Amputation at appropriate level**

Intervention not possible — **Amputation at appropriate level**

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Surgical considerations when treating ulcers in diabetics

- Only when conservative measures have failed
- Goal is to reduce pressure
- Correct mechanical abnormalities

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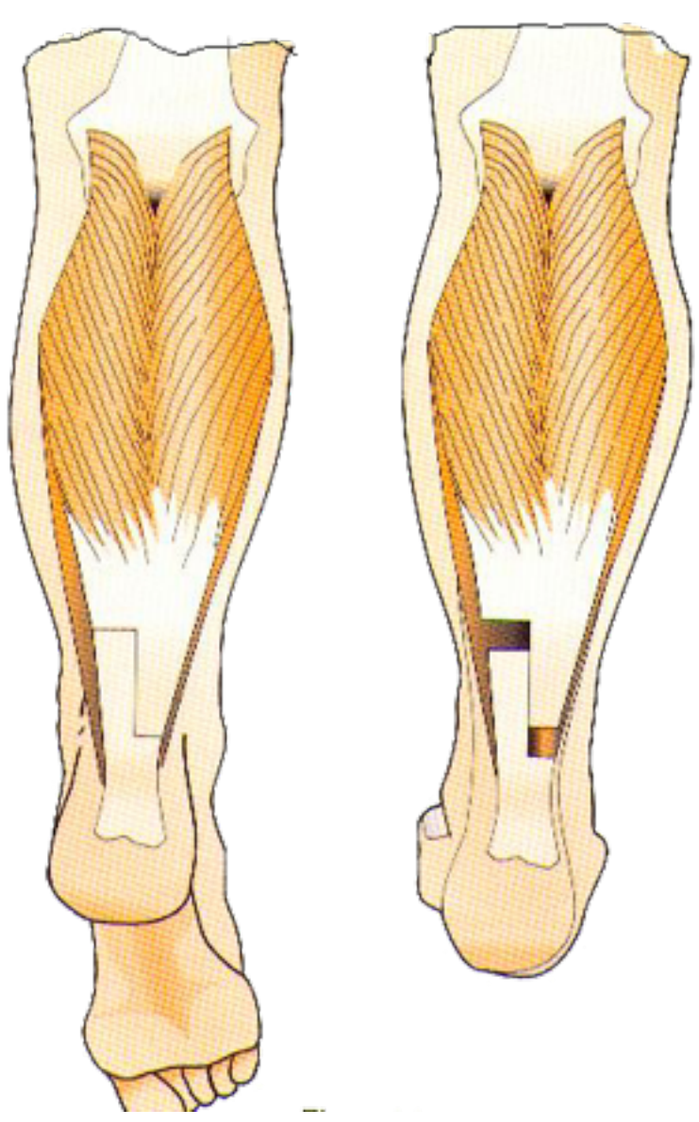
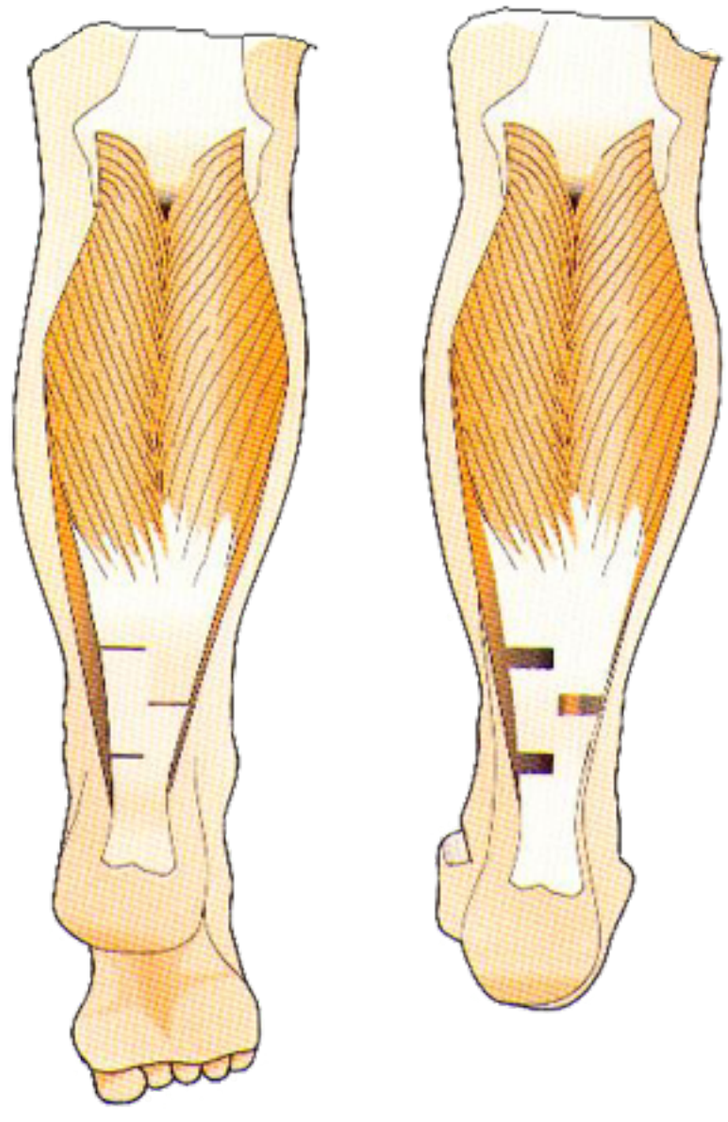
Achilles tendon lengthening:



Open Z-tenotomy



Percutaneus technique

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Other tendon-lengthening procedures :

- FHL proximal/distal
- FDL
- TTP
- EHL
- EDL (hammertoe)
- Peroneus longus

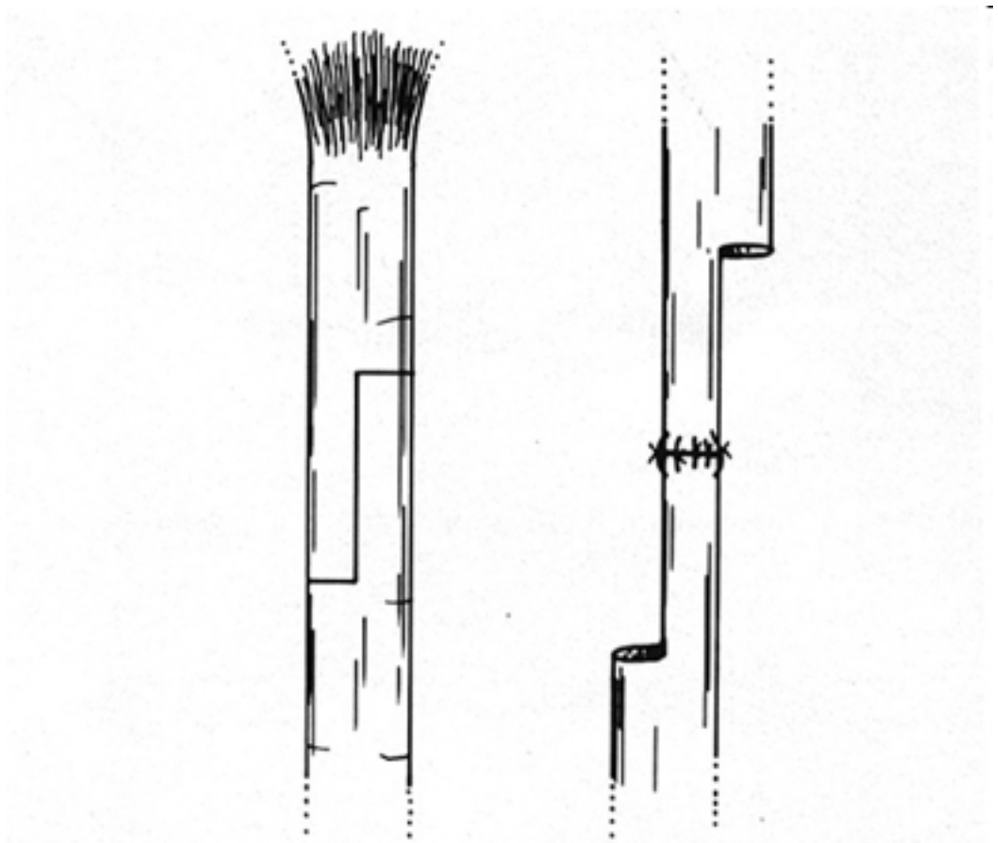

FIG. 68-6 The Z tenotomy technique for tendon lengthening.

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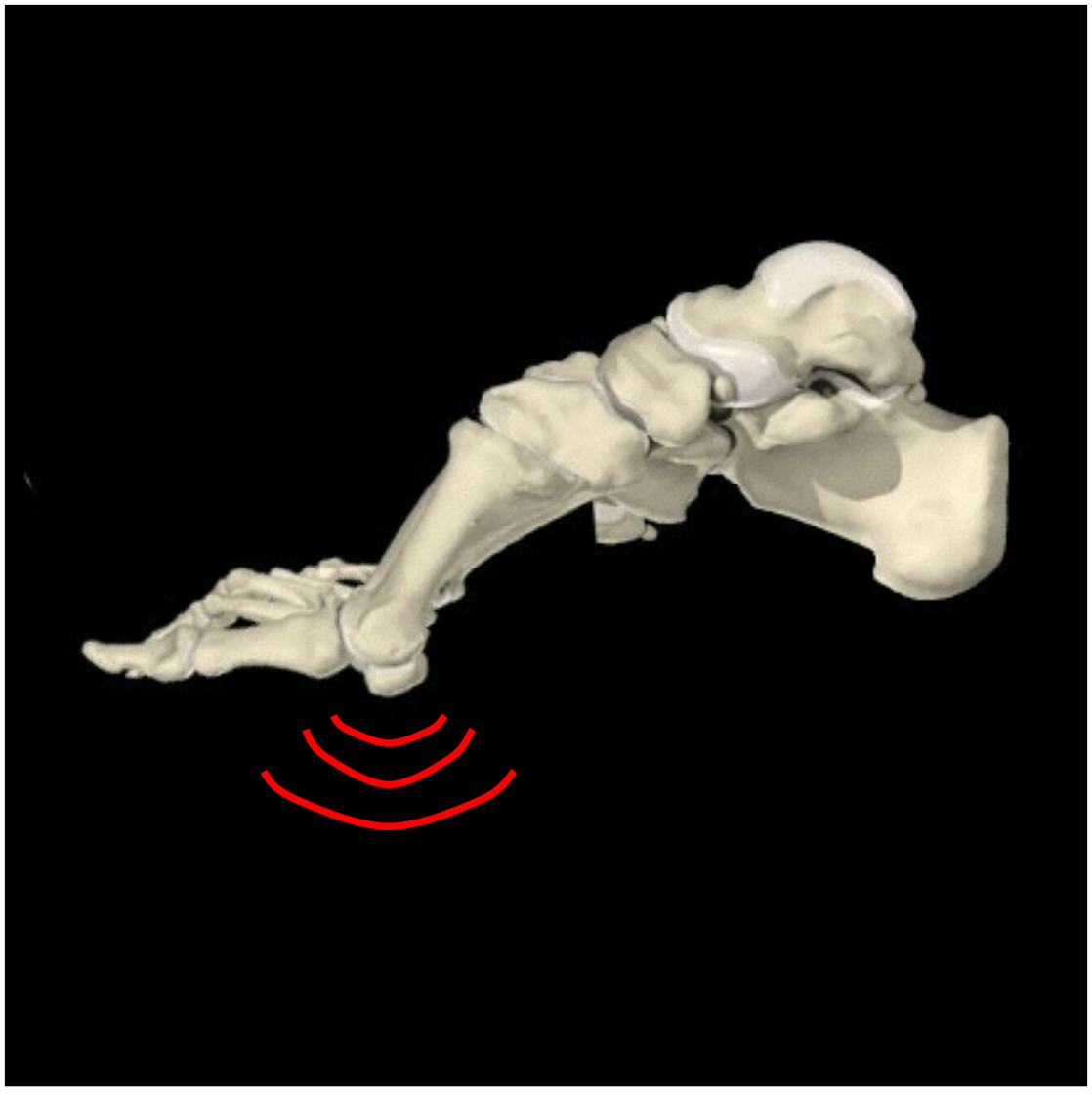
Ulcers caused by bony prominenses



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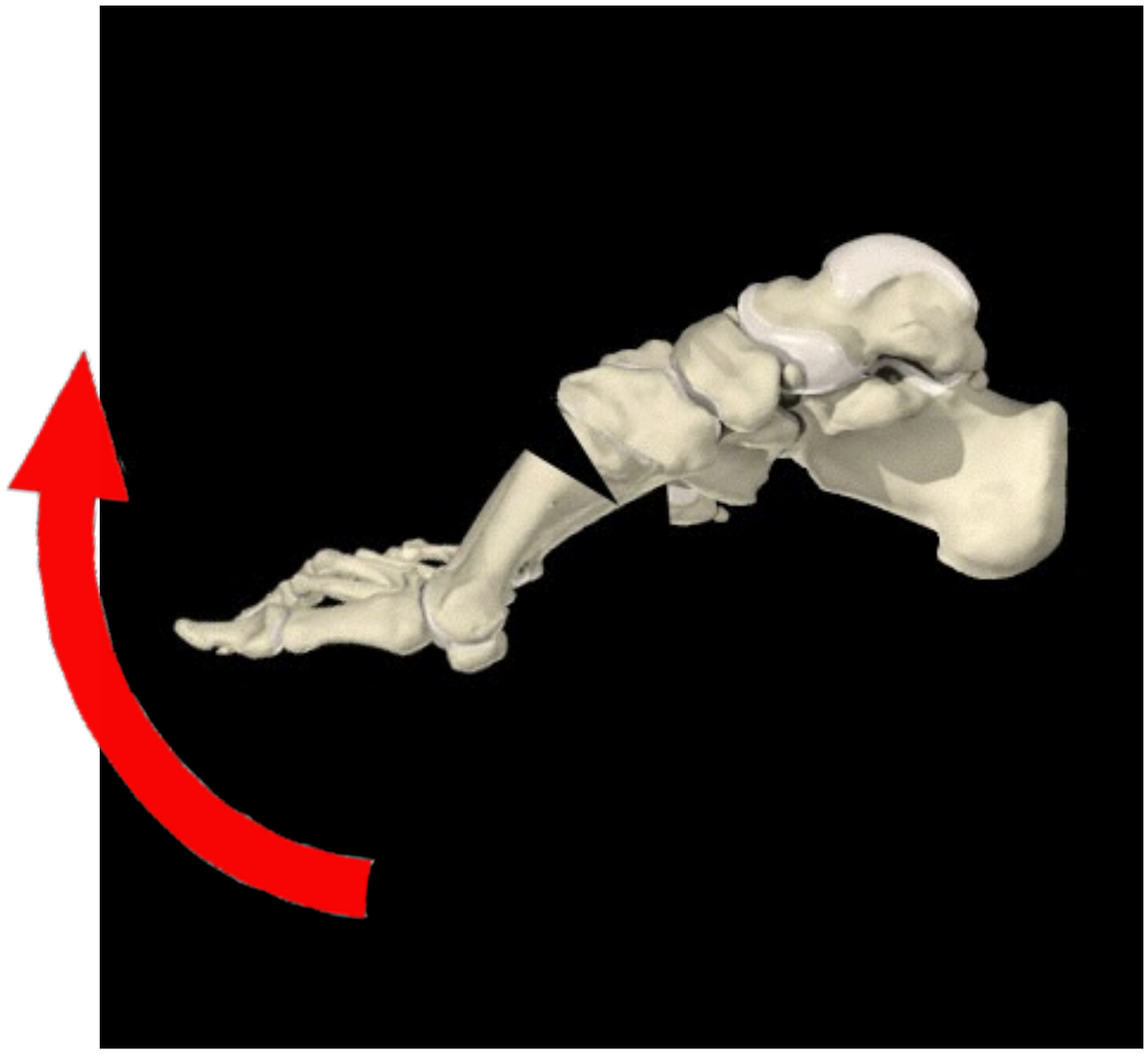
Osteotomy with axis correction



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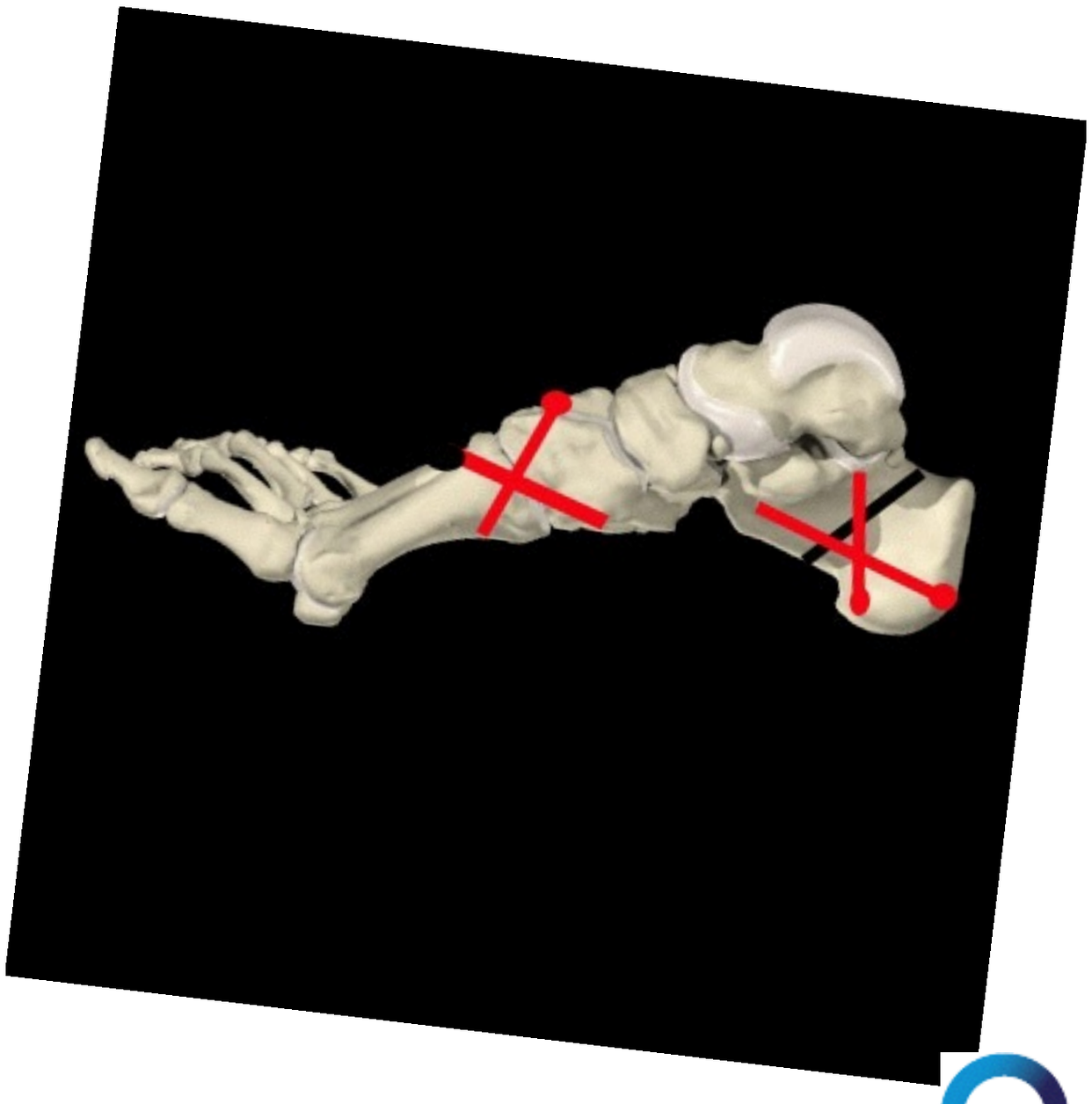

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Resection of bony prominenses

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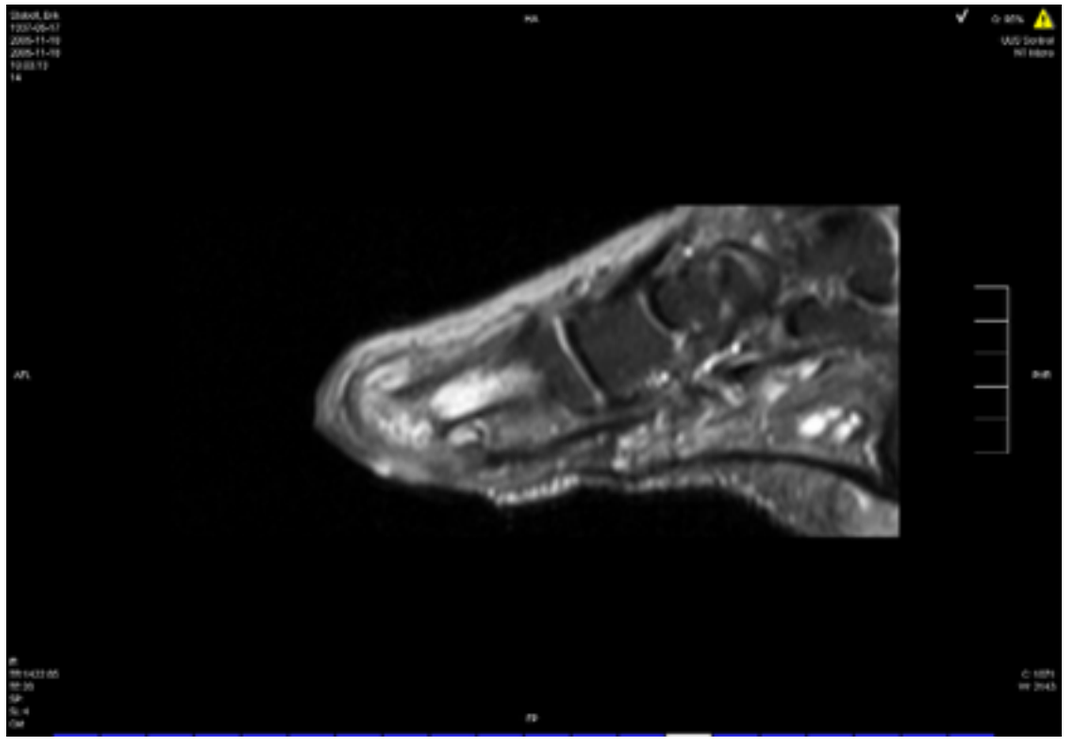
Amputation :

- Revascularization if possible
- Focus of osteomyelitis by MRI



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- Partial foot amputation if possible
  - Selective ray(s) /toes
  - Transmet if >3 lateral og >2 medial

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Neuroarthropathy=Charcot deformity


Normal Foot


Charcot Foot

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Characteristics :

- Spontaneous fracture in and about joint
- Dislocation – destruction
- Most common in the foot
- 3 stages
- Early diagnosis and treatment important

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Treatment :

- Mainly conservative
    - TAFO/CROW
    - TCC
- Insoles
- Surgery ?

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