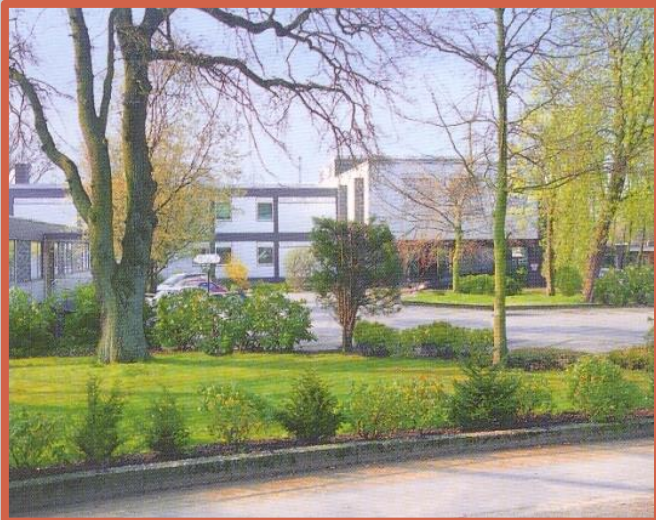


# Charcot Foot: What do we really know?



**R. SPRINGFELD  
FUSSCHIRURGIE  
KLINIK DR. GUTH HAMBURG,  
GERMANY**

**MAIL:  
[DR.SPRINGFELD@DRGUTH.DE](mailto:DR.SPRINGFELD@DRGUTH.DE)**

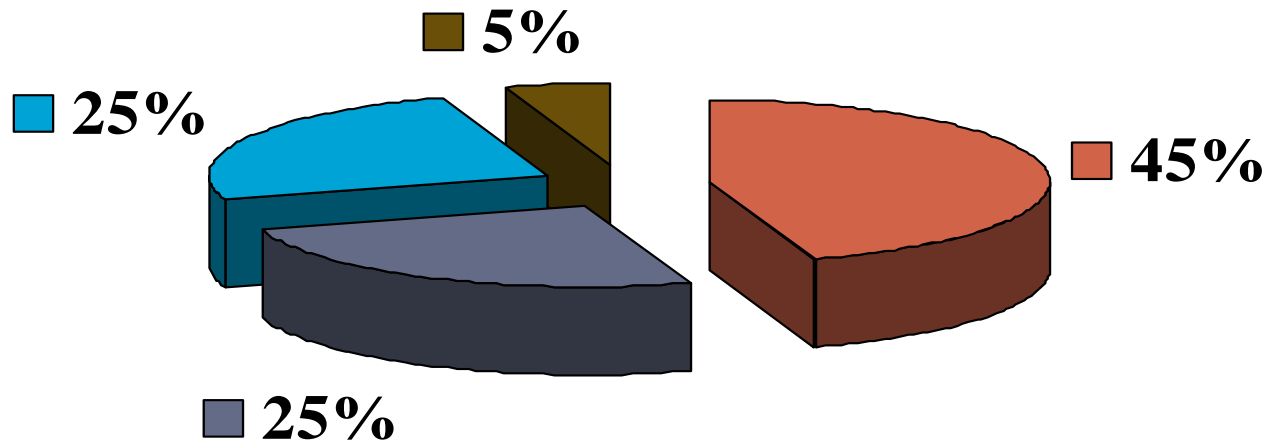
# Charcot (CN): Clinical Appearance



# Etiology of the Foot Lesions

Peripheral Vascular Disease  
(PVD)

Diabetic- Neuro-Osteo- Arthropathy  
(Charcot CN)



PVD+ PNP

Polyneuropathy (PNP)



# Different Types of the Diabetic Foot



**w/o infection**



# Wound Classification acc. Wagner/ Armstrong



Stadiums des Diabets nach Wagner und Armstrong

	1	2	3	4
Wunde	superfizielle Wunde	Wunde bis zur Ebene von Sehnen oder Kapsel	Wunde bis zur Ebene von Sehnen und Kapsel	Nekrose bis zur Ebene von Sehnen und Kapsel
Infektion	mit Infektion	mit Infektion	mit Infektion	mit Infektion
Ischämie	mit Ischämie	mit Ischämie	mit Ischämie	mit Ischämie
Infektion und Ischämie	mit Infektion und Ischämie	mit Infektion und Ischämie	mit Infektion und Ischämie	mit Infektion und Ischämie



# Wagner/Armstrong: 1A (?)





## DFS

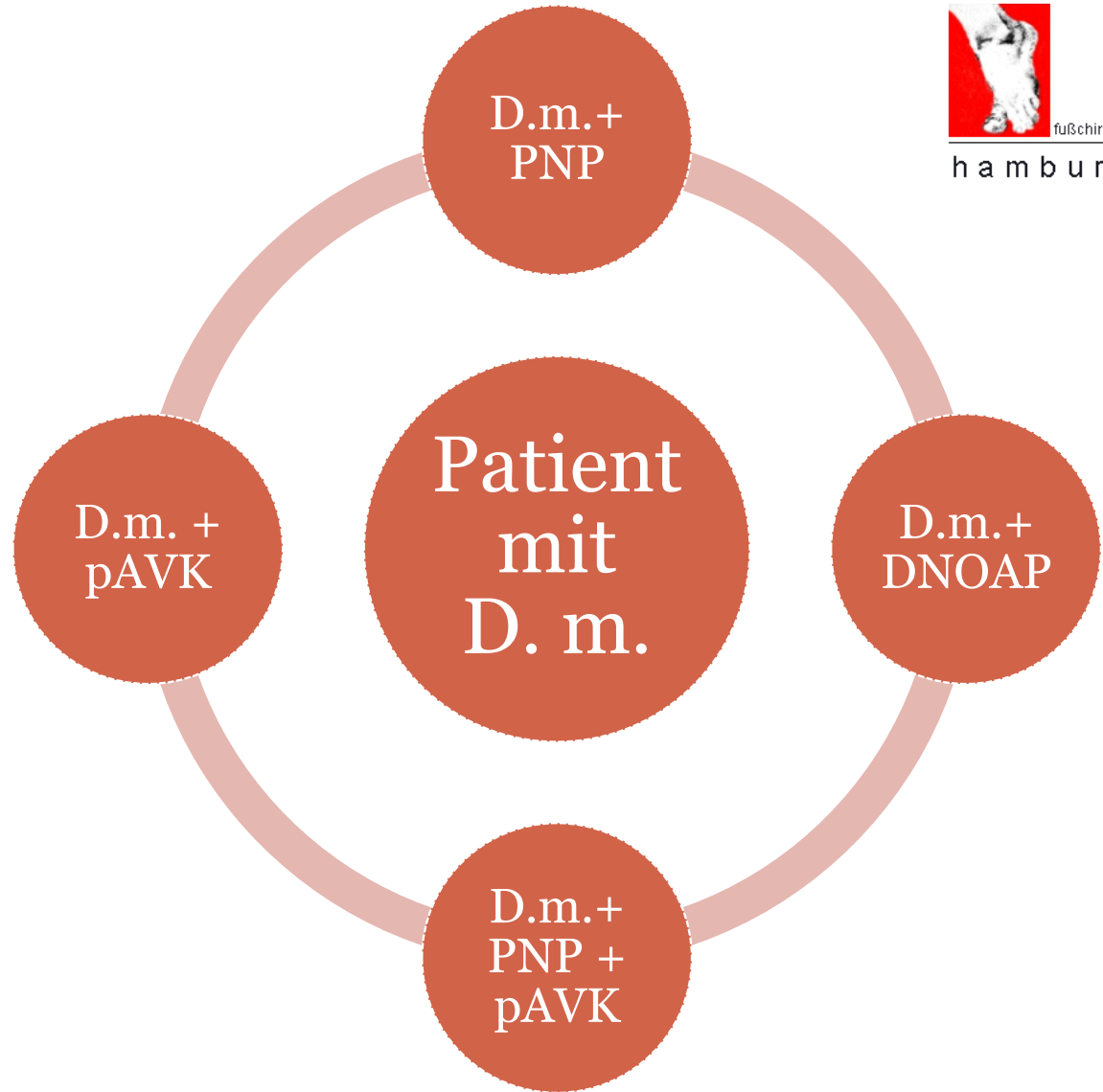
p AVK

PNP

PNP mit Deformation

PNP mit DNOAP

pAVK mit PNP





# CN really a rare Condition?

## USA (2012)

- ADA estimation:  
25 million people with D.m.
- **7,8 %** of population
- CN common complication of D.m.:  
8,5 patients per 1.000 per year

## Germany (2012)

### Regionale Analyse der medikamentösen Behandlungsprävalenz und Arzneimitteltherapie von Diabetes mellitus in Deutschland

Regional analysis of drug treatment prevalence and medication  
of diabetes mellitus in Germany

Autoren

T. Willert<sup>1</sup> J. Walker<sup>2</sup> W. Schramm<sup>1</sup>

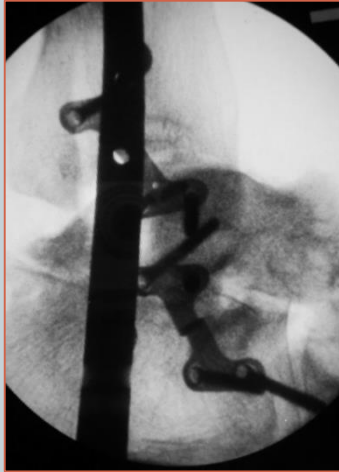
Institut

<sup>1</sup> GECKO Institut für Medizin, Informatik und Ökonomie der Hochschule Heilbronn  
<sup>2</sup> IMS HEALTH GmbH & Co. OHG, Frankfurt/Main

Hamburg	98455	1410844	6,98%
Hessen	389402	5088105	7,65%
Mecklenburg-Vorpommern	161258	1507588	10,70%
Niedersachsen	481275	6861292	7,01%
Nordrhein	617983	8045918	7,68%
Rheinland-Pfalz	275429	3408252	8,08%
Saarland	75034	880912	8,52%
Sachsen	377615	3807881	9,92%
Sachsen-Anhalt	251381	2210858	11,37%
Schleswig-Holstein	154079	2405780	6,40%
Thüringen	214990	2066636	10,40%
Westfalen-Lippe	541200	7363234	7,35%
<b>Gesamt (DE)</b>	<b>5438005</b>	<b>69952132</b>	<b>7,77%</b>



# Treatment Options



# The Charcot Foot: Definition

✓THE HALLMARK DEFORMITY ASSOCIATED WITH THIS CONDITION IS MIDFOOT COLLAPSE, DESCRIBED AS A **“ROCKER-BOTTOM”** FOOT. THE CONDITION CAN APPEAR IN OTHER JOINTS OF THE FOOT AND ANKLE AND WITH OTHER PRESENTATIONS.

✓PAIN OR DISCOMFORT MAY BE A FEATURE OF THIS DISORDER DURING THE ACUTE STAGE, BUT THE LEVEL OF PAIN IS SIGNIFICANTLY DIMINISHED COMPARED TO INDIVIDUALS WITH NORMAL SENSATION AND EQUIVALENT DEGREES OF INJURY.

✓THE SET OF SIGNS & SYMPTOMS THAT OCCUR TOGETHER W/ THIS CONDITION QUALIFIES IT AS A SYNDROME:

✓**CHARCOT FOOT SYNDROME**

# Nomenclature Committee's Recommendation

- ✓ Charcot neuropathic osteoarthropathy (CN)
  - ✓ Charcot foot
    - Charcot's joint disease
    - Charcot arthropathy
- Neurogenic arthropathy
- Diabetic neuropathic osteoarthropathy

ADA Consensus Report: Rogers LC, Frykberg RG, Armstrong DG, et al. The Charcot Foot in diabetes. *Diabetes Care*, September 2011.

# AETIOLOGY OF CHARCOT NEUROPATHY

- sensory neuropathy interfering with the RANK-L /OPG system as a possible explanation for an unleashed inflammatory response to a minor trauma or repetitive stress
- autonomous neuropathy with dysfunctional vascular control and opened AV shunts as a possible reason for local osteoporosis.
- motor neuropathy with paresis of intrinsic foot musculature and consequent development of foot deformity (claw toes, high arched foot) as a reason for increased static and dynamic loading



# Aetiology of the Neuropathy

Perhaps 80% of all patients suffering from polyneuropathy (PNP) have a long standing diabetes mellitus, even if type 2 diabetes was diagnosed just recently.

Alcohol abuse is also contributory to PNP. An additive effect of diabetic metabolism and alcohol or nicotine as neurotoxins has not been examined yet.

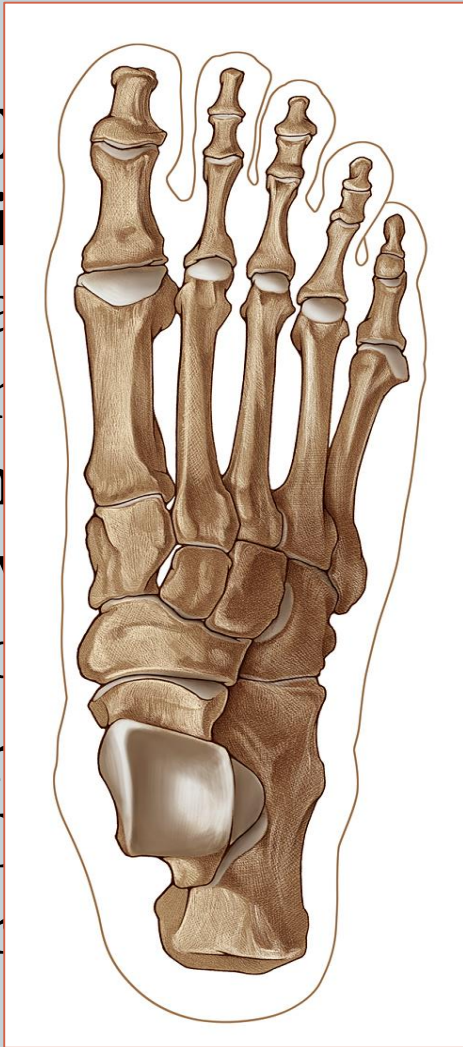
# Neurologic Examination is Key!



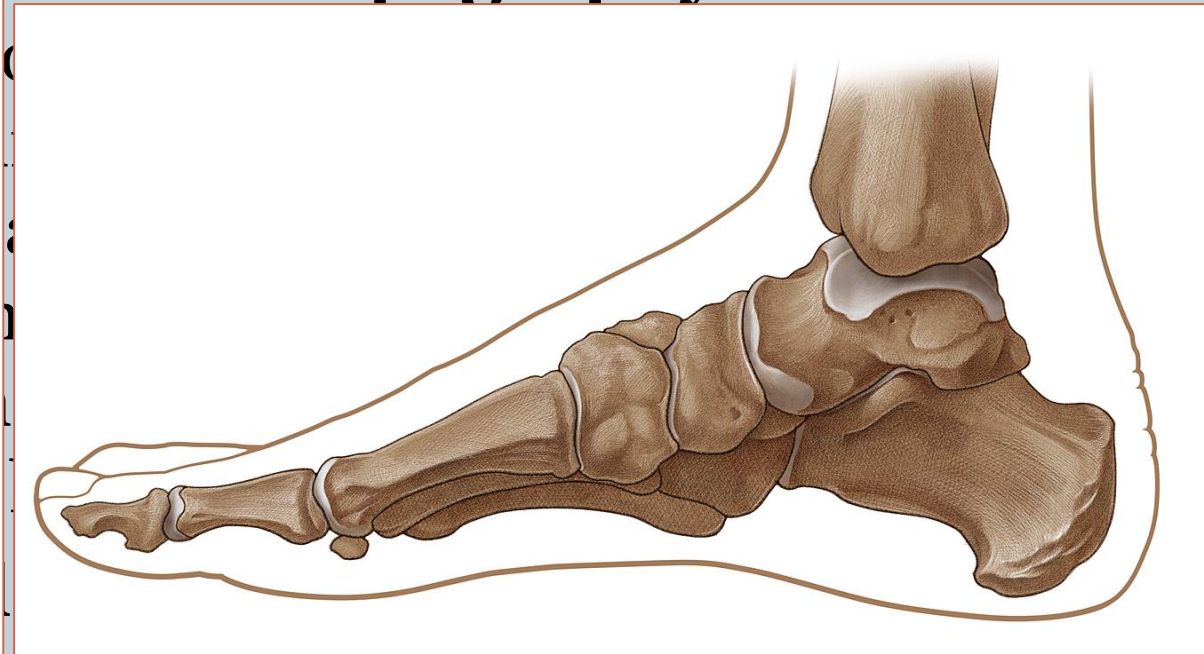
# Classification of Charcot Neuroarthropathy(CN)



CN  
joint  
classification  
similar  
lines  
in  
from  
The  
all  
pr



after the **Topography** of affected



**ction of a specific operative  
n a radiological CN pattern.**

# Classification of Charcot Neuroarthropathy

The **second classification** was established by *Eichenholtz* in 1966 describing destruction as well as repair of joints and bone in the **course of time**.

The stages are named “1 = destruction”, “2 = resolution” and “3 = coalescence”. This clinical (oedema, heat, reddening) and radiological staging system is well accepted internationally.

A “**prodromal**” stage “**o**” could represent a sensible modification in cases of bone bruise on **MRI** without manifest changes on plain x-rays. Another proposal is to **subdivide stage “1” in “1a”** with clinical signs of inflammation and bone bruise on MRI plus “**1b**” with additional osseous destruction visible on conventional radiography.



# Charcot Sanders II, Eichenholtz O



Stage Eichenholtz 1A



**Ulcers** often accompanying CN are best classified using the „**University of Texas Wound Classification System**”. I to III describe ulcer depth; A to D tells if inflammation or ischemia is present in addition to polyneuropathy. Risk of amputation correlates well with the more severe stages (D III).

**Category E** should be introduced in case of dialysis, as practical experience shows a high failure rate of conservative ulcer treatment when end stage renal disease is present.

# Diagnosis of Charcot Arthropathy

**Medical history, clinical examination and conventional radiography** (foot d. p., lateral, mortise view) is sufficient for making the diagnosis of CN. Affected bones and the extent of bone bruise and can be identified precisely with the help of **MRI**.

Any suspicion of *Eichenholtz* stage 0 (or 1a) **must** bring an MRI or a bone scan in addition to plain x-ray.

# Treatment Basics

**Therapy of Charcot neuroarthropathy is conservatively, on principle.**

A deformed but **plantigrade foot** capable of full weight-bearing in a shoe or orthosis and without increase of deformity **is not a candidate for surgery.**

There is **not one single orthosis** for conservative treatment. Each device, TCC, prefab walker, CROW walker or individual AFO, has as different risk-benefit profile and has to be selected by the treating physician.



# Infected Charcot Foot

## **Infected CN are the worst cases!**

To be precise, treatment is no longer targeted to neuro- arthropathy, but has to follow the

## **Rules of septic surgery!**

Even amputations or wide internal resections may be necessary.



# Treatment Acute Charcot



An **acute Charcot** foot may call for in-patient treatment or **off-loading** by means of a wheel-chair over a period of **6-8 weeks**. After decrease of the acute inflammatory stage total weight relief may be replaced by **orthotic treatment** with particular emphasis on **rigid 3-dimensional fixation of foot and lower leg** including elimination of tibial rotation.

**Partial weight bearing is not feasible in the presence of PNP.**

Thus, guidance of weight bearing takes place by limitation of walking time.

# Acute Charcot Dislocation



Closed reduction and retention by means of cast or external fixator is ineffective in case of **acute CN with joint dislocation** and significant instability.

This subtype of CN can only be managed by **open reduction and internal or external fixation (ORIF / OREF)**.

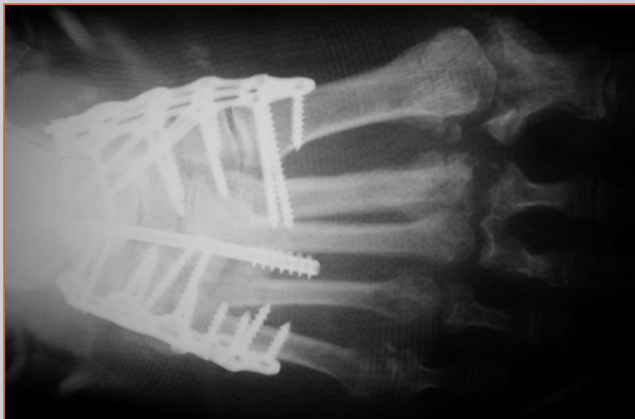
From a biomechanical point of view, the **2-column-model of the foot** has to be taken into account. Fusion of the lateral column should be considered, even if the problem is confined to the medial column only. As soon as **conservative treatment signals unfavourable outcome reconstructive surgery should take place** without waiting for Eichenholtz stage III.

# Charcot Typ Sanders III Acute Dislocation Typ bilateral





# Charcot Typ Sanders III Acute Dislocation Typ bilateral



# Recommendations for Surgical Treatment by ADA

1. SURGICAL TREATMENT IS BENEFICIAL IN CASES REFRACTORY TO OFFLOADING AND IMMOBILIZATION OR IN THE CASE OF RECALCITRANT ULCERS.
2. INITIAL MANAGEMENT OF ACUTE NEUROPATHIC FRACTURES AND DISLOCATIONS SHOULD NOT DIFFER FROM OTHER FRACTURES.
3. **EXOSTOSECTOMY** IS USEFUL TO RELIEVE PRESSURE THAT CANNOT BE ACCOMMODATED WITH ORTHOTICS.

# Recommendations for Surgical Treatment by ADA



4. **LENGTHENING OF THE ACHILLES TENDON** REDUCES FOREFOOT PRESSURE AND IMPROVES ALIGNMENT OF THE REARFOOT TO THE MID- AND FOREFOOT.
5. **ARTHRODESIS** CAN BE USEFUL IN PATIENTS WITH INSTABILITY, PAIN, OR RECURRENT ULCERATIONS THAT FAIL NON OPERATIVE TREATMENT, DESPITE A HIGH RATE OF INCOMPLETE BONY UNION.
6. **FOR SEVERE CN OF THE ANKLE, SURGICAL MANAGEMENT COULD BE CONSIDERED A PRIMARY TREATMENT.**

# Surgical Management of Charcot Neuroarthropathy of Foot and Ankle: A Systematic Review

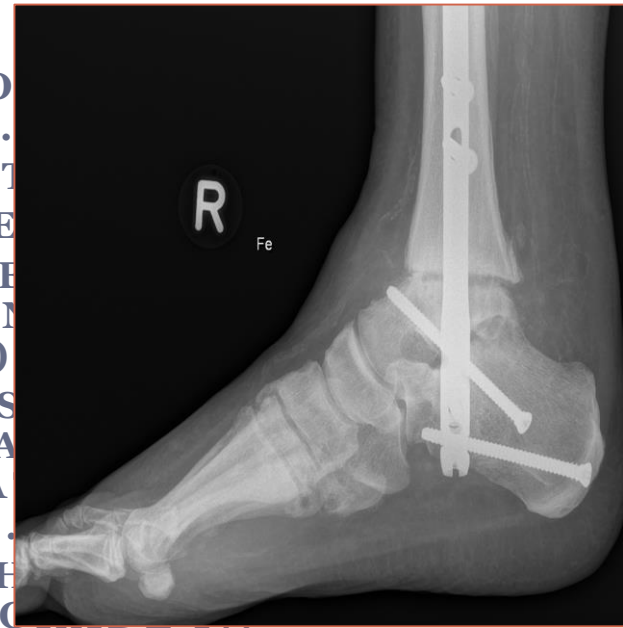
(Lowery, NJ.; et.al.: FAI 2012; 33:113- 121)



1. SURGICAL RECONSTRUCTION
2. MORTALITY
3. EXCELLENCE
4. IMPROVEMENT
5. ARTHROPLASTY
6. INTRAMEDULLARY



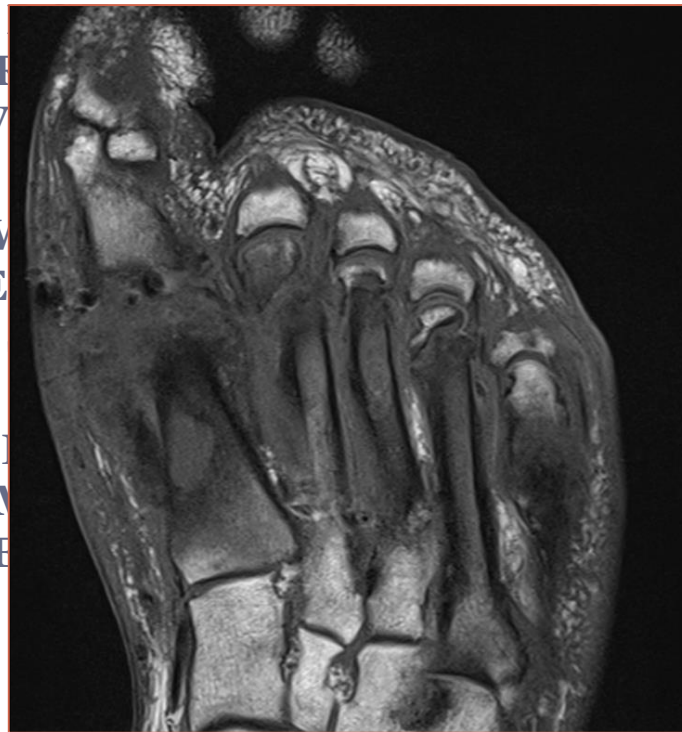
CASE IS INCOMPENSATED  
(GRADE I).  
ON MIDFOOT  
USEFUL TO REDUCE  
DUCES FOREFOOT  
OF ANKLE AND  
(GRADE B)  
IN PATIENTS WITH  
ATIONS THAT  
A HIGH RISK  
(GRADE C).  
EXIST TO THE  
ECTED CN (C)



7. **ALTHOUGH SURGEONS WHO RECONSTRUCT CN MAY FEEL THAT SURGERY IS BENEFICIAL, NO STUDY HAS BEEN DONE COMPARING SURGICAL CORRECTION TO NON-OPERATIVE TREATMENT OR AMPUTATION.**



# Sanders I (Brodsky neglected this type)



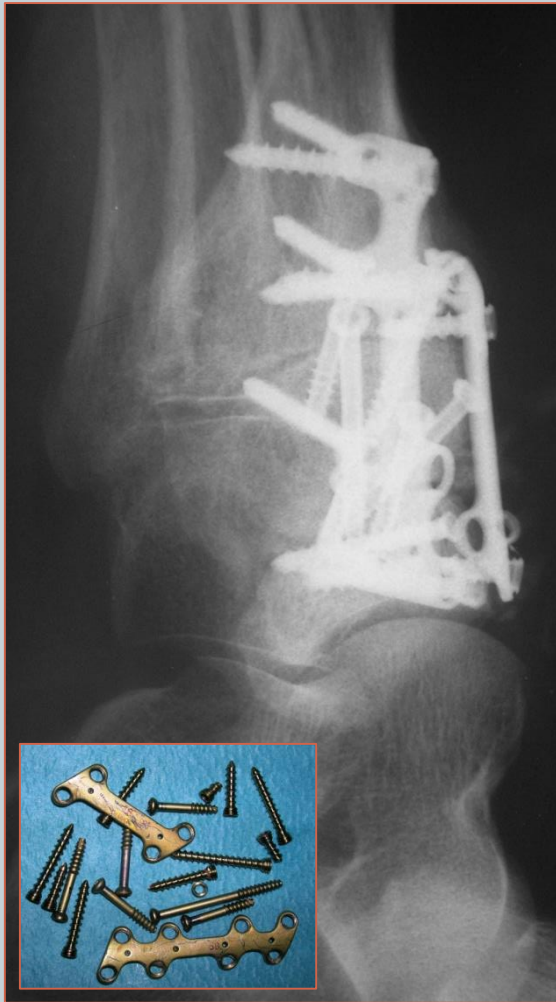
# Sanders II: Lisfranc Joint

A rather common variation is perinavicular involvement and sometimes the neuroarthropathic changes are restricted to the medial or the lateral column.

**Diverging Dislocations** are seen as well as deviations of all metatarsals to the medial or lateral side. A frequent pattern of deformity with this type of CN is forefoot abduction together with flattened medial arch and heel valgus.



# Internal Fixation of Sander II may fail!



# Sanders II: Lisfranc Joint



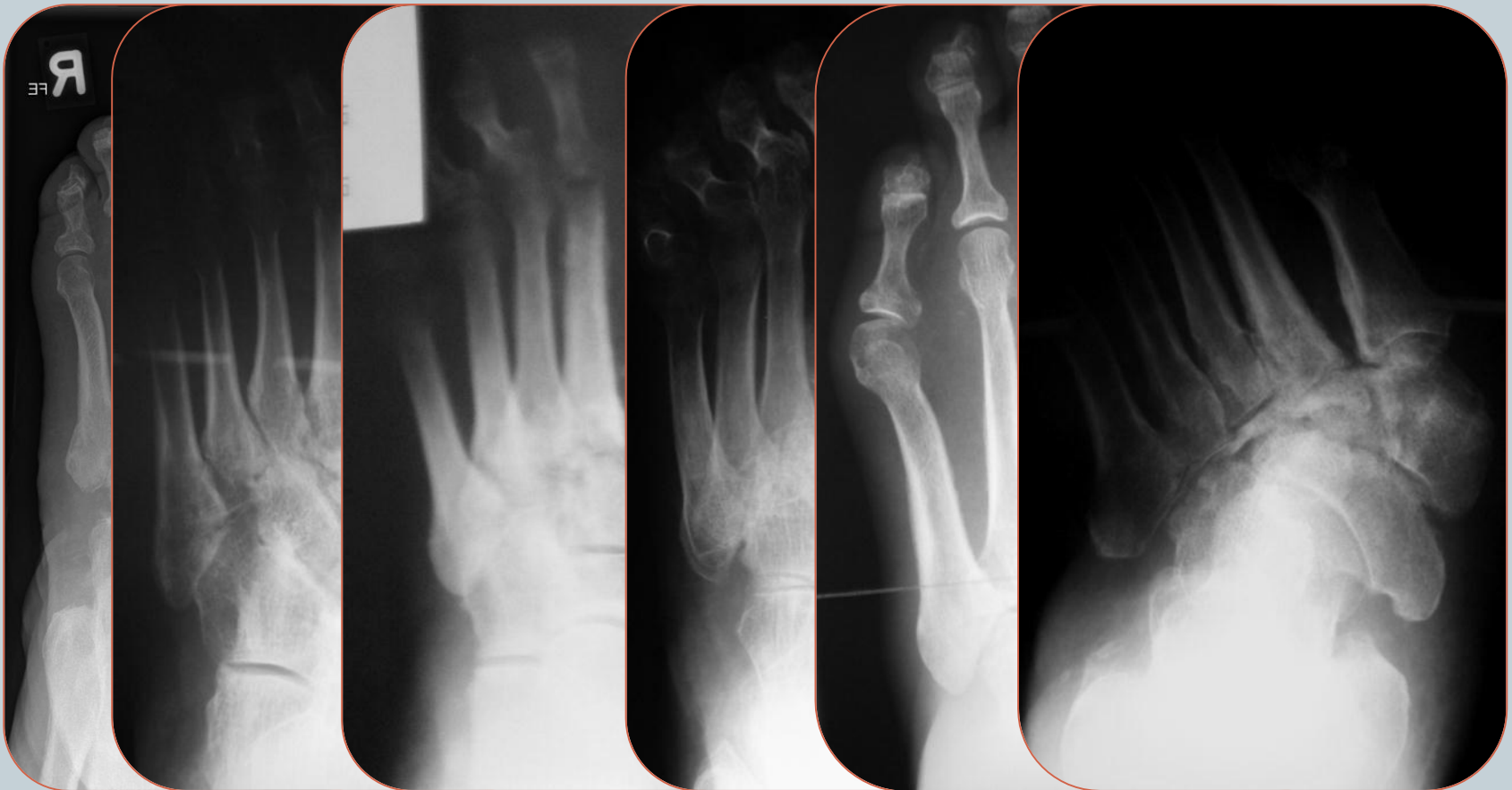
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# Are There Typical Destruction Patterns?



# Sanders III: Chopart Joint



Combination with the Hindfoot

Typical deformity  
bottom foot  
of the foot  
key role for  
foot and leg  
challenging

At least, in  
order to maintain  
case of double  
successful

Length correction  
requires **subtractive arthrodesis**.



is a rocker  
-lying part  
**joint** holds a  
ments of  
n are

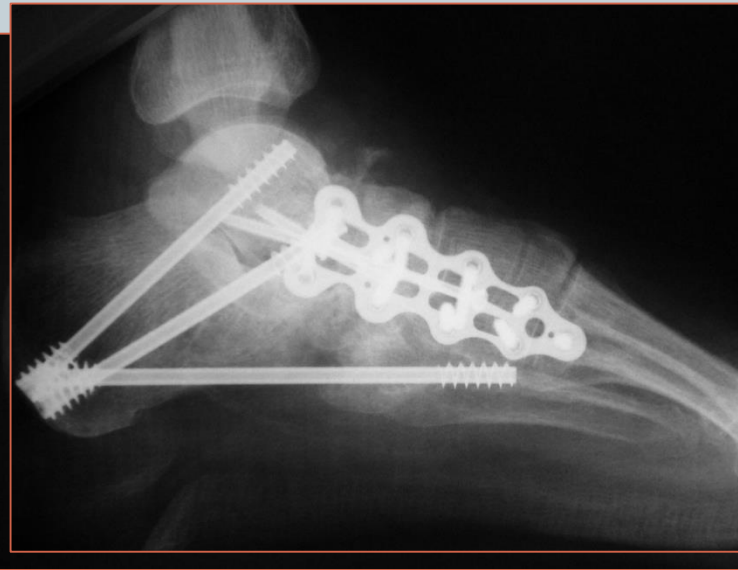
visible in  
e talus. In  
ntor for

ral column

# Sanders III: Chopart Joint



# Stable Internal Fixation



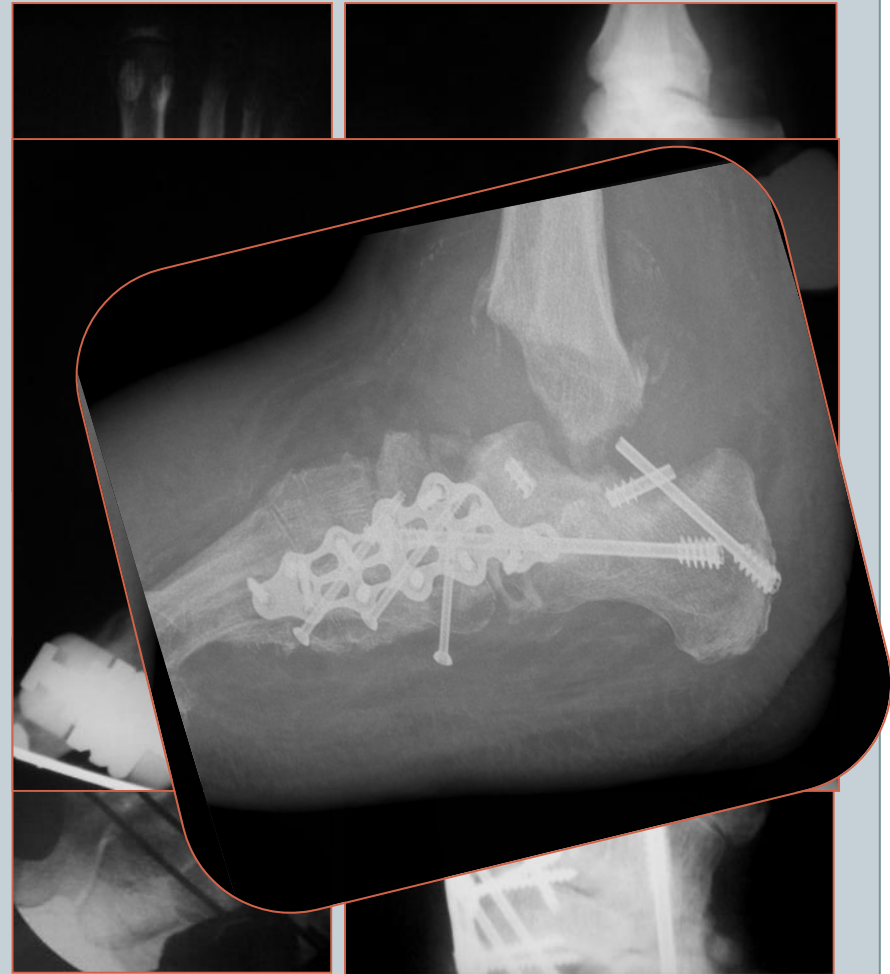
Sanders III > subtalare Fusion  
Sanders II > Fusion laterale column



# Sanders III

## Unexplained:

- subtalar fusion in Sanders III in CN without manifestation of CN in STJ
- Recommendation of osteosynthesis: intern +/- extern
- ATL always, when Gastroc or ATL
- Surgical technique: stabile T- N fusion, how?



# Sanders IV: Ankle , Subtalar Joint



**Frontal plane** deformities in the region of the hindfoot are hardly to manage conservatively, in particular in case of instability.

Surgery aims at solid ankle fusion with broad contact area.

**Astragalectomy** may be a valuable option in the event of an extensive and rigid deformity in order to overcome soft tissue contracture.

**Tibio-calcaneal arthrodesis** in the following needs a months-long duration of orthotic aftertreatment with axial loading of the hindfoot.

# Sanders IV: Ankle, Subtalar Joint



# Instability: Charcot Sanders IV bilateral





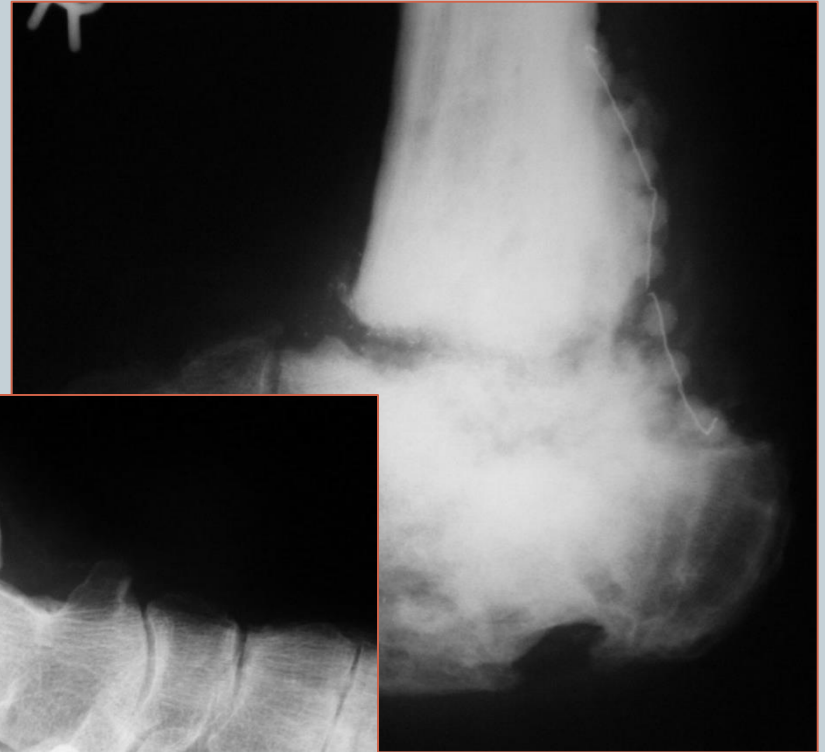
# Sanders V: Calcaneus



option.



# Sanders V: Calcaneus



# Conclusion

- Existing **classificationones** define the **CN insufficient**
- clinical **relevant destruction patterns** which lead to a defined treatment are **not to discover**
- Treatment of **Charcot Arthropathy** is mainly based on the **Experience of single Surgeons**
- Todays surgical therapy correspond to Evidence Level **IV: Good Medical Praticice**

# Thank You for Attention!





