

NON-UNION

Treatment Objectives and principles - a practical approach





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NON-UNION

in diaphyseal fractures of the lower limb

Non Union: Nine month old fracture with no healing progress for 3 months (FDA 1986)






Delayed Union: Failure to consolidate within the normally expected time

New definitions focus on TIME AND PROGRESS:

Delayed union: The healing process does not occur within the expected time interval

Non- Union: The healing process has stopped

Characteristics of various types of nonunion

Vascularized		Avascular		
hypertrophic/vital	atrophic	atrophic	ischemic	defect
				
elephant foot	horse hoof			

TREATMENT OBJECTIVES

- * NON UNION:
 1. eliminate pain (cave painless nonunions exist!)
 2. achieve bony healing
 3. restore function
 4. restore alignment (rotation?)

Delayed UNION
avoid evolution towards Non-union

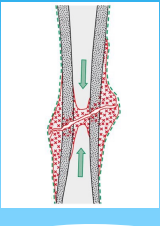
TREATMENT OPTIONS

- * Conservative Treatment (delayed union)
 - * weight bearing restriction (less motion at the fracture)
 - * plaster cast (adding stability!)
 - * Electrical stimulation- Ultrasound- Shock wave???

SURGICAL TREATMENT

Redo ORIF: COMPRESSION! Exchange nailing
Bone graft
Flap (free- pedicle)

Characteristics of hypertrophic nonunion





- Biology: good
- Stability: lacking

Therefore treatment consists of:

- Providing stability
- Correct deformity, if present
- No bone graft required

Vascularized


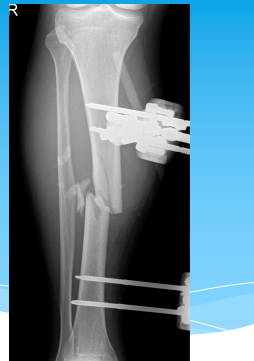
hypertrophic/vital

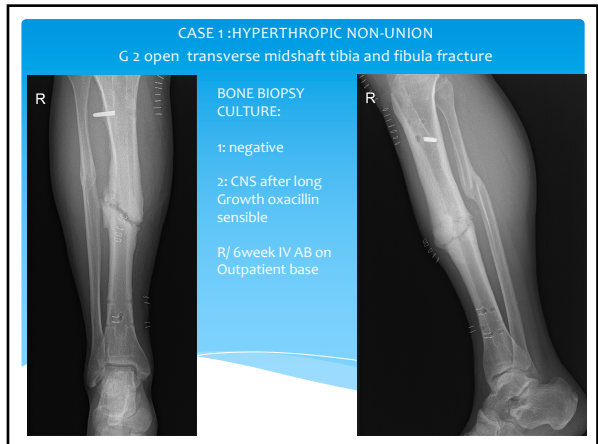
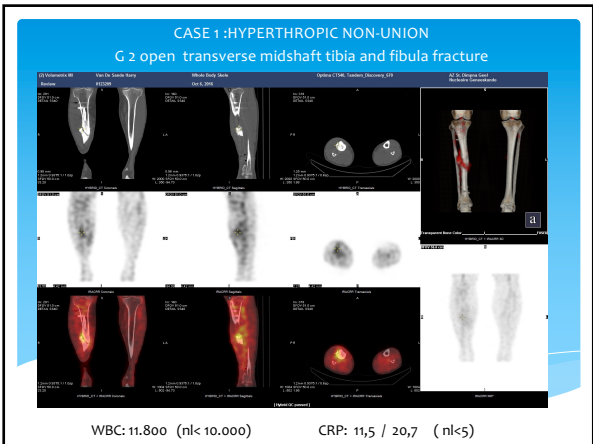
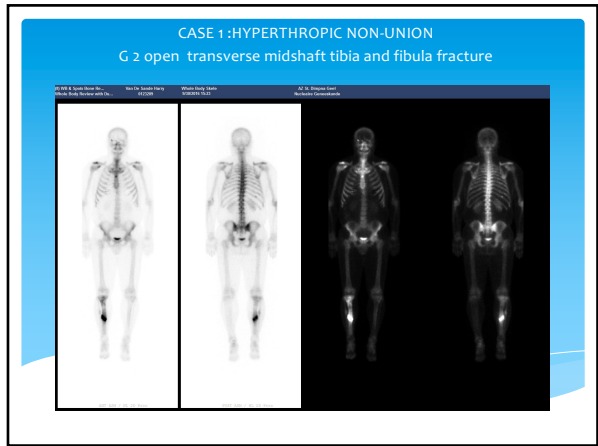
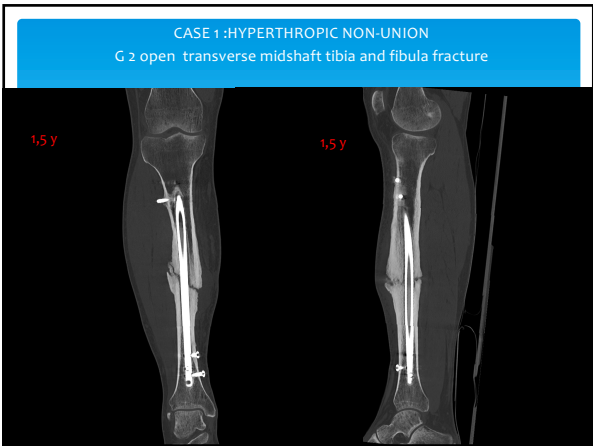
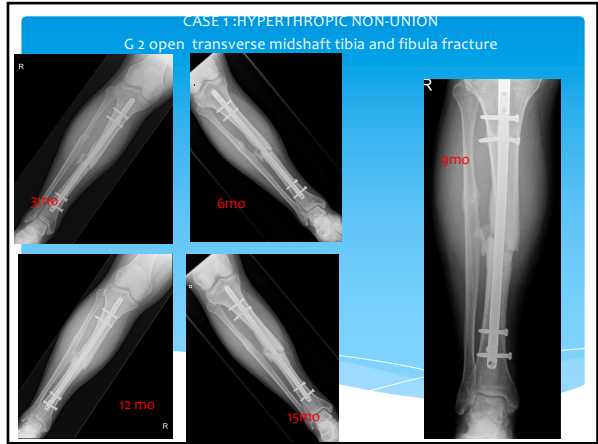
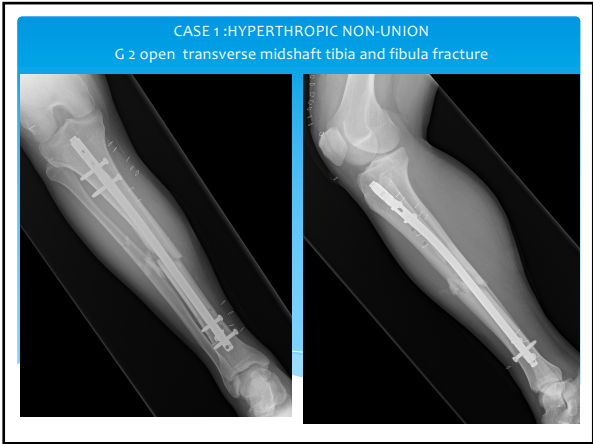



elephant foot
horse hoof

CASE 1 :HYPERTROPHIC NON-UNION

G 2 open transverse midshaft tibia and fibula fracture



CASE 1: HYPERTHROPIC NON-UNION

EXCHANGE NAILING:

TREATMENT PRINCIPLES

1. LARGER NAIL: 10mm-12mm
2. FRACTURE COMPRESSION: BACKSLAP
3. FIBULAR OSTEOTOMY
4. STABILITY ENHANCEMENT: ASLS
5. IMMEDIATE DYNAMISATION

CASE 1: HYPERTHROPIC NON-UNION

9 months after exchange nailing: full union

CASE 1: HYPERTHROPIC NON-UNION

9 months after exchange nailing

CASE 1: HYPERTHROPIC NON-UNION

G 2 open transverse midshaft tibia and fibula fracture

LESSONS LEARN FROM THIS CASE

HYPERTHROPIC NON-UNION is due to

1. BIOMECHANICAL FACTORS:
 - Insufficient fracture stability : a larger Nail diameter would have been better (12mm instead of 10mm) and ASLS
 - Transverse fracture pattern
 - Insufficient reduction and fracture compression: not enough Backslapping
2. BIOLOGIC FACTORS: OPEN FRACTURE LOW GRADE INFECTION

CASE 1: HYPERTHROPIC NON-UNION

G 2 open transverse midshaft tibia and fibula fracture

6 mo

LESSONS LEARN FROM THIS CASE

TREATMENT PRINCIPLES

- 1 After open fracture: suspect and rule out or treat infection
2. TIMING:
 - DO NOT WAIT TOO LONG!
 - if No progression of healing at 6w Or at 3 mo interval
 - Go on to secondary procedure!!!!

Characteristics of hypertrophic nonunion

- Biology: good
- Stability: lacking

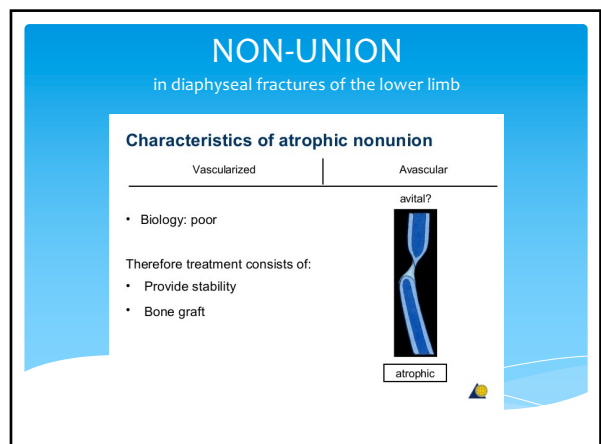
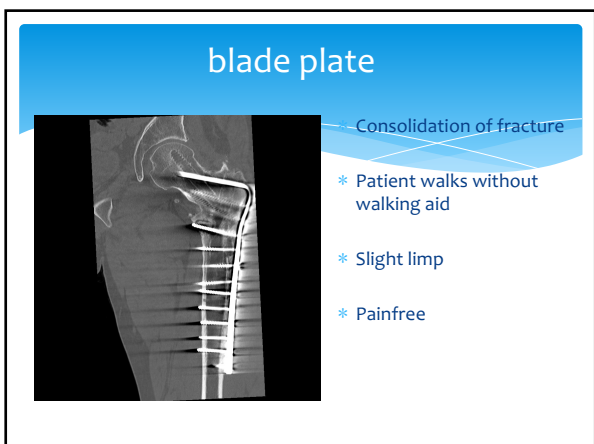
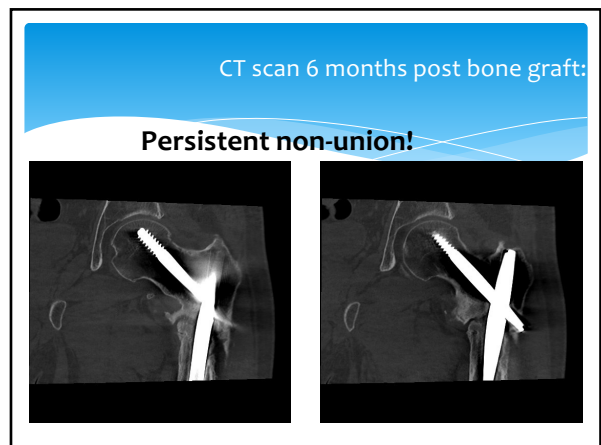
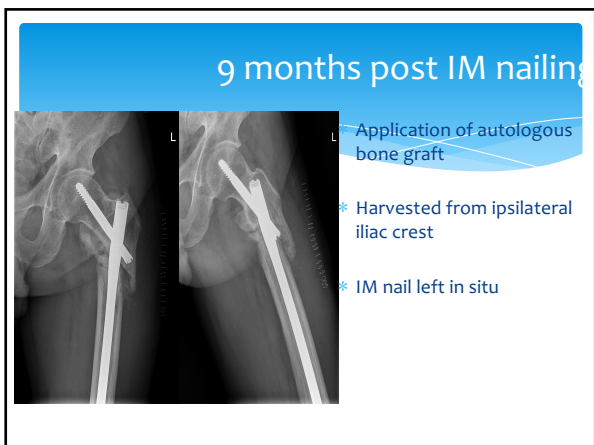
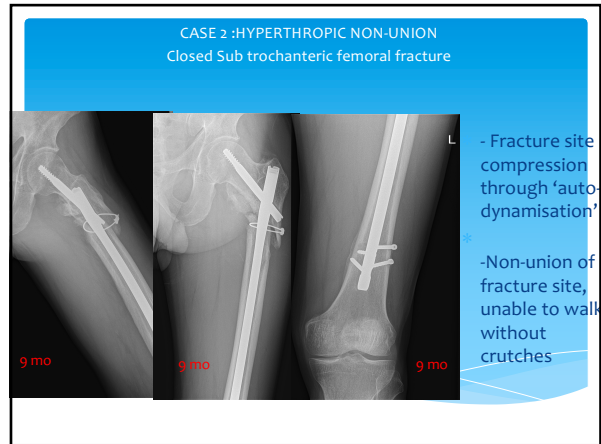
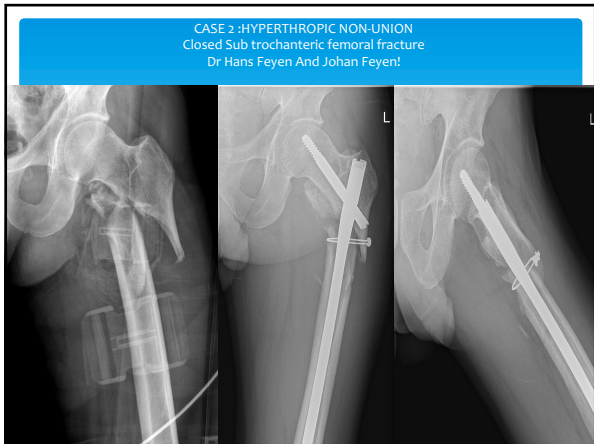
Therefore treatment consists of:

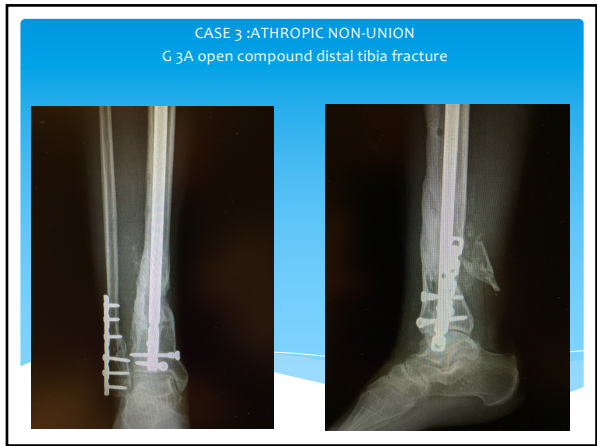
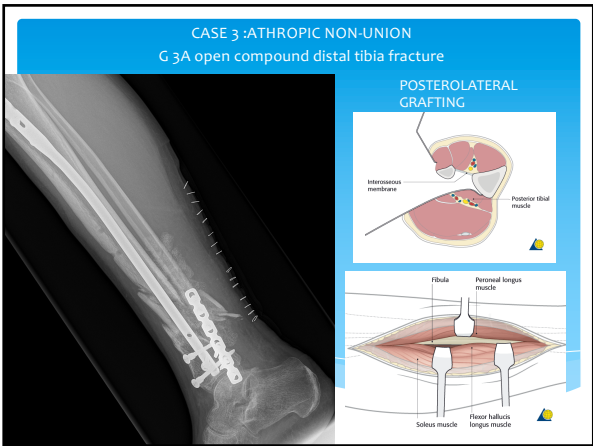
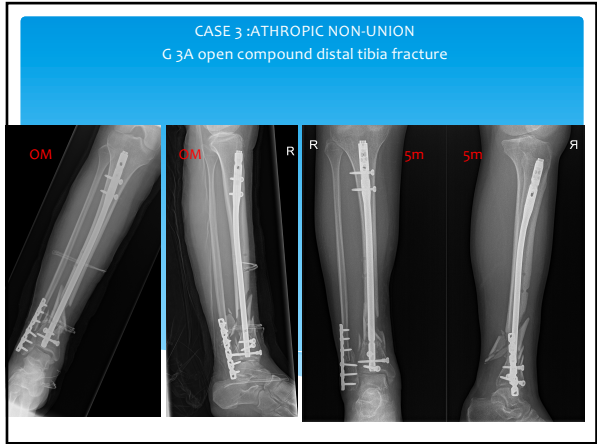
- Providing stability
- Correct deformity, if present
- No bone graft required

Vascularized

hypertrophic/vital

elephant foot horse hoof





CASE 3 :ATHROPIC NON-UNION

BONE GRAFT OPTIONS:

1. Allograft spongious chips
2. Autograft: * Iliac crest
* RIA (Reamer / Irrigator / Aspirator)
3. BMP – OP1

BMP 7 (OP-1)

- Tibial non-unions
 - RCT OP1 v autogenous graft
 - No difference in union rate
 - Less infections
 - Costly (\$10000-20000)
- Open Tibia
 - OP1 v control
 - Less secondary interventions

CONCLUSION : TAKE HOME MESSAGE

DIAGNOSIS	TREATMENT
Case 1: hypertrophic	R exchange nailing
Case 2: hypertrophic	R blade plate
Case 3: atrophic	R Bone graft

STABILITY!!!

BIOLOGIC matrix and bone cells!!!

CONCLUSION : TAKE HOME MESSAGE

DO NOT DO THIS!

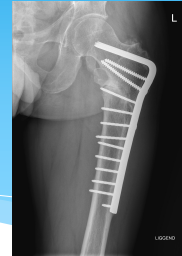
Bone grafting a hypertrophic
Non union without adding stability!



CONCLUSION : TAKE HOME MESSAGE

BUT DO THIS!

REVISE EARLY TO A STABLE CONSTRUCT
COMPRESSING THE FRACTURE!



CONCLUSION : TAKE HOME MESSAGE

Non-union Treatment principles:

1. TIMING: Revise early: do not wait to long; no progression at 6w interval!
2. HYPERTROFIC (stability) vs ATROPIC (biology): think again!
3. In open fractures rule out or treat INFECTION
4. Revision ORIF: COMPRESSION!
5. GRAFT: autograft on muscle bed
6. Environment doubtful: Free flap