

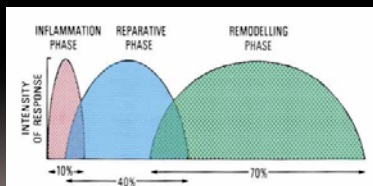
WHEN TO ADD BONE STIMULATION

John Ketz, MD
CSFS 2017

Bone Healing



- Fracture Hematoma (Immediate)
- Inflammatory Phase (Days)
- Reparative Phase (Weeks)
- Remodeling Phase (Months)



1/30/2017

2

Bone Healing



Multiple factors

- Location in the body
- Patient factors
- Surgical vs. Nonsurgical

1/30/2017

3

Bone Healing


- Location
 - Not modifiable



1/30/2017 4

Bone Healing

- Patient factors
 - Modifiable?
- Diabetes
- Smoking
- Malnutrition
- Age
- Irradiation
- EtOH Abuse
- Venous stasis



1/30/2017

Bone Healing


- Surgical vs. Nonsurgical
 - Modifiable



1/30/2017 6

Nonunion/Delayed Union

- Nonunion
 - No radiographic healing 6-9mo
 - No change on 3 consecutive monthly x-rays
- Delayed union
 - Has not advanced at "average" rate for similar fractures



1/30/2017 7

Treatment of Nonunions

- Have to figure out why it didn't heal and what you can change




1/30/2017 8

Treatment of Nonunions

Surgical

- Stabilization
- Bone grafting
 - Autograft, Allograft
- Adjuvants?
 - BMP-2, PRP, DMB




1/30/2017 9

Nonunions

- What about noninvasive options?

BONE GROWTH STIMULATORS

1/30/2017 10




Background

- 1950's - Ultrasound useful for fractures
 - *Corradi Acta Orthop 1953.*
- 1970's - Clinical use of electrical currents and electromagnetic fields
- 1980's - ultrasound

- Led to increasing physician and industry interest


1/30/2017 11



Bone Stimulators

- 3 main types
 - Electrical
 - Capacitive coupling
 - Electromagnetic
 - Pulsed
 - Continuous - combination of direct and alternating current
 - Ultrasound

1/30/2017 12



Bone Stimulators

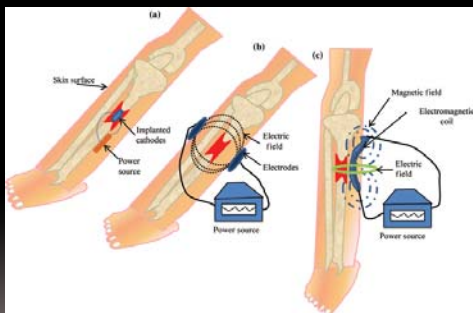


Principle is that it uses external stimulation to create a cellular response to initiate a bone healing response.

1/30/2017

13

How It Works (electrical)

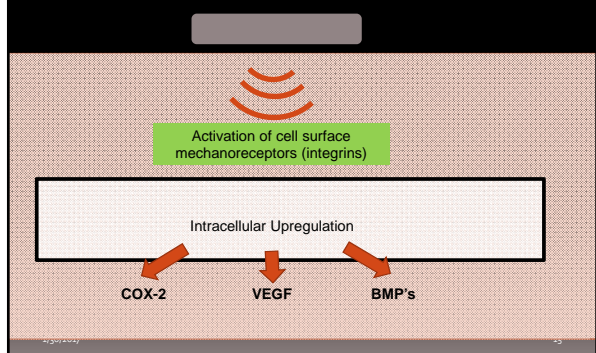


1/30/2017

Griffin et al. - eplasty open access

14

How It Works (ultrasound)



1/30/2017

15

Length of Use

- Wear time
- Electrical 2-4 h/day
- EMF/Ultrasound 20-30min/day



1/30/2017 16

Applications

- Fresh Fractures
- Nonunions
- Spinal Fusions
- Other uses
 - Complicated fusions
 - Osteotomies
 - AVN

1/30/2017 17

Nonunions/Delayed Union

- Revision surgical nonunions
- Nonoperatively treated fractures
 - Atrophic, oligotrophic
- Likely the best indication for the use of bone stimulators
 - "Is there anything else other than surgery"

1/30/2017 18

Nonunion

- 16 yo football player twisted his foot in last game of the season.




1/30/2017 19

UNIVERSITY OF ROCHESTER MEDICAL CENTER

Nonunion

- 4 mo referred due to concern of healing
- Pain in boot
- Refused surgery



1/30/2017 20

UNIVERSITY OF ROCHESTER MEDICAL CENTER

Nonunion

- 6 mo using inserts, no boot, no pain
- Was running without pain



1/30/2017 21

UNIVERSITY OF ROCHESTER MEDICAL CENTER

Nonunion

- 50 y.o. woman s/p fall from horse
- Conservative treatment with cast and limited weight bearing
- No healing at 3 months
- Pain over nonunion



1/30/2017

Medial Malleolus Nonunion

- 5 weeks after BG stimulator started still with pain
- Used walking boot "at times"



1/30/2017

Medial Malleolus Nonunion

- 10 weeks after BG stim started
- No significant healing
- Minimal pain thus no surgery
- BG stimulator continued



1/30/2017

Medial Malleolus Nonunion


- 4 months after BG stim
- Healing occurring
- Less pain



1/30/2017

Medial Malleolus Nonunion

- 7 months after BG stim
- Healed
- No pain
- Full function



1/30/2017

Fresh Fractures


- Mostly studied in tibial fractures (distal radius)
- Accelerated bone healing/Decreased delayed healing
 - *Bussie et al CMAJ 2002*
 - *Cook et al CORR 1997*
- Randomized trial for tibia fractures (IM rod)
 - No difference compared to placebo
 - *Enami JOT 1999*

1/30/2017

Fresh Fractures

Not all fractures need a bone stimulator to heal

Not all fractures or patients are created equal




1/30/2017 28

Fresh Fractures

- 48 yo female with open R pilon fracture

Smoker (1-2ppd)
Diabetes (HbA1C ~8)
Neuropathic
Ulcerative Colitis (on steroids)



1/30/2017 29

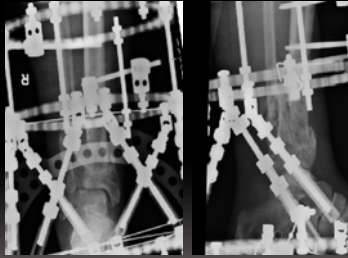
Fresh Fracture

- 4wks
Non healing anteromedial wound



1/30/2017 30

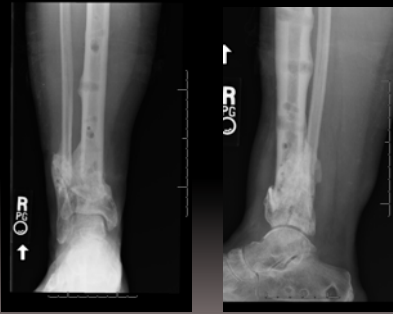
Fresh Fracture



1/30/2017 31

UNIVERSITY OF ROCHESTER MEDICAL CENTER

Fresh Fracture



1/30/2017 32

UNIVERSITY OF ROCHESTER MEDICAL CENTER

Primary Fusions

PEMF and Hindfoot Arthrodesis

- Prospective randomized
- 64 pts., Triple or subtalar arthrodeses
- Control vs. PEMF (12 hrs. / day)
- Increase the rate and speed of radiographic union
- 0 nonunions PEMF group vs. 5 in control group

Dhawan SK et al. J Foot and Ankle Surg 2004

1/30/2017 33

UNIVERSITY OF ROCHESTER MEDICAL CENTER

Difficult Fusions

Ankle and Hindfoot

- Risk of Nonunion 5-40% for ankle fusions and 16% for subtalar fusions
- 3-4 times higher for smokers
- Other risk factors:
 - Infection
 - A.V.N.
 - Previous nonunion
 - Previous adjacent fusion
 - Major medical problems

1/30/2017 34

Difficult Fusions

- 64 y/o diabetic
- Charcot ankle and midfoot



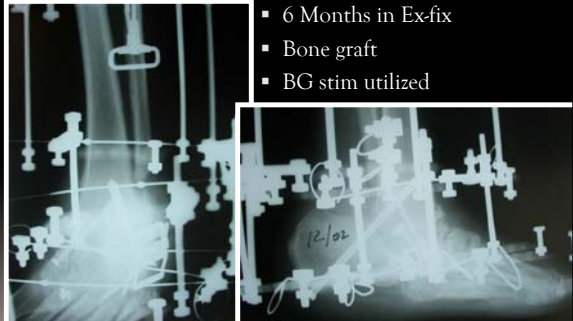
Difficult Fusions

- 64 y/o diabetic
- Charcot ankle and midfoot



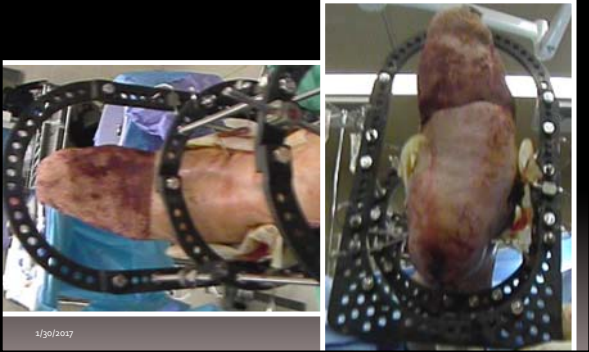
Difficult Fusions

- Internal fixation
- 6 Months in Ex-fix
- Bone graft
- BG stim utilized



UNIVERSITY OF ROCHESTER MEDICAL CENTER

Difficult Fusions



UNIVERSITY OF ROCHESTER MEDICAL CENTER

Difficult Fusions

- Doing well >8yrs



UNIVERSITY OF ROCHESTER MEDICAL CENTER


Difficult Fusions

- High Risk Ankle and Subtalar Fusion
 - ORIF+BG - 12/13 healed
 - Doney and Ward Foot Ankle Int 2002*
- Revision Ankle Fusions
 - 10/10 healed with exfix + stimulator
 - Midis and Conti Foot Ankle Int 2002*

1/30/2017 40

Avascular Necrosis

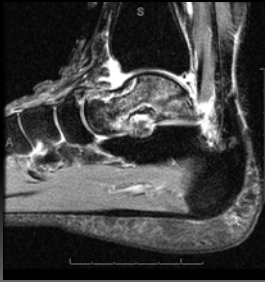
- 23 yo nurse with spontaneous R ankle pain



1/30/2017 41

Avascular Necrosis

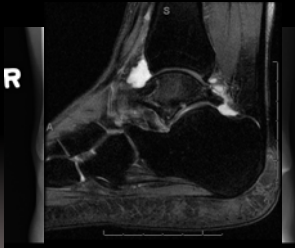
- 6 wks - no response
- MRI



1/30/2017 42

Avascular Necrosis

- 6 mo with continued pain and new radiographic changes
- Patient offered surgical drilling +/- Bone stim



1/30/2017 43

My Bone Stimulator Use

- Minimal use in my practice
- Patient preference
 - Nonop fractures with poor blood supply
- Difficult fractures with limited ability to mechanically stabilize
- Patient factors/Comorbidity

1/30/2017 44

Summary

- Bone stimulators have evidence to suggest that they increase time of healing
- They have relatively little risk
- Increasing conditions which they are covered by insurances
- They **DO NOT** replace the need for good technical practices and decision making for treating difficult problems

1/30/2017 45
