Low-intensity Pulsed Ultrasound
Accelerated Bone Repair

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Overview of Presentation

- What is low-intensity pulsed ultrasound?
- How is it utilized?
- Trials covering different aspects of LIPUS
- Strengths and weaknesses, major faults.
- Future of LIPUS

What is ultrasound?

- Sound waves with frequencies higher than the human ear can perceive.
- Most ultrasound devices range from 20kHz frequency up to several gigahertz.
- Mainly used in imaging of the body

What is LIPUS?

- Low-intensity pulsed ultrasound
- 1.5 MHz frequency that pulses with a width of 200μs, repeating for twenty minutes.
- Lower ultrasound frequency, which allows the sound to penetrate the skin, muscles, tissues and ligaments

Stage 1 : Impact

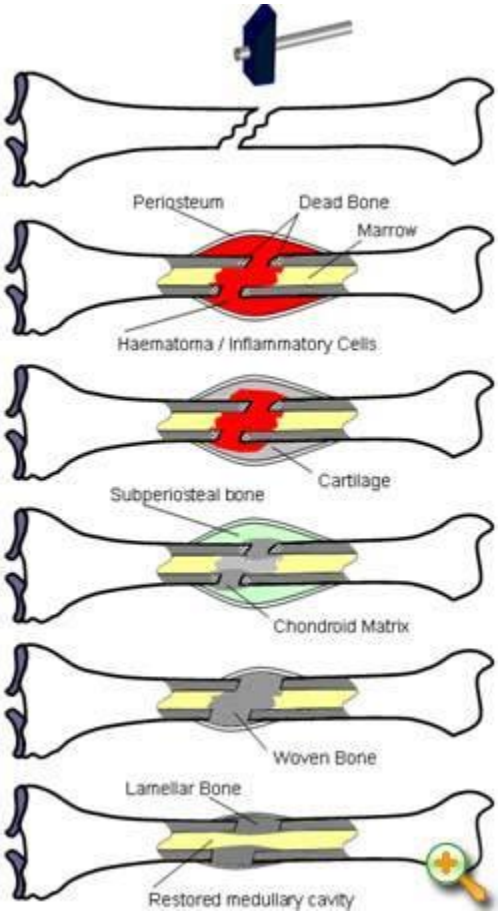
Stage 2 : Induction

Stage 3 : Inflammation

Stage 4 : Soft Callus

Stage 5 : Ossification

Stage 6 : Remodelling



How is it used?

- Device can vary from a large ultrasound machine, used for imaging to small handheld devices for home use.
- Handheld version has a small device and attached node that emits the ultrasound.
- Ultrasound is applied to directly over fracture site.

What is happening?

- Ultrasound applies small amounts of stress to the site of the fracture
- Stimulates cellular activity and blood-flow to the area. LIPUS has been shown to increase the activity of osteoblasts and chondrocytes
- Increase rate of ossification during callus stage of bone regeneration.

Trials testing effectiveness of LIPUS

Trial	Radiographic definition of fracture healing*	Mean days to fracture healing or fraction of patients healed (no. of weeks)		Statistical significance (*P* value)
		LIPUS	Placebo	
Malleolar Handolin *et al*., 2005[34]	Callus formation	14/15 12th postop. week)	12/15 (12th postop. week)	No
Handolin *et al*., 2005[40]	Callus formation	8/10 (12th postop. week)	9/11 (12th postop. week)	No
Radial Kristiansen *et al*., 199[75]	Bridging of 4 cortices	61 ± 3 days	98 ± 5 days	Yes $P < 0.0001$
Tibial Heckman *et al*., 1994[41]	Bridging of 4 cortices Bridging of 3 of 4 cortices	114 ± 7.5 days	182 ± 15.8 days	Yes $P = 0.0002$
Leung *et al*., 2005[42]	Bridging 3 of 4 cortices	11.5 ± 3.0 weeks	20 ± 4.4 weeks	Yes $P < 0.05$
Emami *et al*., 1999[37]	"Signs of healing like cortical thickening"	155 ± 22 days	129 ± 12 days	No
Rue *et al*., 2004[43]		56.2 ± 19.6 days	55.8 ± 15.5 days	No

*Although individual trials may have reported other criteria for fracture healing, signs of radiographic healing were of interest for the current review.

Advantages to using LIPUS

- Shows slight advantage over traditional methods of fracture treatment (setting and cast).
- Easy and quick procedure with little discomfort for the user.
- Room for growth and expansion of technology

Disadvantages to LIPUS

- Trials conducted were mostly inconclusive and had skewed results (i.e. athletic patients)
- Has shown to not affect recovery of fractures in entire studies.
- Bias results with trials being conducted with members of companies selling devices.
- Devices being sold to the public are mostly placebo, with little to no effect on fractures

Future of LIPUS

- More robust studies, with wider range of patients
- More variations of tech, with designs specifically for regions of the body
- Further research into the effects of ultrasound on the chemical and molecular level of fractures.
- Expansion into other fields of medicine, such as drug delivery with implanted device, and add new applications.

Questions?