810 NM LIGHT THERAPY IMPROVES AXONAL REGENERATION AND FUNCTIONAL RECOVERY FOLLOWING ACUTE SPINAL CORD INJURY

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- 11,000 new cases year
- 55% between 16-20 y/o
- 46% in the thoracic or lumbar region
- Her interest is in the secondary injury
  - Demyelination
  - Axonal degeneration
  - Neuronal death
  - Cavitation
  - Glial scarring
  - Inflammation
    - Cytokines
    - Cell invasion: neutrophils, macrophages and activated microglia
  - All of which exceed the injured area

Treatments
- Current
  - Anti-inflammatories: methylprednisolone
  - Removal of inhibitory factors
  - Growth factors
  - Transplantation
- Light therapy in low doses can have stimulatory effects
  - Increases DNA< RNA and protein synthesis
  - Improves axonal
- High dose > 10 J/cm2 can have the reverse, negative effect

Hypothesis: transcutaneous application of light promotes axonal regeneration and functional reenervation of spinal cord neurons following transection in rats

- Can light penetrate the spinal cord?
  - 810 nm, 150 mW laser, measure penetration: got 50% transmission through tissues, except higher in blood
  - Got 9 mw to spinal cord
  - In vivo measurements showed a peak of wavelength for deep penetration at 800-810 nm
  - Conclusion 810 nm light optimal to penetrate to spinal cord
- Transected rat spinal cords
- 810 nm 150 mW, 29 minutes, 57 seconds, 14 days = 1589 J/cm2 per day
- Through a fiberoptic fiber that gave a homogeneous beam
- Found increased axons distal to the lesion 5 wks post injury
- Laser treated had 9 mm of growth past the lesion, control had 3 mm???
• 10% actual axonal regeneration in laser treated group

Spinal cord injury and function
• Laser treated were able to cross a ladder faster, but had the same number of “foot falls”
• Conclusion: laser improved some locomotor abilities

Most recent work: determine optimal parameters for light therapy:
• Number of days: no difference between 14 and 2
• Improved if did 7 days of TX after the injury over the injury and then moved it distally
• 24 hour delay in TX after injury does not seem to make a difference
• Laser affects over 200 genes involved in spinal regeneration

Summary
• 6 hours post injury: neutrophils invade, cytokines?
• 48 hr-14 days: macrophages and activated microglia invade + astrocytic activation leading to scar
• Light alters gene expression after injury
  o Cytokines decrease
  o No decrease in neutrophil invasions
  o But significant decrease in macrophage and microglia invasion
  o Decreased inflammation and scarring
  o So improved axonal regeneration and functional recovery