Developmental & Maladaptive Plasticity
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We see what we expect.
Expectation drives perception.
A BIRD IN THE BUSH
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We ignore the unexpected.
Expectation limits perception.
i cdnuolt blveiee taht I cluod aulaclty uesdnatnrdf
waht I was rdanieg. The phaonmneal pweor of
the hmuan mnid, aoccdrnig to a rsecheearr at
Cmabrigde Uinervtisy,
it deosn't mttaer in waht oredr the ltteers in a
wrod are, the olny iprmoatnt tihng is taht the frist
and lsat ltteer be in the rghit pclae. The rset can
be a taotl mses and you can sitll raed it wouthit
a porblem.
This is because the human mind does not read every letter by itself, but the word as a whole. Amzanig huh? Yaeh and I awlyas tghuhot slpeling was ipmorantt!
Expectations are important.
Old Science

CNS damage is irreversible.

Treatment protocols are based on adaptive neuroplasticity.
New Science

Brain, Spinal Cord & PNS can...

- Regrow
- Reorganize
- Reallocate
“The Future is Not What it Used to Be.”
Restorative Neurology

Makes the most of what is there and stimulates further improvement.
The Silent Synapse

Documented at all levels of the central and peripheral nervous systems.
Moral of Story

More there than you think

Insights from Pediatrics

• Delay for Recovery
• Habits Hide Recovery
• Disuse Atrophy
Delay for Recovery

Timeline for Recovery 3 – 4 years.

Babies learn to move with damaged, immature neurology.

Early movements are abnormal.
Delay for Development

Children 4 – 8 years learn novel complex movements with recovered & more mature motor systems.
Habit Hides Recovery

First movements dominate as maladaptive neuroplasticity.
Will she be able to play tennis?
Early Abnormal Movement Patterns are Habits

To uncover normal neurology, do something new.
Disuse Atrophy

Brain, efferent motor, muscles, afferent sensory and everything in between is atrophic.
“Use It or Lose It”
Disuse Atrophy

“Use It and Grow It”
Activity Dependent Neuroplasticity
Neonatal SCI

Difficult mid forceps delivery
C1-3 block
Quadraparesis
Age 10 days
Flickers of Rt hand movement noted by NICU nurse. - Decision to support.

3 Years Later
Ventilator dependant. Off ventilator 1 hour x 2 per day. - Dependent all ADLs.
Decision to Treat

Disuse Muscle Atrophy
Threshold Electrical Stimulation

 Neuromuscular Electrical Stimulation

 high intensity
 short duration

 Threshold Electrical Stimulation

 low intensity
 long duration
Pre-TES  5 weeks later
TES

Low level, afferent, sensory stimulation produces rapid change in...

- Awareness
- Muscle Bulk
- Function
Function is Improved with Increased Awareness

Passive
Threshold Electrical Stimulation (TES)

Active
sEMG Biofeedback
sEMG-Triggered Stimulation (ETS)
Awareness Improves Strength

Early change
+ 10 – 20% MVC
Threshold Electrical Stimulation
TES

6 months nightly.
Children have no knowledge of normal.

sEMG Biofeedback produces change in minutes.

“That’s what dorsiflexion is…”
EMG Triggered Stimulation
ETS

Closed Loop Neurofacilitation
Patient raises EMG to Threshold
Stimulator completes action
Short Term Change

- awareness & function
- accessory muscle activation

Two Strengthening Protocols
Home based, effective
Children Love It

Teaches correct movement.
Last Words

Baby is not a small child.
Child is not a small adult.
TES, EMG Biofeedback & ETS are useful in mild to moderate severity injury.
Neither technique overcomes severe spasticity.
Incidental Observations TES

Bowel, Bladder & Sexual Function
Wound healing, skin integrity
Improved local blood flow
Thank you.
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