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<td>Selective dorsal <strong>rhizotomy</strong></td>
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Neurosurgical Management of Childhood Spasticity: Selective Dorsal Rhizotomy

Richard C. E. Anderson

AACPDM Annual Meeting
September 21, 2016
No disclosures or conflicts of interest
• Scope of the problem:
  • Most spasticity from cerebral palsy
  • Incidence of CP between 1:250-500 live births in United States
  • Spasticity affects 70-80% of children with CP
  • Spasticity leads to pain, muscle stiffness/tightness, and fatigability
  • If persistent, leads to permanent muscle and tendon shortening and bony deformities
  • Large studies of natural history show functional ability of children with spastic CP plateaus during childhood and declines during adolescence
How can we "kill" spasticity?
• First critically analyzed by Foerster in early 1900s: complete sectioning of L1-L3, L5-S1 just below conus; included stimulation; some sensory loss; mapped dermatomes

• Reintroduced by Fassano and popularized by Peacock in late 1970s; introduced “selectivity” based on intraoperative electrophysiology; performed through L2-S1 laminectomy

• Reported indications include spasticity from CP, MS, TBI, SCI, stroke, hereditary paraparesis, neurodegenerative disorders, and others

• Good outcomes in children and adults (recently)

• Only surgical intervention for spastic CP supported by class I evidence for permanent reduction of spasticity
• Muscle tone regulated by output of alpha motor neurons from spinal cord
• Early CNS injury reduces the descending inhibition from the spinal cord on the alpha motor neurons
• Excitatory Ia afferents from muscle spindles exert a greater influence on alpha motor neurons
• Transecting dorsal rootlets decreases the input of Ia afferents to alpha motor neurons
• Helps restore the excitatory/inhibitory balance of the alpha motor neurons
Meta-analysis of 3 randomized clinical trials comparing SDR+PT versus PT alone
- Steinbok et al. 1997
- McLaughlin et al. 1998
- Wright et al. 1998*

Included children between 3-18 years of age with spastic diplegia

Underwent SDR with or without EMG data for dorsal root transection criteria

Primary outcomes at one year
- Ashworth score
- Gross Motor Function Measure (GMFM)
Outcomes

Outcomes

Outcomes

• Extensive literature review (>200 articles) supports the following after SDR:
  – Class I:
    • Decrease in lower limb spasticity (Ashworth); > 25 years
    • Increase in lower extremity range of motion
    • Improvement in motor function (GMFM)
  – Class II:
    • Improvement in disability (PEDI) and ADL performance
    • Improvement in gait including increased stride length and velocity
    • Improvement in suprasegmental effects including upper limb function and cognition
    • High levels of patient satisfaction into adulthood
  – Class III:
    • Reduce the need for future orthopedic procedures
- EMG recording set up to monitor L1-S1 and sphincter
- Localizing radiograph taken prior to incision to identify L1
- L1 laminectomy performed through 1.5 inch skin incision
- Intraoperative ultrasound used to localize conus
- Dura opened at tip of conus
• Exiting L1 root identified and used to establish stimulating threshold for both motor and sensory root
• L1-S1 dorsal roots isolated on one side and wrapped in silastic sheet
• Each root divided into rootlets
• Manual palpation of muscles by PT/OT in OR
• “Selective” lesioning of spastic rootlets using electrophysiology
• Next stimulate dorsal rootlets to identify spastic rootlets for lesioning
• Abnormal responses
  – Tetanus
  – Persistent responses after stimulus ceased
  – Clonus
  – Contraction of muscles not in stimulated myotome
  – Contraction of muscles in contralateral leg
50% rootlets cut randomly ≠ 50% rootlets cut 'selectively'
Included children with severe spasticity (GMFCS >3)
Compared those receiving SDR (n=71) and ITB (n=71)
Matched for age and preoperative GMFM scores
Outcomes at one year included: GMFM, tone, PROM, patient satisfaction, and rate of orthopedic surgery
All outcomes were improved with both SDR and ITB
Compared to ITB, SDR provided a larger magnitude of improvement in tone (p<.0001), PROM (p<.01), and GMFM (p<.0001), and a lower rate of orthopedic surgery (19% vs 41%; p<.01)
SDR in adults

- 21 patients with spastic diplegia
- Ages between 18-39 years old
- All ambulatory with GMFM I and II
- All underwent SDR via single level laminectomy with intensive PT postop
- Evaluation at 4 months; mean f/u 18 months
- Results:
  - Significant reduction in LE spasticity
  - Improvements in self reported ambulation, ADLs, pain, coordination, and independence
  - 50% of patients requiring assist devices preop became independent ambulators

SDVR for Mixed CP

- Included 50 children with mixed spasticity/dystonia
- All GMFCS III and IV
- Assessments preop and at 2, 6, and 12 months
- MAS, ROM, GMFCS, and Barry-Albright Dystonia scale
- Underwent combined dorsal AND ventral rhizotomy with intensive rehab postop
- Results:
  - Significant improvements in tone, ROM, and BAD (all $p < .0001$)
  - 9 patients improved GMFCS score
  - $>60\%$ underwent subsequent orthopedic surgery
SDVR for Mixed CP

Conclusions

- SDR most powerful way to reduce spasticity permanently
- Appropriate for children with severe spasticity at all functional levels
- Selection criteria for SDR vary widely
- Focus on patient and caregiver’s goals
  - Reduce tone? Ease ADLs? Better chair position?
  - Improve function?
  - Reduce future complications, procedures, and pain?
- Establish realistic expectations
- Recent evidence SDR may benefit young adults and children with mixed tone (SVDR)