Outcomes and Perioperative Considerations for Unilateral Selective Dorsal Rhizotomy in Children with Spastic Hemiplegia with Pre- and Postoperative Quantitative Gait Analysis

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Abstract

Background: Selective dorsal rhizotomy (SDR) is a procedure used to improve function, decrease pain and reduce spasticity in children and adults with cerebral palsy or stroke. Positive outcomes have been reported by numerous authors but pediatric data are typically limited to patients with spastic diplegia, quadriplegia or triplegia.¹-³ Pre- and postoperative assessment has been reported using measures such as the Modified Ashworth Scale or visual gait assessment, but quantitative assessment with motion analysis is lacking in this population.⁴

Objective: This case series analysis reviews outcomes of children with spastic hemiplegia following unilateral SDR including comparison of pre- and postoperative quantitative gait analysis (QGA) and discusses perioperative considerations including medication, therapy and bracing.

Methods: Pre- and postoperative quantitative gait analysis (QGA) was used to quantify outcomes of three pediatric patients in the setting of a tertiary medical center. A retrospective chart review including past medical history, operative report including intraoperative EMG-directed sectioning of dorsal nerve rootlets, and rehabilitation protocol was also analyzed to assess the postoperative outcomes.

Results: All subjects demonstrated improvements in gait. All subjects also experienced functional improvements in community ambulation and gross motor function. Two of the three subjects received Botulinum toxin injections pre-operatively and one required no further injections to the lower limbs following surgery.

Conclusions: The results highlight objective functional improvement of pediatric patients with spastic hemiplegia following SDR. Gait analysis data provides objective quantitative outcomes in patients undergoing unilateral SDR for spastic hemiplegia. The implications of this study are limited in that it is a case series analysis and thus lacks internal validity and generalizability, but the level of detail is limited in that it is a case series analysis and thus lacks internal validity and generalizability, but the level of detail is lacking in this population.⁴

Background & Objectives

Preoperative Baseline Characteristics

- Patient 1: 6 year old male, spastic right hemiplegia
  - GMFCS Level: II
  - 3 series of botulinum toxin with serial casting on left
  - Preoperative Baseline: GMFCS Level 2.5, 62.5% of sensory dorsal rootlets sectioned (L2 to S1)

- Patient 2: 6 year old female, spastic left hemiplegia
  - GMFCS Level: II
  - 2 series of botulinum toxin with serial casting on left
  - Preoperative Baseline: GMFCS Level 2.5, 62.5% of sensory dorsal rootlets sectioned (L2 to S1)

- Patient 3: 4 year old male, spastic triplegic right-left
  - GMFCS Level: II
  - No series of botulinum toxin
  - Preoperative Baseline: GMFCS Level 2.5, 36% of sensory dorsal rootlets sectioned (L2 to S1)

Methods

Preoperative Baseline Characteristics

- Patient 1: Right Kinematics
  - Pre-SDR: 11 months
  - Post-SDR: 1 month

- Patient 2: Left Kinematics
  - Pre-SDR: 18 months
  - Post-SDR: 2 months

- Patient 3: Right Kinematics
  - Pre-SDR: 6 months
  - Post-SDR: 13 months

Results: Postoperative Gait Analysis

Patient 1: Right SDR December 2013
- 62.5% of sensory dorsal rootlets sectioned (L2 to S1)
- Normalized velocity and stride length
- Improved hip and knee kinematics and kinetics
- Improved functional gait in community on follow-up reports

Patient 2: Left SDR May 2013
- 36% of rootlets sectioned (L2 to S1)
- Normalized velocity and cadence
- Improved kinematics of trunk, pelvis, hip, knee, ankle
- "Excellent" improvement in gait reported on 18 month follow-up

Patient 3: Right SDR September 2011
- 52% of rootlets sectioned (L2 to S1)
- Normalized velocity and cadence
- Improved kinematics of trunk, pelvis, hip, knee, ankle
- Improved gait pattern and function reported on follow-up

Discussion

- Pre-SDR, patients undergo an in-depth review of their medical history and imaging studies, consultation with a physical therapist, neurosurgeon, and orthopedic surgeon, and evaluation with PT and OT. Testing includes QGA, MRI lumbar spine and brain, pelvic x-ray, and lumbar spine x-ray (if concern for scoliosis). Children are weaned off anti-spastic medications prior to surgery and tapered on low dose gabapentin.
- Post-SDR rehabilitation protocol includes oral pharmacotherapy for pain management, knee immobilization to maintain hamstring length and decrease spasticity, and mobilization with PT 24 hours following surgical stabilization with a 2 week admission to inpatient rehabilitation followed by intensive outpatient therapies tapering over 1 year.
- Our rehabilitation protocol is discussed with the family by the physical therapist, who coordinates the team in the pre- and postoperative rehabilitation management.

Conclusions

- This case series demonstrates utility of QGA as an outcomes measurement for patients following SDR. This is the first time to the authors’ knowledge that QGA has been used to assess outcomes following unilateral SDR.
- SDR in combination with perioperative rehabilitation was a successful intervention for spasticity management in these pediatric subjects with spastic hemiplegia. These patients did not experience any significant adverse events following surgery.
- QGA should be considered as an objective outcomes measurement for surgical and rehabilitation interventions.

References