Improvement in Upper Extremity Function and Trunk Control After Selective Posterior Rhizotomy

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Selective posterior rhizotomy is being increasingly used in the treatment of spasticity associated with cerebral palsy. Anecdotal reports in the literature note that this procedure results in improved upper extremity function and trunk control. We present a systematic analysis of the results of selective posterior rhizotomy performed on patients with cerebral palsy at Santa Rosa Children's Hospital. Patients were videotaped before surgery and one year postoperatively. These videos were reviewed blindly by an occupational therapist who graded patients' performance on three tasks: assumption of side sitting, maintenance of side sitting, and block building. Statistically significant improvements were noted in all three categories with p values of .0003, .0001, and .0044 respectively. These results support the anecdotal reports of improvement in upper extremity function and trunk control with selective posterior rhizotomy.

Method
Subjects
A total of 21 children diagnosed with spastic cerebral palsy underwent SPR at Santa Rosa Children's Hospital, San Antonio, Texas, from June 1987 to February 1990. Two of the 21 children did not attend their postoperative follow-up appointment. Five of the children, who were severely impaired and were operated on for ease in caretaking, were never intended to participate in the routine postoperative therapy and videotape protocols. The remaining 14 children (11 males and 3 females) constituted the study group. Twelve were considered of normal or above normal intelligence, whereas two had impaired intellect. The range of age at the time of surgery was 3 years to 18 years. Before surgery, 5 children were community ambulators (3 independently and 2 with crutches), 3 ambulated in therapy with walkers, and 6 were nonambulatory. Hand preference was noted in 13 children: 8 were right-handed and 5 were left-handed.

Procedure
As part of a routine protocol, all patients selected for SPR undergo a thorough assessment and evaluation by a team composed of a pediatric neurosurgeon, a pediatric orthopedic surgeon, a pediatric occupational therapist, and a pediatric physical therapist. Part of this assessment is a videotape made before the operation and one year postoperatively. The videotape records functional movement patterns (rolling, side sitting, long sitting, bench sitting, creeping, half-kneel, pull to stand, stand, and ambulation), maintenance of static developmental positions, equilibrium responses (while sitting on a therapy ball and on a bench), and fine motor tasks (block building with reaching in different planes of movement, bead threading, pegboard, writing, and ball throwing). For the block-building task, the children are seated on a bench with the
hips and ankles as close to 90° as possible and the blocks are placed on a table of appropriate height.

The videotapes were reviewed blind by an occupational therapist. The therapist graded the assumption and maintenance of side sitting to each side on a scale of 1 to 5. For assumption of side sitting, the scores were as follows:

1 = Assumes independently with normal pattern
2 = Assumes independently but with improper pattern. Uses hands to place lower limbs
3 = Assumes with minimal assist of therapist. Requires assist at pelvis
4 = Assumes with moderate assist of therapist. Requires assist at both shoulder and pelvis
5 = Unable to assume position. Therapist places in side sitting

For maintenance of side sitting, scores were as follows:

1 = Maintains without upper limb support. Trunk elongates on weight-bearing side
2 = Maintains only with upper limb support
3 = Maintains only with minimum assist. Requires support of both upper limbs or requires intermittent support of therapist at pelvis to maintain position
4 = Maintains with moderate assist. Therapist supports at pelvis
5 = Unable to maintain position without therapist support at shoulder and pelvis

The therapist recorded the number of blocks stacked by each hand—seven was the maximum score. The quality of the grasp on the block was not graded, and refusal to use the nonpreferred hand was scored as a zero; this occurred in two children. The therapist also recorded her subjective observations.

Results

As an analysis of the separate left side and right side scores for each of the three tasks showed no significant difference between the right and left scores, the right and left values were summed for further calculations (see Figures 1-3).

With a paired t-test, the difference between preoperative performance and postoperative performance was statistically significant in all three tasks. For the assumption of side sitting, the preoperative mean was 6.4 (SD = 2.3) and the postoperative mean was 4 (SD = 2.2, p = 0.0003) with a 95% confidence interval of the difference 1.35 to 3.51. For the maintenance of side sitting, the preoperative mean was 4.9 (SD = 2.4) and the postoperative mean was 3 (SD = 1.8, p < 0.0001) with a 95% confidence interval of the difference 1.15 to 2.57. For

![Figure 1. Preoperative and postoperative scores for the assumption of the sitting position (right and left summed).](image-url)
Figure 2. Preoperative and postoperative scores for the maintenance of the sitting position (right and left summed).

Figure 3. Preoperative and postoperative scores for block stacking (right and left summed).
block stacking the preoperative mean was 8.6 (SD = 5.7) and the postoperative mean was 11.1 (SD = 4.2, p = .0044) with the 95% confidence interval of the difference = 3.99 to −.93. One of the 14 patients lacked a preoperative score and is not included in the block stacking data.

The subjective observations noted included improved head position, decreased facial grimacing, decreased hand fisting, improved oral-motor control, and improved speech. Improved breath control and diminished drooling were noted in 5 of the 14 children. Increased joint laxity in the thumbs and fingers was noted in 2 children.

Discussion

Our results statistically confirm anecdotal reports by Fasano et al. (1980) and Peacock et al. (1987) of improved trunk and upper limb control after SPR. Peacock et al. (1987) have attributed improvement in upper limb function to both the ascending collateral effect in the spinal cord and the more stable sitting base achieved after reduction of tone in the lower limbs.

The greater improvement seen in the maintenance of side sitting as compared with assumption of side sitting reflects the complex postural adaptations needed to perform transitional patterns efficiently. The maintenance of a static side sit position requires only small shifts of weight.

Though statistically significant, improvement in block building after SPR was not as dramatic as that seen with the side-sitting task. This result probably reflects the quantitative rather than qualitative grading of the task. Maturation in the younger children was not considered a significant explanation for improvement, as developmental scales such as the Denver Developmental Screening Test indicate that more than 90% of 42-month-olds are able to stack eight blocks. Five of 14 patients achieved the maximum score (14 blocks, or 7 for each hand) before SPR. Obviously a more discriminating test should be used to assess upper extremity function. Of the five children who preferred the left hand preoperatively, two were classed as ambidextrous postoperatively. This finding indicates the pathological nature of the left hand preference in the cerebral palsy population, that is, the left preference is related to abnormal motor function and movement patterns of both hands (Satz, Orsini, Saslow, & Henry, 1985; Bakan, Dibb, & Reed, 1973).

There are two limitations of this study. The first is that it is retrospective and therefore inferior to a prospective study because it was not randomized and its design was not structured to answer a set of questions. The second is that the assumption and maintenance of side sitting were scored with a Likert scale. This type of scoring allows subjectivity to enter the grading system, as patient performance does not always fall completely into one category or another. Nevertheless, the findings help us understand the effects of SPR on trunk and upper extremity function.

Effect of Study

The results of this study have led us to alter our assessment of patients selected for SPR to enable the evaluation of the specific benefits of the procedure on trunk control, upper extremity function, and speech. Specifically, our preoperative and postoperative videotapes will include performance of lateral weight shift in the sitting position, lateral reach, the ability to reach with extension and flexion rotation, length of reach, speech, breath control, articulation, and tasks for the assessment of grasp. Although improvement in upper extremity and trunk function is not the primary goal in children with SPR selected for rhizotomy, it can be an important gain in moving toward independent functioning.

References