The role of selective posterior rhizotomy in the management of cerebral palsy

Cerebral palsy is a static, central nervous system disorder variably manifested by spasticity, dystonia, athetosis, weakness, persistent primitive reflexes, and disordered motor control. When spasticity is the major interfering factor in a child's independent function or daily care, surgical reduction of spasticity can be beneficial. Selective posterior rhizotomy is a neurosurgical procedure designed to decrease spasticity. The history, rationale, patient selection, surgical technique, and postoperative management of selective posterior rhizotomy are reviewed, emphasizing the role of a multidisciplinary approach to facilitate patient evaluation and management.

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CEREBRAL PALSY is a motor disorder that results from damage to the developing central nervous system often associated with a variety of perinatal risk factors.[1] Although neonatal survival has improved over the past 30 years, the prevalence of cerebral palsy has basically remained the same.[2,3]

The primary motor disturbances in cerebral palsy can be categorized as spastic, dyskinetic (dystonic or athetoid), hypotonic, ataxic, or mixed. The spastic type is the most frequent[4] and can be further classified as monoplegia, hemiplegia, diplegia, triplegia, or quadriplegia (total body involvement). Spastic patients have impaired function due to improper coordination of muscle activity,[5] lack of relaxation of antagonistic muscles,[6] and the presence of contractures or other deformities, all of which are secondary to the neurologic impairment.[7] Nashner et al. have analyzed postural control in spastic children and documented abnormalities in the phasing of muscular responses to balance perturbations.[5]

Electromyographic studies of spasticity in cerebral palsy have shown that reciprocal excitation of antagonistic muscles is particularly characteristic of this group.[6] Abnormalities in spinal interneuronal networks may be involved in motor dysfunction associated with spastic cerebral palsy in addition to the direct effects of brain damage.[6,8] Contractures and deformities associated with spastic cerebral palsy have long been attributed to chronic muscle

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imbalance about the joints and to pathophysiologic changes within the muscles and tendons themselves.[9]

Orthopedic procedures including lengthening, release, and transfer of tendons are used to treat or prevent deformities that become disabling.[10] The lengthening of tendons, however, may cause undesirable weakness because the range over which the muscle is mechanically efficient is altered.[11] Selective posterior rhizotomy is a neurosurgical procedure designed to reduce spasticity in the lower extremities.[12,13] Functional improvement following rhizotomy is believed to be dependent on the degree of strength and motor control that the child innately possesses, making patient selection a vital part of the procedure. Postoperative physical and occupational therapy are important for strengthening and achieving functional skills, once spasticity is relieved.

HISTORY OF NEUROSURGICAL PROCEDURES

Neurosurgical procedures to reduce spasticity have included various types of posterior rhizotomy[12-17] as well as anterior rhizotomy,[18] cordectomy,[19] myelotomy,[20] and the implantation of cerebellar[21] or spinal cord stimulators.[22] Although some success in reducing spasticity has been achieved with many of these procedures, undesirable complications have also occurred.[23] The concept of posterior rhizotomy was taken from the work of Sherrington in the late 1800s.[24] He found that division of posterior spinal nerve roots in hypertonic decerebrate cats relieved the excessive muscle tone. When inhibition of anterior horn cells is reduced by an upper motor neuron lesion, division of posterior spinal nerve roots decreases spasticity by interrupting facilitatory input from afferent neurons, particularly those from the muscle spindle.[25] Foerster[14] applied this principle clinically and in 1913 reported on a large series of patients who underwent posterior rhizotomy to reduce spasticity. Included were 94 patients with congenital spastic paraplegia. He divided the entire posterior spinal nerve roots from L-2 to S-2, usually sparing L-4, to preserve extensor tone and sensation. To prevent potential losses of sensation, Gros[15] adapted this procedure in 1967 by dividing only four-fifths of the spinal nerve rootlets at each level from L-1 to S-1. In the 1970s, Fasano[12] began evaluating each nerve rootlet by electrical stimulation and decided to ablate a rootlet based on the intraoperative electromyographic responses obtained. Responses that were characterized by a lack of inhibition or by diffusion to inappropriate muscle groups were considered to be abnormal, and rootlets associated with such responses were selectively divided. Fasano worked at the level of the conus using a T-12 to L-1 laminectomy since this was the proximal origin of the lumbosacral posterior nerve roots. In 1981, Peacock[25] altered the surgical procedure by performing a multilevel laminectomy from L-2 to L-5 to allow true positive anatomical identification of each sensory nerve root. This procedure preserved the lower sacral nerve roots involved in sphincter control.[13,25]

SELECTIVE POSTERIOR RHIZOTOMY

Rationale and operative techniques

Spasticity is a part of the upper motor neuron syndrome, which is distinguished by tendon hyperreflexia and velocity-dependent resistance to passive movement caused by damage to supraspinal centers with subsequent decreased inhibition at the spinal level.[26,27] Although increased fusimotor drive was once believed to be a cause of spasticity, there is now evidence that afferent input is normal in spastic patients.[27] The balance between inhibition and excitation at the alpha motor neuron is disturbed directly through loss of inhibitory input and possibly through subsequent neuronal changes occurring after an upper motor neuron lesion.[27] Selective posterior rhizotomy theoretically reduces facilitatory input to the alpha motor neuron by dividing the sensory spinal nerve rootlets associated with hyperactive muscle responses. A narrow midline laminectomy is made from L-2 to L-5, preserving the posterior facet joints. Using anatomical landmarks and electrical stimulation of anterior nerve roots, the posterior roots from L-2 to S-2 are

positively identified. Electromyography of lower extremity muscle groups, as well as visual inspection and palpation, are used to monitor the motor responses to electrical stimulation. Each posterior nerve rootlet is stimulated using specially adapted blunt microneurosurgical hook electrodes such as Peacock rhizotomy electrodes (Aesculap Surgical Instruments, Burlingame, CA). Electromyographic (EMG) responses that are characterized by lack of inhibition, clonus, diffusion of contraction to inappropriate muscle groups, and other irregularities are considered to be abnormal, and rootlets associated with such responses are divided. The remaining rootlets are left intact to preserve sensation. Approximately 50 to 70 rootlets are examined and between 25% and 60% are eventually ablated, depending on the clinical situation.

Postoperatively, patients remain flat in bed for five days as a precautionary measure against potential dural leaks. As a further safeguard, no passive trunk rotation or flexion is allowed for the first postoperative month, and active exercise is gradually increased within the child's comfort level. Retrospective study of children undergoing multilevel laminectomies has not shown an increased incidence of spinal deformity when the laminectomy is confined to the lumbar level.[28]

Following rhizotomy, intensive postoperative physical therapy is recommended, especially for those children in whom functional gains are anticipated. Occupational therapy to enhance activities of daily living and upper extremity function may also be facilitated by the general reduction in muscle tone which accompanies rhizotomy.[13]

Selection of patients

Although selective posterior rhizotomy appears to be an excellent technique to reduce spasticity, it must be remembered that spasticity is only one feature of cerebral palsy. In addition to spasticity, there may be weakness, synergistic motor patterns, lack of selective motor control, persistent primitive reflexes, lack of normal postural responses, dyskinesia, secondary contractures, other joint deformities, and associated problems of learning: sensory integration, vision, and hearing. This makes the selection of patients and the establishment of realistic goals essential when recommending surgical intervention.

A combined approach to evaluation has been adopted at our facility in which children undergo simultaneous evaluations by the neurosurgeon, orthopedic surgeon, and physical therapist. In this way, a variety of surgical and nonsurgical interventions can be considered and recommended at one clinical visit. Evaluating the child's function, discussing the potential benefits of rhizotomy or orthopedic surgery, and recommending nonsurgical treatment occurs with the child and family as active participants. This allows the clinical team to interact, challenge each other, learn from one another, and address the clinical problem at hand.

Medical history and evaluation

Prior to examination, a history of perinatal, nonprogressive brain damage is obtained. That damage is frequently related to the sequelae of prematurity, especially intraventricular hemorrhage. In addition to the medical history, developmental milestones and current levels of function are ascertained and documented. Although the best results have been obtained in intelligent spastic diplegic patients,[13] other children who lack independent functional skills, such as spastic quadriplegics, may benefit from reducing spasticity when the goals are to facilitate daily care and prevent further deformity. When functional mobility is present, it is important to consider the potential benefits and risks that may result from reducing spasticity for the child. Realistic goals should be set based on the child's current abilities. Fig 1 outlines evaluation guidelines for patients in whom improvement in functional ability is anticipated. Table 1 lists factors to consider when selecting patients for selective posterior rhizotomy.

During the physical examination, the presence of spasticity is confirmed by eliciting velocity-dependent, increased resistance to passive movement, hyperactive tendon reflexes, and clonus and by noting the frequently reduced passive range of motion. Spasticity must be differentiated from

other forms of hypertonia including rigidity and dystonia, since these will not respond to posterior nerve rootlets section.

An evaluation of the range of joint motion is made with special attention to hip abduction, popliteal angle (hamstring flexibility), hip extension, and ankle dorsiflexion. Significant fixed contractures are noted as well as any deformity such as mid-tarsal break, ankle varus, or torsional deformity of the femur or tibia. Radiographs of the spine and hips are scrutinized for scoliosis and potential subluxation or dislocation of the hip joints.

Fixed contractures and deformities are not addressed by rhizotomy and require orthopedic surgery. If rhizotomy is otherwise indicated, it may be performed first and followed by correction of remaining contractures. Selective posterior rhizotomy is felt to facilitate orthopedic releases and in some cases eliminate the need for them. Some children have primarily "dynamic" contractures which are constant postures observed during movement or periods of alertness. The limitation in range of motion is mainly due to spasticity and cocontraction of muscle groups. Rhizotomy is of prime value in these cases. Fixed contractures that persist under general anesthesia should not be expected to resolve with neurosurgical treatment alone. In *Peacock's Capetown series,* which began in 1981, Arens found approximately 60% of the patients who underwent successful rhizotomy either received or were expected to require subsequent orthopedic surgery.[28] Rhizotomy and orthopedic procedures

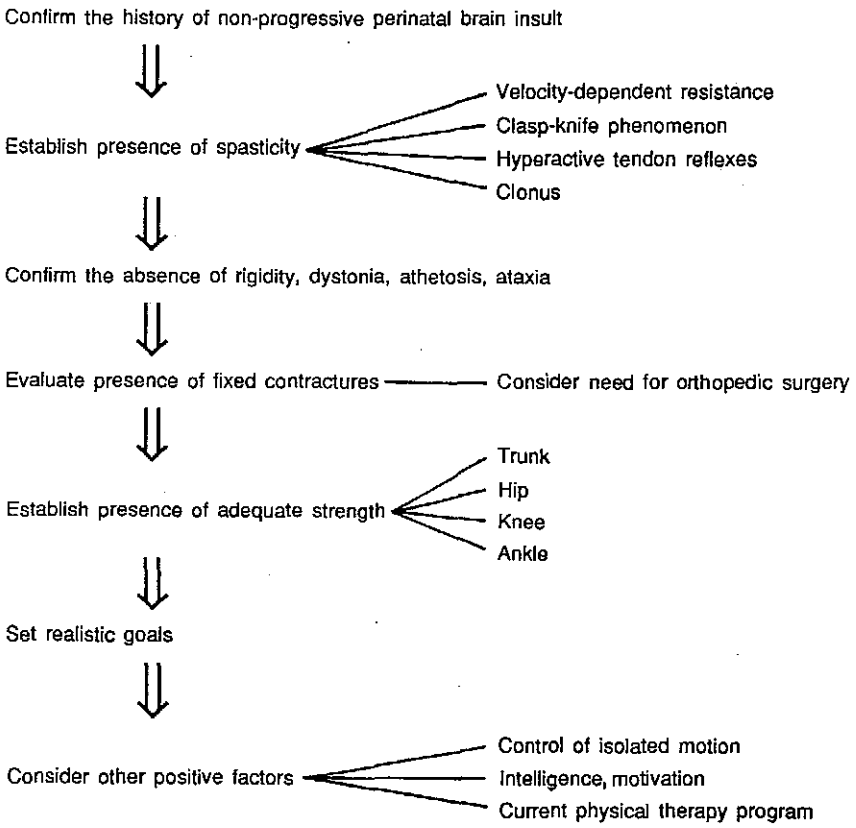

Fig 1. Evaluation guidelines for functional patients.

Table 1. Factors to consider in patient selection for selective posterior rhizotomy

Good prognostic factors	Poor prognostic factors
Purely spastic	Athetosis, dystonia, ataxia
Range of motion adequate for function	Contractures, deformities
Adequate strength	Weakness, hypotonia
Balance	Primitive reflexes
Selective motor control	Use of mass synergies
Ambulates without device	Nonambulatory
Intelligent and motivated	Mentally retarded
Has physical and occupational therapy program	No therapy available

may be viewed as complementary, rather than as strict alternatives.

Reducing spasticity is unlikely to augment function in those children with weakness, poor balance, and lack of isolated joint control. Evaluating sitting balance is helpful in determining trunk control, which also impacts on standing and walking skills. Slow tilting in four directions tests the trunk-righting responses, and quick disturbances are used to elicit protection reactions of the upper extremities.

Selective control of movement can be observed during spontaneous movement or tested in cooperative children by requesting active motion in various combinations of hip, knee, and ankle positions. For example, the child is asked to perform hip flexion, knee extension, and ankle dorsiflexion simultaneously. Many children cannot isolate joint motion and must flex the hip and knee in order to dorsiflex the ankle. All of these tests are beneficial in determining the probable outcome for selective posterior rhizotomy.

The most difficult area to assess in spastic children is the underlying strength of muscles used in antigravity control. Asking the child to voluntarily initiate and inhibit movement helps to distinguish reflex-based movement, such as a positive support reaction from active control during activities such as squat to stand. The degree of antigravity control can be estimated using evaluation of upright control developed by the Rancho Los Amigos Hospital assessment of hemiplegic patients.[29] Children who walk with assistive devices may be highly dependent on their upper extremities and probably use their spasticity for antigravity control more than those who walk independently. The child who does not walk independently or with crutches by age seven is unlikely to develop this skill.[30] Children who retain primitive reflexes, lack normal foot placement, and lack parachute reactions have poor prognoses for ambulation.[30]

Weakness in the independent ambulator is evidenced by lateral, forward, or backward trunk lean, positive Trendelenberg, wide-based stance, knee-extensor thrust, knee hyperextension in the absence of ankle plantar flexion contracture, and excessive dorsiflexion in stance. Weakness is likely to be present in children who have undergone previous neurectomies or in those patients whose tendons have been overlengthened. Rhizotomy is rarely recommended for hemiplegic patients since they generally achieve good function without surgery and often have weakness and hypoplasia of their involved side in addition to spasticity. Their limited problems can often be addressed by relatively simple orthopedic procedures, such as heel-cord lengthening, rather than a more invasive laminectomy.

Other factors to consider when functional improvement is the goal of surgery are age, intelligence, motivation, and availability of postoperative physical and occupational therapy. Children under

four years of age have usually not developed severe contractures, but they are more difficult to assess in terms of their strength and motor control. Adults and older children have often developed contractures and deformities, and they may have had previous orthopedic surgery that may contribute to weakness. Although individuals from the ages of 20 months to adulthood have successfully undergone the procedure, most of the patients range from 4 to 10 years of age.

CASE HISTORIES

Appropriate referral and selection of patients is vital to the success of surgical management. Pediatricians, physiatrists, therapists, neurologists, orthopedists, and neurosurgeons involved in the care of patients with cerebral palsy should be knowledgeable about the selection criteria for selective posterior rhizotomy. A goal-oriented, team approach to patient evaluation provides a more comprehensive method of management, helps parents avoid confusion, and educates professionals to the strengths and weaknesses of their respective approaches. The following case examples from the combined neurosurgical and orthopedic cerebral palsy clinic are presented to illustrate the evaluation and selection of patients.

Case 1. Seven-year-old female with a history of normal birth and delayed development

Diagnosis: Spastic diplegia (also mixed spastic-dystonic diplegia)

History: Had a normal full-term birth with no neonatal complications. Diagnosis was made at 2 years of age due to delayed walking, but etiology was unknown. Full neurological work-up ruled out other diagnoses. Previous treatment included physical therapy, bracing for excessive plantar flexion and genu recurvatum, alchohol blocks to calf with slow recovery and no functional improvement, and no previous surgery.

Presenting problem: Increasing tightness in lower extremities, requiring walker to ambulate. Previously, she was independently ambulatory.

Examination: Spasticity was present in lower extremities: hyperactive tendon reflexes, velocity dependent increase in passive movement, and clonus.

Range of motion: Had mostly dynamic tightness, for example, quick stretch of the hips revealed only 20 degrees of abduction, but with slow, firm pressure 35 degrees were obtained. Popliteal angles were 155 degrees and ankle dorsiflexion was 0 degrees bilaterally.

Trunk control: Fair, with evidence of righting but lack of stability when challenged. There was a possible dystonic influence.

Selective control: Ankle and knee motions were synergistic.

Upright motor control: Weakness was observed in hip and knee flexion and extension, hip abduction, and calf muscles.

Gait: Poor clearance in swing with toe drag and circumduction noted. Excessive plantar flexion and knee hyperextension were present in terminal stance.

Upper extremities: Good fine motor function with associated reactions seen during gross motor activity.

Discussion: Rhizotomy was not recommended due to weakness, influence of dystonia, and truncal instability. Orthopedic surgery was not required. Previous intervention to reduce tone in calf muscles was unsuccessful. Contractures were mostly dynamic and not severe.

Recommendation: Physical therapy and recreational activities to increase strength and endurance. Conservative management of excessive plantar flexion and correction of back-knee through use of an ankle-foot orthoses (AFOs) preceded by trial of a walking cast.

Comment: The ideal patient for rhizotomy is the purely spastic diplegic. Although the term "spastic" is often used to qualify a patient, a more detailed examination focusing on any concomitant weakness and motion disorders will often disqualify the patient as a candidate for the procedure.

Case 2. Six-year-old boy with a history of prematurity and delayed motor milestones

Diagnosis: Spastic diplegic cerebral palsy

History: Premature birth at 31 weeks weighing 3 lbs with patent ductus arteriosis. Placed on ventila-

tor for 12 days. Had delayed motor milestones; creeping since age 2 and using ring walker at age 3. Had no previous surgery and was receiving physical therapy (PT) and occupational therapy (OT) once or twice weekly.

Presenting problem: Lower-extremity muscle tone and limitations in range of motion interfered with standing, transferring, potential ambulation, sitting stability, and daily living activities.

Examination: Mild spasticity in upper extremities, moderate to severe spasticity in lower extremities, hyperactive tendon reflexes and clonus, scissoring of lower extremities, and no evidence of dystonia or athetosis.

Range of motion: Limited at hips to 20 degrees abduction, popliteal angles were 90 degrees, and ankle dorsiflexion was −30 degrees. Fixed contractures of hamstrings and plantar flexors, as well as valgus foot deformities were present.

Trunk control: Fair stability with sacral sitting due to extensor thrust. Lost balance backward and had trunk righting laterally. Protective reactions were intact.

Selective control: Tended to move in mass patterns, but contractures interfered with testing.

Upright motor control: Was unable to rise from squat, but had good mid-range control of flexed-knee stance when given support for balance. Contractures interfered with positioning in standing for testing.

Discussion: Appeared to have potential for improved function through reduction of spasticity; however, fixed contractures were a problem judged to require orthopedic surgery. As he was not using his lower extremities functionally, goals were to improve sitting posture, allow functional use of standing for transfers, dressing, and possibly ambulation, and to correct deformities and prevent further development of deformity. He had some possible weakness and lack of selective control, but extensor thrust in sitting and scissoring severely limited function as well as lack of range of motion at hips, knees, and ankles.

Recommendation: Selective posterior rhizotomy to reduce spasticity first, followed by intensive physical and occupational therapy for trunk and lower extremity strengthening, improving range of motion, and increasing independence in daily living skills. Reevaluation and orthopedic surgery for judicious release of reamining contractures planned for approximately 6 months following rhizotomy.

Postoperative findings: 15 mos after rhizotomy and 6 mos after the tendo-achilles percutaneous lengthening, and the lengthening of the medical hamstrings: Muscle tone was low to normal throughout lower extremities; range of motion was within normal limits; strength was fair to good at hips and knees and trace to poor at ankles; selective hip and knee motion was present; and some ankle motion could be elicited. He stood with AFOs and walker, walked short distances with walker and standby to minimum assistance, transferred to wheelchair with standby assist, and sat with straight spine.

Comment: Selective posterior rhizotomy and orthopedic surgery accomplish different outcomes. In this case, tone was reduced by rhizotomy and residual contractures released by orthopedic surgery. The procedures were complementary to each other for maximum patient benefit.

Case 3. Two-year-old boy with mildly delayed motor milestones

Diagnosis: Spastic diplegia

History: Birth by Cesarean section at 36 weeks preceded by pregnancy complicated by hypertension with poor fetal growth. Motor development was only mildly delayed.

Presenting problem: Toe walker with problems in running and balance.

Examination: Mild spasticity present primarily in calf musculature.

Range of motion: Within normal limits except for ankle dorsiflexion, which was limited to neutral.

Motor skills: Independent toe-toe gait with slightly increased base of support was observed. Sitting and crawling appeared to be normal. Functional weakness was suspected to hip abductors due to lateral lean in unilateral stance. Strength and selective control appeared to be otherwise within normal limits but could not be formally tested.

Discussion: Primary problem was plantar flexor

spasticity and tightness. Function was excellent. Selective posterior rhizotomy was not recommended due to limited spasticity and mild involvement.

Recommendation: Casting to reduce equinus ankle posture followed by orthopedic surgery if casting fails.

Case 4. Four-year-old boy with history of prematurity and delayed motor milestones

Diagnosis: Spastic quadriplegic cerebral palsy

History: Birth via Cesarean section at 30 weeks weighing 3 lbs, 8 oz with neonatal complications included bradycardia. Diagnosis of cerebral palsy occurred at 10 months of age, and motor milestones were delayed with no independent sitting or crawling to date. Speech skills were good, and upper-limb functions were limited to gross activities such as computer-switch activation.

Presenting problem: Increased muscle tone interfered with positioning in sitting and standing as well as hand function.

Examination: Significant spasticity of all four limbs, brisk reflexes and clasp-knife phenomenon, sustained clonus and crossed adductor responses; mild athetosis (finger fanning) and mild tonal fluctuation were present.

Range of motion: Had a strong dynamic component to limitations; hip abduction reached 40 degrees, popliteal angles were 140, and ankle dorsiflexion was neutral bilaterally.

Trunk control: Head and trunk control were poor with low truncal tone and inconsistent head control. Minimal righting of head and trunk elicited in small ranges only. No functional protective reactions were seen, and he required full support in sitting.

Selective control: Lower extremity motion appeared primarily reflex-based (ie, crossed extensor, positive supporting, and reflex stepping).

Antigravity control: Had limited strength in head and trunk musculature. Demonstrated some knee extension in supported flexed-knee stance; however, evaluation was complicated by lack of selective control.

Discussion: Spasticity was a major factor in the disability; however, many other factors were problematic including weakness, lack of selective control, lack of balance and trunk control, and mild dystonia. Independent motor function was minimal. Orthopedic intervention was not required; however, deformities may develop with time. Rhizotomy may be considered to assist with positioning, comfort, and daily care and to help prevent development of deformities. Lack of head and trunk control, however, may be aggravated.

Recommendation: Emphasize strength and control of neck and trunk musculature in physical and occupational therapy and reconsider for selective posterior rhizotomy in 6 to 12 mos if spasticity is a major interfering factor in positioning and daily care.

Comment: Selective posterior rhizotomy may be considered for some severely involved patients who otherwise would not qualify under the ideal indications previously described. Each patient must first have goals established, then priorities set as to which goals are best accomplished by therapy and which by surgery.

PHYSICAL AND OCCUPATIONAL THERAPY

Prior to rhizotomy surgery, therapists emphasize preventing further losses in range of motion, strengthening the trunk and lower extremities, teaching childen about the postoperative program, and arranging for necessary equipment. Early postoperative physical therapy includes educating patients and parents about laminectomy precautions, patient positioning, bed mobility, transfers, and exercises in addition to treatment to improve mobility and strength. Postoperatively, the child may have hypersensitivity of the feet and limbs, flexor spasms, relative hypotonia of the trunk and lower limbs, and weakness, which should improve with time. AFOs to help maintain neutral foot and ankle positions and walkers or standers are used for support and alignment during early weight-bearing. The reverse style walker may be helpful for more erect trunk posture.

The emphasis of therapy is on strengthening rather than reducing tone. Although abnormal movement patterns persist, freedom from spasticity and cocontraction of muscles is expected, allowing children to make better use of selective control when present. Even though the procedure is aimed at reducing lower-extremity spasticity, better use of the upper extremities, observed in some patients, has been attributed to improved sitting posture and reduction in input to ascending interneuronal networks.[13]

Improving gross and fine motor skills to develop functional independence continues to be the overall goal of therapeutic intervention. Although treatment is highly individualized, reviews of approaches to postoperative occupational therapy and physical therapy provide guidelines for the therapist who is unfamiliar with the surgical procedure.[31-33]

SURGICAL OUTCOME

The functional outcome of surgery appears to be highly dependent on the degree of strength and motor control present prior to surgery. Clinical evaluation of 60 patients one to five years after rhizotomy revealed that those with spastic diplegia had the most functional improvement.[13] Reassessment of 52 of these children up to seven years after surgery revealed that gains were maintained and complications of sensory disturbances or lumbar pain were minimal. Weakness was observed in some muscle groups in 46 cases, and further orthopedic surgery was required for 24 children, while 9 were awaiting orthopedic surgery.[28]

More objective evidence of functional improvement was sought using a two-dimensional kinematic analysis of gait in the sagittal plane. Stastistically significant improvements in the knee and thigh range of motion and stride length were found in 16 ambulatory patients following selective posterior rhizotomy.[34] A recent study using instrumented gait analysis methods has revealed a significant decrease in EMG activity in response to quick stretch, and improved joint range of motion, stride length, and velocity during gait following selective posterior rhizotomy.[35] Phasing of muscle activity during gait was not significantly altered in the twelve patients examined.

Evaluation of electrophysiologic parameters such as the H-reflexes (an analogue to the ankle jerk using electrical stimulation to evoke the stretch reflex) and cortical somatosensory-evoked potentials by Cahan et al. confirmed postoperative reduction in muscle tone.[36] They also reported the presence of electrophysiologic abnormalities of the spinal cord in patients with cerebral palsy. Some of these abnormalities were reduced following selective posterior rhizotomy.

CURRENT AND FUTURE RESEARCH

Over 25 centers now perform selective posterior rhizotomy. Several recent symposia have been held to review the use of the procedure to date. Many centers in the United States have presented their early results following selective posterior rhizotomy and are undertaking further studies to quantify the outcomes of the procedure in cerebral palsy. (Symposium: Pathophysiology and Management of Spasticity in Spinal Cord Injury and Cerebral Palsy, May 25-27, 1988, University of Virginia, Charlottesville, VA and Pediatric Orthopedic Society Rhizotomy Tutorial: December 1-2, 1988, UCLA and UCI/Rancho Los Amigos Medical Center, Los Angeles, CA.) Studies investigating both orthopedic surgery and rhizotomy will refine our understanding of how surgical procedures can be used for spastic cerebral palsy and help to optimize patient selection and management.

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A prominent feature in many children with cerebral palsy is spasticity that interferes with function, daily activities, and care, and leads to contractures and postural abnormalities. Selective posterior rhizotomy is a neurosurgical procedure to reduce spasticity; it is beneficial when spasticity is the primary handicapping problem. When other features of cerebral palsy, such as dystonia, athetosis,

weakness, loss of selective motor control, and primitive reflexes are present, they persist following surgical reduction of spasticity. Patients exhibiting these features are unlikely to improve their motor skills and are generally considered to be poor candidates for the procedure.

Although the long-term goals of selective posterior rhizotomy and some orthopedic procedures overlap, they are not strict alternatives. The rhizotomy is designed to reduce spasticity whereas orthopedic surgeries are designed to eliminate contractures and deformities. A goal-oriented approach is used to develop a management plan for each child; that plan may involve orthopedic surgery, selective posterior rhizotomy, neither type of surgery, or both neurosurgery and orthopedic surgery. Reducing spasticity can make orthopedic management easier, and children may require orthopedic procedures after rhizotomy. Selective posterior rhizotomy should be used judiciously in carefully selected patients in coordination with therapy and orthopedic management.

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