Selective posterior lumbosacral rhizotomy for the management of cerebral palsy spasticity

A 10-year experience

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Abstract **One hundred and sixty-eight patients had selective lumbosacral posterior rhizotomies for the treatment of cerebral palsy spasticity at Red Cross War Memorial Children's Hospital and Groote Schuur Hospital during the 10-year period 1981 - 1991. There was no mortality and insignificant early postoperative morbidity. Long-term follow-up on 110 patients has revealed satisfactory tone reduction in 95% of cases. The majority showed improvement in standing, sitting and locomotion. Thirteen patients had minor persistent sensory disturbances and 20% have developed asymptomatic spondylolysis or grade I spondylolisthesis. Most therapists, patients and parents remain enthusiastic about the results of this procedure.**

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Selective posterior lumbosacral rhizotomy has been successfully used in the management of spasticity for almost 100 years. Since Otfrid Foerster's[1] comprehensive description of its use in the treatment of cerebral palsy, many refinements have been introduced to make the procedure more specific for spasticity.[2-4] The selection of nerve roots by electrical stimulation helps preserve sensory fibres and consequently minimises some of the sequelae that were a worry in the past.[2,3,5]

In 1981, Peacock introduced a modification of the selective posterior rhizotomy technique whereby the cauda equina was exposed in its entirety; this made the identification of nerve roots at their exit foramina specific and safe. Since 1986, he has popularised this operation in the USA and it is now used successfully in many centres around the world.[3,6,7] We reported our initial follow-up on our first 53 patients in 1989[8] and we now present a 10-year experience with a considerably larger number of patients in the belief that this procedure makes an important contribution to the improvement and well-being of a carefully selected group of spastic cerebral palsied patients.

Patients and methods

Incidence, age and gender

One hundred and sixty-eight patients with spastic cerebral palsy were operated on at Red Cross War Memorial Children's Hospital and Groote Schuur Hospital between 1981 and 1991.

Based on a standardised *proforma*, patients were assessed pre- and postoperatively by means of clinical examination and video, both by their individual physiotherapists and by the authors. The majority of children were attending cerebral palsy schools and receiving specialised neurodevelopmental physiotherapy at least twice weekly.

Short-term follow-up was available on all 168 patients, but long-term assessment has only been possible on 110 patients country-wide. All our results will refer to these 110 patients unless otherwise specified.

At the time of their rhizotomy 80 children were under the age of 12 years (41 between 2 and 5 years, 39 between 6 and 11 years) and 30 were between 12 and 26 years. Eighty were male and 30 were female.

Type of cerebral palsy and associated intelligence

Of the 76 patients with spastic diplegia, 42 were assessed as being of average or above-average intelligence. Twenty-nine of the 34 patients who were spastic quadriplegics were below average, and required special care or non-academic training.

Associated orthopaedic procedures

Forty-three children had had tendon lengthening or tendonotomies before rhizotomy. Forty-one required orthopaedic surgery post-rhizotomy and 11 patients had had procedures both before and after rhizotomy.

Results

Postoperative complications (163 patients)

Short-term postoperative complications were minimal. There was no mortality, 2 children with severe lordosis developed wound haematomas, and 1 had a temporary cerebrospinal fluid leak which closed spontaneously.

Tone

Long-term tone reduction was obtained in 104 patients (95%). Of the 6 patients assessed as having minimal tone reduction, mass patterns persisted in 3 and it was difficult to assess pre- and postoperative quantitative differences in 2 children. One patient was dystonic. The residual tone was assessed as higher than normal, but still considerably reduced in 51 patients, normal in 36 and hypotonic in 17.

Sitting, standing, locomotion

Improved posture made sitting easier in 87 patients. In 23 it was either unproblematical pre-operatively or remained unchanged. Standing improved in 79, remained the same in 29 and worsened in 2 patients. Locomotion improved in 97 patients, stayed the same in 12 and worsened in 1.

Power

Power was improved in 16 patients and remained unchanged in 65. Significantly, weakness previously masked by the spasticity became evident after rhizotomy in 29 patients.

Sensory disturbance

All patients who could communicate complained of sensory disturbances in the legs and/or sides of the feet immediately postoperatively. These were dysaesthetic in nature and aggravated by touch or rubbing on the bed clothes. This was still disturbing to 25 patients for between 6 months and 1 year. Thirteen had persistent patchy, irregular areas of pin-prick and proprioceptive loss in the L3 - L5 dermatomes and 7 had persistent patchy areas of dysaesthesia.

Spinal abnormalities

Postoperative radiographs of the spine have revealed spondylolysis and grade I spondylolisthesis in 20% of the 100 patients in whom radiographs were obtained. Four children had mild low back pain on direct questioning and this has not progressed to date.

Patient, parental and physiotherapists' responses to the outcome of the procedure (97 patients)

In 86 patients overwhelmingly positive comments were obtained from parents, physiotherapists and patients. They felt the operation had helped them considerably and would definitely recommend it to others. Three patients were ambivalent and in 8 cases either the therapists or the parents felt that the operation had not benefited them. In 13 cases conclusions regarding outcome were not known.

Discussion

Cerebral palsy encompasses a group of static encephalopathies of the immature brain that result in disorders of movement and posture. It is often associated with other neurological disabilities, such as mental retardation and speech and visual problems.[9] The management of cerebral palsy requires a diverse range of treatment strategies and selective posterior lumbosacral rhizotomy should only be considered where spasticity of the legs is a major handicapping factor. Sherrington's[10] experimental dorsal root sections on cats demonstrated clearly that posterior root section helped hypertonicity generated by the gamma muscle spindle system and surgical experience has confirmed that all other tonal abnormalities, such as dystonia and choreo-athetosis, are not improved by rhizotomy.[11]

The efficacy of selective posterior rhizotomy in reducing spasticity is confirmed by our study, which showed that the tone was successfully reduced in 95% of patients and that tone reduction has persisted for up to 10 years. Follow-up studies of periods of 15 years have confirmed the longevity of this tone reduction.[12]

As it is now possible virtually to guarantee tone reduction for gamma spasticity, it is very important to

decide whether or not this will help a particular patient. Spasticity is often associated with weakness and many patients derive useful functional support from spasticity of the legs in standing and walking. Loss of spasticity often 'unmasks' weakness resulting in loss of function, particularly in the early postoperative period. It can be seen from our results that a significant 29 patients had noticeable long-term weakness after rhizotomy. Admittedly, with time and muscle-strengthening physiotherapy, power improves, but it is very important repeatedly to assess underlying weakness, particularly of the quadriceps and truncal supporting muscles, when a decision regarding rhizotomy is being made.[13]

Ninety-six patients improved their patterns of locomotion. Objective assessment is difficult, but comparative videos are most useful in this respect and gait analysis studies in the USA confirm the beneficial effect of rhizotomy on ambulation.[14-16]

Complications from this procedure are reassuringly low. Immediate postoperative complications are negligible. All patients have initial dysaesthesia, which usually disappears after 6 weeks. Thirteen patients complained of persistent patchy anaesthesia which, although clinically detectable, is often very inconsistent on repeated testing. Seven patients had persistent dysaesthesia often described as 'shocks' or 'burning of the feet'. One of the important contributions intra-operative nerve stimulation has made to selection is that circuits involved in spasticity may be identified and, most importantly, that those not involved, i.e. those carrying normal sensation, may be preserved.

Orthopaedic concern has been expressed regarding the long-term effect of laminectomies on the growing spines of children, especially in those with cerebral palsy where there is muscle imbalance and where it is known that the incidence of spinal deformity is already higher than in the general population. We followed up our first 55 children looking specifically for mechanical disorders of the spine and found that the incidence of abnormalities such as scoliosis and lordosis is approximately that of cerebral palsy in general. We did, however, identify a tendency towards spondylolysis and spondylolisthesis which we felt may relate to the laminectomy for rhizotomy *per se*.[17] The incidental incidence of spondylolysis in our cerebral palsied patients is 1%.[18] A recently completed survey revealed a 20% incidence of spondylolysis and spondylolisthesis postoperatively, which is higher than the national Western population averages of 5 - 7%.[18] Undoubtedly, the spondylolysis and spondylolisthesis is a result of the laminectomy, but it may also be that the increased general activity, e.g. sport and running, afforded by the new mobility after rhizotomy and perhaps by the associated lordosis, adds to the strain on the isthmus. All our cases were demonstrated by routine follow-up radiographs and all patients are virtually asymptomatic. The long-term observations of children with spondylolysis and spondylolisthesis reported elsewhere in the literature suggest that this is a very static condition and virtually never requires fusion.[19] None of our children have progressed since their condition was detected. The technique of replacing spinous processes and lamina after laminectomy (laminoplasty) suggests that this may well prevent spinal deformities developing in the future.[20] Another study has also suggested that the lumbosacral spine is particularly resistant to spinal deformity, although the numbers in this study were small.[21]

Other methods of doing rhizotomies, where the nerve roots are exposed as they enter the conus, involve a much smaller bone exposure, but we think this increases the difficulty of nerve root identification. The absence of postoperative incontinence in our patients confirms the accuracy and merit of exposure of the nerve roots as they exit from the intervertebral foramina.

Many patients comment on unexpected peripheral benefits derived from rhizotomy. In the severely handicapped quadriparetic patient, rhizotomy can be performed to make nursing easier. Similarly, self-sufficient diplegic patients may experience difficulty when going to the toilet. In 1 of our adult diplegic patients, constipation was relieved by this procedure. Once the difficulty in getting on and off the toilet had been overcome, bowel habit returned to normal! Also in one younger child enuresis was 'cured' in a similar fashion. Many physiotherapists attest to the improvement in general psychological well-being after incapacitating spasticity is relieved in their patients.

A large number of our patients had orthopaedic surgery both before and after rhizotomy. Rhizotomy does not affect fixed joint contractures, which must be dealt with orthopaedically. Provided tendons are not weakened or over-lengthened, prior orthopaedic surgery is not a contraindication to rhizotomy. Similarly, dislocated hips must be dealt with orthopaedically. Rhizotomy should never be contemplated as a treatment for this condition.

Selective lumbosacral posterior rhizotomy is best seen as a useful inclusion in the armamentarium of those concerned with the treatment of patients with cerebral palsy. It should be offered after careful selection by a multidisciplinary team in the knowledge that it is a safe and useful procedure in the South African context.

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