NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE

INTERVENTIONAL PROCEDURES PROGRAMME

Interventional procedure overview of selective dorsal rhizotomy for spasticity in cerebral palsy

A surgical procedure aimed to ease muscle rigidity and improve mobility in people with cerebral palsy. The operation consists of cutting of some of the nerves in the spine that are responsible for muscle rigidity

Introduction

This overview has been prepared to assist members of the Interventional Procedures Advisory Committee (IPAC) in making recommendations about the safety and efficacy of an interventional procedure. It is based on a rapid review of the medical literature and specialist opinion. It should not be regarded as a definitive assessment of the procedure.

Date prepared

This overview was prepared in February 2006.

Procedure name

- Selective dorsal rhizotomy (SDR)
- Limited dorsal rhizotomy
- Selective posterior dorsal rhizotomy

Specialty societies

- British Paediatric Neurology Association
- British Orthopaedic Association
- Society of British Neurological Surgeons
- British Paediatric Neurosurgical Group

Description

Indications

Cerebral Palsy is a condition that can result from various disease processes affecting the brain either during gestation or in early childhood. About 75% of patients with Cerebral Palsy have lower limb spasticity (increased muscle

tone and rigidity). Other symptoms may include movement or balance abnormalities, and speech, or visual difficulties

Current treatment and alternatives

Current conservative treatment options include oral medication, orthotic devices, physiotherapy. Botulinum Intramuscular injections may also be used. In other cases corrective orthopedic procedures, such as a tendonotomy may be appropriate. Electrical stimulation and continuous intrathecal baclofen infusion are other treatment options.

What the procedure involves

Muscular tone (tension) is normally controlled by nerve centres in the brain, however in patients with Cerebral Palsy such centres may be affected. In such patients muscle tone greatly depends on a sensory-motor reflex arc between muscles and spinal cord nerves. This reflex involves sensory nerves bringing information from a muscle back to the spinal cord, and a motor nerve that goes back to the muscle, causing it to contract. The aim of selective dorsal rhizotomy is to down-regulate this spastic reflex by reducing sensory input.
Selective Dorsal Rhizotomy is a surgical procedure carried out under general anaesthesia to the lower area of the spine. The duration of the operation is about five hours During surgery, an incision is made along the lower back and a laminectomy in one or more vertebrae is made to uncover and test small nerve rootlets that make up the spinal sensory nerves. Usually 3-5 rootlets are identified. Some rootlets found to have abnormal electromyographic responses are subsequently selectively cut. All motor nerve rootlets are preserved so leg movement is not affected.

Intensive physiotherapy will be required for around three months to one year, as patient who was previously able to walk has to learn to walk again.

Efficacy

A meta analysis of three randomised controlled trials comparing selective dorsal rhizotomy (SDR) and physiotherapy with physiotherapy alone found that gross motor function improved by an additional 4% with SDR and physiotherapy than with physiotherapy alone (i.e. an 8% over a 4% improvement respectively, p=0.008). The follow up period in the primary studies was between 9 and 12 months[1].

In a non-randomised controlled trial of 61 patients undergoing SDR, botulinum toxin type A injection, or rehabilitation therapy there were no significant differences in scores of walking speed in any of the three groups between baseline and 20 moths follow up. However, patients treated by SDR showed a transient but significant decrease in walking velocity at 3 months compared to baseline[2].

The gross motor performance measure of patients undergoing SDR was found to increase at 2 years of follow up (54.6 to 63.4 points) in a non-

randomised controlled study. This was not significantly different to the improvement among patients having corrective orthopaedic surgery (54.1 to 60.7 points) (p=0.751). Similarly, self case score increased from 73.7 points to 84.1 points following SDR, and from 75.2 to 83.4 points with orthopaedic surgery (p=0.932)[3].

Case series studies have found that SDR reduced median muscle spasticity scores in abductor muscles from 2 to 0 points (Ashworth scale) in children with Cerebral Palsy categorised as walkers (p=0.007) and also from 2 to 0 points in children characterised as non-locomotors defined as non walkers and non crawlers. (p=0.001) at 12 months follow up[4]; and from 2.9 to 0.4 points in a mixed cohort of patients with spasticity at 4 years[5].

81% (169/208) of patients in a case series of children with Cerebral Palsy receiving SDR demonstrated improvement in ambulatory function at 1 year follow up[5]..

Safety

Neither the meta analysis of 3 randomised controlled trials, nor the non-randomised controlled trials report on SDR safety outcomes. Therefore, there are no comparative data available from the studies included in this overview to consider the safety profile of SDR against that of other therapeutic options for spasticity.

A case series of 250 patients undergoing SDR (mean patient age of 5.9 years, follow up of at least 2 years in 49 patients) found that 58% (145/250) of patients suffered severe postoperative pain and 40 % (100/250) complained of dysesthesia [6]

Common bowel and bladder complications that were reported include constipation 20% (49/250)[6], and urinary retention in between 5% (13/250)[6] and 10% (20/208)[5] of patients. Other, less common but more serious complications reported include intra-operative bronchospasm in 5% (13/250)[6] of patients undergoing SDR, and postoperative aspiration pneumonia at a rate of about 1% (2/208)[5] and (3/250)[6].

Radiologically observed scoliosis was found in 6% (12/208) of patients followed up to 4.2 years although this was not considered to be functionally important[5]. Periods of increased spasticity during times of increased stress at months or years after surgery have been reported in 45 (10/250) of patients undergoing SDR in one case series[6]

Literature review

Rapid review of literature

The medical literature was searched to identify studies and reviews relevant to selective dorsal rhizotomy for cerebral palsy. Searches were conducted via the following databases, covering the period from their commencement to 06/02/02; Medline, PreMedline, EMBASE, Cochrane Library and other

databases. Trial registries and the Internet were also searched. No language restriction was applied to the searches. (See Appendix C for details of search strategy.)

The following selection criteria (Table 1) were applied to the abstracts identified by the literature search. Where these criteria could not be determined from the abstracts the full paper was retrieved.

Table 1 Inclusion criteria for identification of relevant studies

Characteristic	Criteria
Publication type	Clinical studies were included. Emphasis was placed on identifying good quality studies. Abstracts were excluded where no clinical outcomes were reported, or where the paper was a review, editorial, laboratory or animal study. Conference abstracts were also excluded because of the difficulty of appraising methodology.
Patient	Patients with cerebral palsy
Intervention/test	Selective dorsal rhizotomy
Outcome	Articles were retrieved if the abstract contained information relevant to the safety and/or efficacy.
Language	Non-English-language articles were excluded unless they were thought to add substantively to the English-language evidence base.

List of studies included in the overview

This overview is based on one meta anlaysis of 3 randomised controlled trials[1], two non randomised controlled trials [2,3]and 2 case series (3 publications[5,4,6].

Other studies that were considered to be relevant to the procedure but were not included in the main extraction table (Table 2) have been listed in Appendix A. For case series studies, the sample size cut off for inclusion was 200 cases or more. All meta-analyses, RCT's other than those already included in the reviewed meta-analysis, and other controlled trials identified are described in Table 2.

Existing reviews on this procedure

There were no published reviews identified at the time of the literature search. A Cochrane protocol for selective dorsal rhizotomy in the management of children with spastic cerebral palsy has been published with the review expected to be published in the autumn of 2006 http://www.mrw.interscience.wiley.com/cochrane/clsysrev/articles/CD003360/frame.html

Related NICE guidance

Below is a list of NICE guidance related to this procedure. Appendix B details the recommendations made in each piece of guidance listed below.

Interventional procedures:
None

Technology appraisals:
None

Clinical guidelines:
None

Public health:
None

Table 2 Summary of key efficacy and safety findings on selective dorsal rhizotomy for cerebral palsy

Abbreviations used: SDR – selective dorsal rhizotomy, CP – cerebral palsy, GMFM – Gross motor function measure,			
Study details	**Key efficacy findings**	**Key safety findings**	**Comments**
McLaughlin J (2002)[1] **Meta analysis** USA and Canada **n=90 (number having SDR not stated)** Children with CP – inclusion criteria varied between study sites, SDR and physiotherapy vs. physiotherapy alone. Mean age = 5.5 years, Male =53%, gestational age =31.7 weeks, birth weight =1,849g, prenatal cause of CP = 87% (78/90), baseline GMFM score = 62.5, non-ambulatory = 57%. **Follow-up = all patients followed up to either 9 or 12 months** Disclosure of interest: Funding provided by a foundation	**Operative parameters** There was a statistically significant inverse correlation between the baseline GMFM-66 score and the percent of dorsal rootlets cut (p=0.0002). This was independent of study site. **Clinical outcomes** A weak inverse correlation was found between the percent of dorsal root tissue cut and change in Ashworth spasticity score (p=0.03) and GMFM score (p<0.001). A small but statistically significant benefit of SDR and physiotherapy over physiotherapy was found. GMFM scores improved by 4% in the control groups and 8% in the SDR groups (data read from figure) (p=0.008). It is not clear whether this benefit is clinically important.	No safety data from the primary studies is presented.	Primary researcher was also the author of one of the studies included, allowing for analysis of unpublished raw data, and ability to recalculate variables, but potential subjectivity. Follow-up limited to 12 months (2 studies) and 9 months (1 study) Medline, Cochrane and meeting abstracts searched for RCTs up to December 2000. No further details of search strategy provided. Multiple regression undertaken to assess factors of treatment group, study site, age, sex, birth weight, ambulatory status, and baseline clinical scores. In one study less dorsal root tissue was transected (25%) than at the other two studies (41% and 45%). Functional GFMF outcome scores were assessed blindly in all patients Method for data pooling used – blocked Wilcoxon's test. Completeness of follow-up is not reported

Abbreviations used: SDR – selective dorsal rhizotomy, CP – cerebral palsy, GMFM – Gross motor function measure,

Study details	Key efficacy findings	Key safety findings	Comments
Wong A M K (2005)[2] **Non-randomised controlled trial** Taiwan **n=61 (n=20 SDR,** Ambulatory children with spastic diplegia CP. Children with Ashworth spasticity scores 1 and 4 were excluded. Patients received regular rehabilitation therapy for 6 months before baseline. Patients were then entered into study arms of botulinum toxin type A (BTA) injection, SDR, or rehabilitation only, based on parent's choice of therapy. Mean age = 5 years, Male=59%, relying on walking aid = 51% No statistically significant difference between groups in terms of age, height, weight, sex, ambulation ability, or other baseline gait parameters. **Follow-up = 20 months** Disclosure of interest: Study supported by a national grant.	**Gait analysis** outcome / Baseline / 3 months / p= / 20 months / p= Velocity BTA 31.3 / 35.7 / N/S / 32.5 / N/S SDR 33.5 / 25.3 / <0.05 / 38.9 / N/S Rehab 35.5 / 36.6 / N/S / 40.3 / N/S Cadence BTA 92.0 / 100.8 / N/S / 92.8 / N/S SDR 88.5 / 76.4 / N/S / 94.9 / N/S Rehab 93.0 / 90.0 / N/S / 85.6 / N/S Step length BTA 26.0 / 26.2 / N/S / 24.7 / N/S SDR 21.4 / 16.0 / N/S / 278 / N/S Rehab 25.6 / 26.0 / N/S / 25.2 / N/S The BTA group showed a statistically significant improvement in walking velocity over baseline score at 6 months, 38.7 $\pm$ 12.4 % of body height per second and 31.3 $\pm$ 10.2% of body height per second ($p<0.05$) but the difference did not persist past 12 months. The SDR demonstrated a significant deterioration in velocity at 3 months 25.3 $\pm$ 12.0% of body height per second vs. 33.5 $\pm$ 12.8% of body height per second at baseline. However this score recovered at 6 months and was better than baseline at 12 and 20 months follow up (not a significant difference).	No safety data was presented in the study report	During the study period SDR treatment costs were paid for by insurance while BTA was not. No between groups analysis was performed (only within groups). Outcomes assessed by a computer assisted gait analysis system. Measuring gait velocity, cadence, and step length (corrected for patient height) Further study of SDR in children in whom repeated BTA injection produced a ceiling effect may be warranted. No details of blinding of outcomes assessors. Completeness of follow-up not reported

Abbreviations used: SDR – selective dorsal rhizotomy, CP – cerebral palsy, GMFM – Gross motor function measure,

Study details	Key efficacy findings	Key safety findings	Comments
Buckon C E (2004)[3] **Non-randomised controlled trial** USA **n=25 (n=18 SDR)** All children found by an MDT to be appropriate for SDR or orthopaedic soft tissue procedures. Parents chose the treatment therapy after discussions with clinicians. SDR vs. aponeurotomy / tenotomy with post surgical physiotherapy in both groups Mean age = 6 years and 1 month, Male = 76%, ambulatory = 92%. There were no significant differences between groups at baseline in any of the clinical outcomes measured. **Follow-up= 2 years** Disclosure of interest: No commercial party conferred a benefit on the author.	**Motor impairment** The gross motor performance measure (GMPM), was used to assess impairment at baseline 6 months, 12 months and 2 years. There were no significant differences between baseline and follow-up, or sub scores between the groups SDR baseline (n=18) / SDR 2 years / Ortho surgery baseline (n=7) / Ortho surgery 2 years / *p= GMPM total: 54.6 ± 7.0 / 63.4 ± 7.2 / 54.1 ± 7.8 / 60.7 ± 9.4 / 0.751 Within the SDR group GMPM scores improved by 8.13 points (95% CI 4.08 to 12.18) at two years follow up (p<0.001) **Functional limitation** Functional outcomes were evaluated by the GMFM (functional limitation dimension). There were no significant differences between baseline and follow-up scores or sub scores between the groups SDR baseline(n=18) / SDR 2 years / Ortho surgery baseline (n=7) / Ortho surgery 2 years / *p= GMFM total: 89.2 ± 13.2 / 89.5 ± 11.1 / 78.2 ± 13.0 / 85.7 ± 7.1 / 0.540 Within the SDR group GMFM scores improved by 6.32 points (95% CI 1.76 to 10.88) at two years follow up (p=0.011) **Disability** The paediatric evaluation of disability index SDR baseline(n=18) / SDR 2 years / Ortho-surgery baseline(n=7) / Ortho-surgery 2 years / *p= Functional skills Self care: 73.7 ± 13.1 / 84.1 ± 14.2 / 75.2 ± 12.7 / 83.4 ± 14.2 / 0.932 Mobility: 70.5 ±10.1 / 77.8 ± 10.4 / 69.3 ± 12.6 / 76.7 ± 16.1 / 0.511 social: 69.2 ± 8.8 / 75.0 ± 7.9 / 67.5 ± 6.9 / 75.1 ± 11.6 / 0.905	No safety data was presented in the study report	All 25 families asked to participate agreed to do so. All outcomes were evaluated by 2 investigators who were trained in using the scales The post surgical physiotherapy care was not standardised between the groups as it was focused to the remedial need, and may have influenced outcome Analysis shows some significant changes between different outcome measurement points, but not necessarily between baseline score and follow up. Completeness of follow-up not reported * p= describes differences between groups in change from baseline score to follow up.

Abbreviations used: SDR – selective dorsal rhizotomy, CP – cerebral palsy, GMFM – Gross motor function measure,

Study details	Key efficacy findings	Key safety findings	Comments
Abbott R (1992)[6] and (1993)[4] **Case series** USA **n=200 for efficacy outcome and 250 for safety** Cases from 1986 onwards. 600 cases were evaluated for SDR, and cases chosen that were likely to benefit from surgery Children with spastic diplegia and quadriplegia Sensory roots were stimulated and leg muscle activity monitored, if diffusion was present the rootlet was cut, up to a maximum of 50% of rootlets. Increased activity begun after discharge under supervision of a physical therapist. Age=5.9 years, **Follow-up = 12 moths for efficacy outcomes and up to 2+ years for safety** Disclosure of interest: not stated.	**Operative parameters** Mean length of stay was 10.7 weeks **Muscle tone** Median scores and range on the Ashworth scale Outcome / Baseline (n=250) / 12 months (n=49) / p= Walkers Abductors: 2 (1 to 3) / 0 (0 to 0.5) / 0.007 Hip flexors: 1 (0 to 2) / 0 (0) / 0.007 Quadriceps: 1.3 (0 to 2) / 0 (0) / 0.005 Hamstrings: 1.5 (0 to 2) / 0 (0 to 0.5) / 0.003 Plantar flexors: 3 (1 to 3) / 0 (0 to 0.5) / 0.001 Non locomotors Abductors: 2 (1 to 3) / 0 (0 to 2) / 0.001 Hip flexors: 1 (0 to 2) / 0 (0 to 2) / 0.001 Quadriceps: 2 (0.5 to 2) / 0.2 (0 to 1) / 0.001 Hamstrings: 2 (1 to 3) / 0 (0 to 1) / 0.001 Plantar flexors: 3 (1 to 3) / 0 (0 to 2) / 0.001 **Goniometry** Median and range as evaluated by movement analysis Outcome / Baseline (n=250) / 12 months (n=49) / p= Walkers Hip abduction: 45 (15 to 45) / 45 (37.5 to 45) / 0.02 Hip extension: 2.5 (-5 to 15) / 15 (-10 to 15) / N/S Knee extension: 145 (125 to 180) / 174 (160 to 180) / 0.005 Dorsiflexion: 7.5 (-5 to 20) / 13.7 (0 to 20) / N/S Non locomotors Hip abduction: 0 (12.5 to 45) / 45 (17.5 to 45) / 0.02 Hip extension: -1 (-12 to 15) / 15 (-5 to 15) / 0.044 Knee extension: 138 (133 to 170) / 156 (120 to 180) / N/S Dorsiflexion: 0 (-12.5 to 20) / 18.7 (7.5 to 20) / 0.044 Although the walking group did experience a deterioration in goniometric measurements of the plantar flexor range no child deteriorated past the neutral position at the ankles.	**Complications** Incidence **Pulmonary** Intraoperative bronchospasm: 5% (13/250) Aspiration pneumonia: 1% (3/250) **Bowel and bladder** Urinary retention: 5% (13/250) Constipation: 20% (49/250) Ileus: 1% (3/250) **Postoperative discomfort** Severe pain: 58% (145/250) Dysthesia: 40% (100/250) **Sensory** Proprioceptive loss: 1% (3/250) Pain / temperature loss: 1% (2/250) Two of the 3 patients with pneumonia required artificial ventilation. In addition 2 patients had lung segment or lobe collapse intraoperatively leading to the abandonment of the procedure. One patient with urinary retention remained on a catherarisation programme at 18 months follow up. Authors suggest that children with a history suggesting spastic bladder are at greatest risk of this complication Increased spasticity during periods of increased stress (illness anxiety) occurred in 4% (10/250) of patients months or years after surgery. All these patients were spastic quadriplegics at baseline 2% (6/250) of patients have undergone osteotomies of the femur for progressive hip dislocation. All these children were crawling at baseline. Children considered at risk are now placed in orthosis with single lateral upright bracing	Not stated whether this was a consecutive and exhaustive sample, or selected cohort. No details of blinding of outcome assessment Post operative physiotherapy programme (if any) not described. One investigator carried out all surgery. Change to preoperative medication during the series to reduce bronchospasm 50 patients followed up for more than 2 years at time of analysis of safety outcomes. Only 49 of 200 patients analysed for efficacy outcomes at 6 and 12 months Kappa score for reproducibility of Ashworth score was 0.55 for intra-observer retest and 0.64 for inter-observer analysis .

Abbreviations used: SDR – selective dorsal rhizotomy, CP – cerebral palsy, GMFM – Gross motor function measure,

Study details	Key efficacy findings	Key safety findings	Comments
Kim D-S (2001)[5] **Case series** South Korea **n=208 (198 Cerebral Palsy)** Selected patients meeting criteria for posterior rhizotomy. Spastic diplegia or quadriplegia with CP, spastic hemipleagia of cerebro-vascular cause, or spastic quadriparesis due to incomplete spinal cord. Access either by laminectomy or later in the cohort by laminoplasty. Posterior nerve root cut into 3 or 4 and stimulated, with 50 to 70% of abnormal rootlets cut. Procedure repeated from S2 to L2 and at L1 50% of the bilateral root cut without testing Mean age = 5.9 years, Spastic CP n=198, hemiplegia following cerebrovascular insult n=8, spastic quadraparesis after cervical cord injury n=2. **Mean follow-up = 4.2 years** Disclosure of interest: not stated	**Ability to walk** The ability to walk (Peacock grading) showed a improvement in gait quality from 4.2 points at baseline to 5.19 points at 1 year ($p<0.001$). 81.3% (169/208) of patients showed improvements in ambulatory function. **Muscle tone** As measured by the Ashworth scale mean and standard deviation. Baseline (n=208) / 1 year (n=208) / 4 years (n=132) Hip adductors: 2.9 ± 1.45 / 0.4 ± 0.72 / 0.4 ± 0.84 Hamstrings: 3.2 ± 1.32 / 0.2 ± 0.39 / 0.2 ± 0.53 Quadriceps: 2.4 ± 1.05 / 0.5 ± 0.69 / 0.6 ± 0.53 Gastrocnemius: 3.6 ± 0.77 / 0.4 ± 0.55 / 0.7 ± 0.51 Clonus: 0.8 ± 0.25 / 0.07 ± 0.21 / 0.15 ± 0.29 Significant improvement s in the spasticity of all tested muscles were noted at 1 and 4 years There was no statistically significant difference in results between the hemiplegic and diplegic groups. 50% (37/74) of patients with arm spasticity showed milder symptoms at the upper extremity after SDR **Range of motion** Changes in passive range of motion in degrees Baseline (n=208) / 1 year (n=208) / 4 years (n=132) Flexion contracture of the hips: -10.5 ± 12.23 / -3.3 ± 5.26 / -4.6 ± 6.33 Abduction of the hips: 37.5 ± 16.44 / 59.5 ± 17.56 / 62.5 ± 15.56 Popliteal angle of the knee: -31.7 ± 15.23 / -27.5 ± 14.25 / -27.9 ± 13.75 Dorsiflexion of the ankle: -1.3 ± 7.76 / 5 ± 6.76 / 4.8 ± 5.95 All patients showed an overall improvement (over 95%) in the range of abduction of the hips and dorsiflexion of the ankles, a decrease in the flexional contracture of the hips, and more normal popliteal angles.	**Complications** Incidence Hypotonia at final follow up: 3% (7/208) Urinary retention: 10% (20/208) 2 patients suffered long term incontinence Postoperative spinal deformity: 6% (12/208) Radiographic findings only and no functional findings, relating to excessive laminectomy Transient sensory changes: 7% (15/208) 5 patients had changes to final follow up Long standing back pain: 3% (7/208) Aspiration pneumonia: 1% (2/208) Involuntary arm movement: 1% (2/208) The majority of SDR patients suffered temporary hypotonia following the surgery but this resolved over 2 to 3 months for most. The most common postoperative discomfort was back pain that was experienced by all patients Radiologicaly observed scoliosis occurred in 9% (5/58) of patients who had laminectomy, and 2% (2/150) who had laminoplasty.	Retrospective study No value for degree of certainty of statistical results are given for most outcomes. Long standing spasticity in older children resulted in more severe musculoskeletal contracture which was more difficult to correct with SDR. Authors state that other causes other than spasticity can influence child ambulation Post operative physiotherapy regimen (if any) is not described.

Validity and generalisability of the studies

- Improvement in physiological outcome may be poor predictors of functional improvement. Conversely even a small improvement of a physiological measurement may impact disproportionally on disability or caring requirements.
- *Some studies do not report on ability to walk, which is probably the most important efficacy outcome.*
- There is no evidence about the quality of life impact of the operation, either on patients or carers / family members.
- Significant variation in operative procedure, including the extent of nerve testing before rhizotomy.
- Selection criteria for study entry varied between studies. It could be expected that patients with more severe spasticity at baseline are not going to report as favourable outcomes as less impaired children.
- The studies included in the overview do not allow for the effect of age on outcome to be considered.

Specialist advisors' opinions

Specialist advice was sought from consultants who have been nominated or ratified by their Specialist Society or Royal College.

Dr G Cole, Dr A Roberts, Mr M Vloeberghs, Mr M Carter, Mr N Buxton, Dr M Clarke

- All but one of the advisors considered SDR to be an established procedure.
- The potential benefits of SDR are reductions in pain, improved functional outcomes through greater motor ability and reduced spasticity, and fewer corrective orthopaedic procedures.
- Adverse events that have been reported with this procedure include Bladder and bowel disturbances, limb weakness, joint subluxations, progressive scoliosis or kyphosis, and sensory disturbance.
- Additionally the following complications are theoretically possible; paralysis, dividing the wrong nerve rootlets, death, hypotonicity, and weight gain
- Standard outcome measures are lacking but audit criteria might include paediatric quality of life, gross motor function measurement, reduction in spasticity, perioperative morbidity, scoliosis, and sphincter function problems.
- A number of advisors commented that there is some controversy as to where SDR sits among other management options for spasticity in cerebral palsy.
- It has been commented that a reduction in spasticity does not always result in improved motor function.
- SDR is an irreversible procedure with long term outcomes not well researched.

- The most useful comparator would be continuous infusion with a baclofen pump, although this is not yet established for long term use.
- Few surgeons are currently experienced in this procedure in the UK, and the potential diffusion of SDR is likely to be to 10 or fewer specialist centres.
- Standard microsurgery facilities are required, and intraoperative spinal cord electrophysiology monitoring may be required, although there is some disagreement between advisors on the merits of this.
- Patient selection for this procedure is not well understood, and patient work up through a multidisciplinary team is seen as essential.

Issues for consideration by IPAC

- Many studies were available, and the majority were only detailed in appendix A.
- Many studies are 10-20 years old, suggesting the procedure may be established in other parts of the world.

References

1 McLaughlin J, Bjornson K, Temkin N et al. (2002) Selective dorsal rhizotomy: meta-analysis of three randomized controlled trials. *Developmental Medicine & Child Neurology* 44: 17-25.

2 Wong AM, Pei YC, Lui TN et al. (2005) Comparison between botulinum toxin type A injection and selective posterior rhizotomy in improving gait performance in children with cerebral palsy. *Journal of Neurosurgery* 102: 385-389.

3 Buckon CE, Thomas SS, Piatt JH, Jr. et al. (2004) Selective dorsal rhizotomy versus orthopedic surgery: a multidimensional assessment of outcome efficacy. *Archives of Physical Medicine & Rehabilitation* 85: 457-465.

4 Abbott R, Johann-Murphy M, Shiminski-Maher T et al. (1993) Selective dorsal rhizotomy: outcome and complications in treating spastic cerebral palsy. *Neurosurgery* 33: 851-857.

5 Kim DS, Choi JU, Yang KH et al. (2001) Selective posterior rhizotomy in children with cerebral palsy: a 10-year experience. *Childs Nervous System* 17: 556-562.

6 Abbott R. (1992) Complications with selective posterior rhizotomy. *Pediatric neurosurgery* 18: 43-47.

Appendix A: Additional papers on selective dorsal rhizotomy for cerebral palsy not included in summary Table 2

The following table outlines the studies that are considered potentially relevant to the overview but were not included in the main data extraction table (Table 2). It is by no means an exhaustive list of potentially relevant studies.

Article title	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in Table 2
Chicoine MR, Park TS, Kaufman BA. Selective dorsal rhizotomy and rates of orthopedic surgery in children with spastic cerebral palsy. Journal of Neurosurgery 1997; 86(1):34-39	Case series n=178 FU=44 months	Larger studies are included in table 2	Children treated later with SDR had a higher rate of subsequent orthopaedic surgery than those treated younger.
Graubert C, Song KM, McLaughlin JF, Bjornson KF. Changes in gait at 1 year post-selective dorsal rhizotomy: results of a prospective randomized study. Journal of pediatric orthopedics 2000; 20(4):496-500.	RCT n=32 FU=1 year	Same cases as those Included in McLaughlin (1998) study	Changes in ankle dorsiflexion, foot progression angle and hip and knee extension were greater with SDR than physiotherapy
McLaughlin JF, Bjornson KF, Astley SJ, Graubert C, Hays RM, Roberts TS et al. Selective dorsal rhizotomy: efficacy and safety in an investigator-masked randomized clinical trial. Developmental Medicine & Child Neurology 1998 Apr; 40(4):220-232	RCT n=38 FU=2 years	Included in McLaughlin (2002) meta analysis	SDR provided a greater reduction in spasticity than physiotherapy (p=0.02)
Maenpaa H, Salokorpi T, Jaakkola R, Blomstedt G, Sainio K, Merikanto J et al. Follow-up of children with cerebral palsy after selective posterior rhizotomy with intensive physiotherapy or physiotherapy alone. Neuropediatrics 2003; 34(2):67-71	Case series n=44 FU=to 5 years	Larger studies are included in table 2	A loss of spasticity was reported in both SDR and physiotherapy groups
O'Brien DF, Park TS, Puglisi JA, Collins DR, Leuthardt EC, Leonard JR. Orthopedic surgery after selective dorsal rhizotomy for spastic diplegia in relation to ambulatory status and age.[see comment]. Journal of Neurosurgery 2005; 103(1 Suppl):5-9.	Case series n=158 FU=7.5 years	Larger studies are included in table 2	Orthopaedic surgery is more likely in patients destined to be non-ambulators.
Peter JC, Arens LJ. Selective posterior lumbosacral rhizotomy for the management of cerebral palsy spasticity. A 10-year experience. South African Medical Journal 1993; Suid-Afrikaanse Tydskrif Vir Geneeskunde. 83(10):745-747.	Case series n=100 FU=to 10 years	Larger studies are included in table 2	Satisfactory tone reduction in 95% of cases
Salame K, Ouaknine GE, Rochkind S, Constantini S, Razon N. Surgical treatment of spasticity by selective posterior rhizotomy: 30 years experience. Israel Medical Association Journal: Imaj 2003; 5(8):543-546.	Case series n=154 FU=11 years	A mixed cohort of patients with spasticity only 60 had cerebral palsy. Data not analysed separately	Painful spasms alleviate in 80% of cases, and reduction of spasticity achieved in all cases

Steinbok P, Reiner AM, Beauchamp R, Armstrong RW, Cochrane DD, Kestle J. A randomized clinical trial to compare selective posterior rhizotomy plus physiotherapy with physiotherapy alone in children with spastic diplegic cerebral palsy. Developmental Medicine and Child Neurology 1997; 39(3):178-184	RCT n=30 FU=9 months	Included in McLaughlin (2002) meta analysis	Gross motor function measure improved significantly more in the SDR group (11.3%) than the physiotherapy group (5.2%)
Steinbok P, Schrag C. Complications after selective posterior rhizotomy for spasticity in children with cerebral palsy. Pediatric neurosurgery 1998; 28(6):300-313.	Case series n=158 FU=29 months	Larger studies are included in table 2	Aspiration pneumonia was the most common Intraoperative complication occurring in 2 patients
Steinbok P, Hicdonmez T, Sawatzky B, Beauchamp R, Wickenheiser D. Spinal deformities after selective dorsal rhizotomy for spastic cerebral palsy. Journal of Neurosurgery 2005; 102(4 Suppl):363-373	Case series n=105 FU=4.3 years	Larger studies are included in table 2	55% of children had scoliosis at last follow up with 25% having worsening of 10 degrees or more
Wright FV, Sheil EMH, Drake JM, Wedge JH, Naumann S. Evaluation of selective dorsal rhizotomy for the reduction of spasticity in cerebral palsy: A randomised controlled trial. Developmental Medicine and Child Neurology 1998; 40(4):239-247	RCT n=24 FU=1 year	Included in McLaughlin (2002) meta analysis	Gross motor function measure improved significantly more in the SDR group (12.1%) than the physiotherapy group (4.4%)

Appendix B: Related published NICE guidance for selective dorsal rhizotomy for cerebral palsy

Guidance programme	Recommendation
Interventional procedures	None applicable
Technology appraisals	None applicable
Clinical guidelines	None applicable
Public health	None applicable

Appendix C: Literature search for selective dorsal rhizotomy for cerebral palsy

Procedure number:	Procedure Name:	
Databases	**Version searched (if applicable)**	**Date searched**
The Cochrane Library	Issue 1: 2006	6.02.06
CRD	-	6.02.06
Embase	1980 – week 5 2006	6.02.06
Medline	1966 – Jan week 4 2006	6.02.06
Premedline	-	6.02.06
CINAHL	1982 – week 4 2006	7. 02.06
British Library Inside Conferences (limited to current year only)	-	7. 02.06
National Research Register	Issue 1: 2006	7. 02.06
Controlled Trials Registry	-	7. 02.06

The following search strategy was used to identify papers in Medline. A similar strategy was used to identify papers in other databases.

1. Cerebral palsy/
2. cerebral pals$.tw
3. spasticit$.tw
4. spastic diplegia.tw
5. spastic quadriplegia.tw
6. Quadriplegia/
7. increase$ muscle tone.tw
8. rhizotomy/
9. sensory nerve root interruption.tw
10. ((function$ or posterior or dorsal) adj rhizot$).tw
11. sensory root rhizot$.tw
12. sensory nerve root rhizot$.tw
13. sensory nerve root interruption.tw
14. or/1-7
15. or/8-13
16. 14 and 15