

What’s the Evidence?

Selective Dorsal Rhizotomy for children with cerebral palsy

Key findings

* Selective Dorsal Rhizotomy (SDR) is an operation that aims to reduce spasticity and improve function in children with cerebral palsy.
* There is strong evidence that SDR can reduce spasticity, but the evidence is more limited for long-term improvements in functioning.
* Children who are able to walk are likely to benefit most.
* More research is needed to understand if SDR leads to long-term improvements in function and movement.
* Families considering SDR need to be aware of the commitment to intensive physiotherapy following surgery.

**Published November 2016**

**What were we asked?**

We were asked whether Selective Dorsal Rhizotomy (SDR) is an effective procedure for children with cerebral palsy.

**What did we do?**

We structured the question using the [PICO](http://www.pencru.org/research/researchterms/#pico) format. Is Selective Dorsal Rhizotomy effective for reducing spasticity and improving function in children with cerebral palsy? If there are any benefits, are they sustained in the long term?

We searched NHS Evidence, The Cochrane Library, TRIP, NICE, and PubMed databases, and brought the information together in this summary. These searches were last updated in May 2016. We asked an expert in cerebral palsy and parents from our [Family Faculty](http://www.pencru.org/getinvolved/ourfamilyfaculty/) to review and comment on the accuracy and accessibility of the summary.

**What did we find?**

*What is spasticity?*

Muscle tone is maintained by a circuit of information passing along nerves to and from the spinal cord. Spasticity occurs when sensory nerves in the muscles send too many signals to the spinal cord. This causes a message to be sent back to the muscle making it contract without the person being able to control it. People with spasticity describe their muscles as feeling stiff and difficult to move.

*What is Selective Dorsal Rhizotomy?*

Selective Dorsal Rhizotomy (SDR) is an irreversible operation that aims to reduce spasticity in cerebral palsy. The surgery involves opening up the spinal canal. Sensory nerves at the lower end of the spinal cord are divided into rootlets. Equipment is used to find out which of the rootlets are sending too many signals. These overactive rootlets are divided again. This reduces the signals being sent out, and stops the muscles from reacting. SDR is an irreversible procedure.

Intensive physiotherapy is needed after surgery to improve function and increase strength.1 SDR is not suitable for everyone with spasticity. Candidates are assessed carefully when considering the procedure.

Further operations, including orthopaedic surgery, may be required after SDR. This will vary on a case by case basis.

*Is there evidence that SDR is effective in reducing spasticity and improving function?*

Two [systematic reviews](http://www.pencru.org/research/researchterms/#systematicreview) looked at whether SDR reduces spasticity. Both reviews concluded that SDR does reduce spasticity in the short-term.2 3

The same two reviews also explored whether SDR improved movement ability (the ability to sit, stand or walk). They found some evidence that SDR has a small positive benefit on movement ability in the short-term. 2, 3

One review studied the impact of SDR on gait (the way a person walks). It concluded that SDR improved gait in the short-term. 3

NICE guidance states that the evidence available shows that SDR reduces spasticity. However they did not find enough high quality evidence to show an improvement in function after SDR. 1, 4

*Is there evidence that any benefits are sustained in the long-term?*

A [systematic review](http://www.pencru.org/research/researchterms/#systematicreview) explored the long-term outcomes after SDR. They found moderate evidence that SDR improves gait in the long-term. The same review found no evidence that SDR improved movement ability or the ability to complete daily activities or participate in community or social life in the long-term. 5

Since this review, other studies have explored long-term outcomes for SDR. All of these studies are prospective cohort studies. These studies follow a group of children who all had SDR and there is no control group for comparison. This makes it difficult to know whether any effects are due to having had SDR or something else.

Long-terms effects on spasticity were reported in three prospective cohort studies. All three studies reported that SDR was effective at reducing spasticity between 10 and 17 years after SDR. 6 7 8

Five cohort studies evaluated long-term movement ability. The findings of these five studies vary. This makes it difficult to draw conclusions about the long-term impact of SDR on movement ability. 6, 7, 8, 9, 10

*Is there evidence about the impact SDR may have on any other outcomes?*

More high quality research is needed on important outcomes such as pain, quality of life, and general measures of activity and participation in daily life.

There is some evidence that SDR may improve bladder function.11 There is also some evidence that suggests SDR can reduce upper limb spasticity.12

*What does the evidence tell us about which children are most likely to benefit from SDR?*

A recent [systematic review](http://www.pencru.org/research/researchterms/#systematicreview) looked at criteria used to select children for SDR and the outcomes for those children. They found some evidence for poorer outcomes in children with: excessive curvature of the spine, build-up of fluid in the brain, and learning disabilities. 13

One review looked at movement ability before SDR. Findings from five of the six studies showed children with greater movement ability before surgery had larger improvements in movement, gait and/or tone.13 Another recent study reported similar findings. 14

Current NICE guidance recommends six clinical criteria for identifying children and young people who would be suitable for SDR. These are:

* Abnormal muscle tone
* Good leg muscle strength
* Straight legs and minimal muscle shortening
* Good selective motor control in the legs
* Good cognitive skills
* Not overweight

These criteria are most likely in children in [Gross Motor Function Classification System](https://canchild.ca/system/tenon/assets/attachments/000/001/399/original/GMFCS_English_Illustrations.pdf) (GMFCS) I, II, and III who can walk. However, SDR is not usually recommended for children in GMFCS I. This is because the possible qualitative benefits are not thought to outweigh the potential risks. 1

Some experts believe that SDR could be extended to those in GMFCS IV and V as a replacement for intrathecal baclofen pumps (ITBP). However at present there has been little research to explore this.

Research has also investigated whether there is an ideal age for a child to have SDR. The evidence suggests that age might be important but remains uncertain. 13 14

NICE guidance notes that most of the research describes children who had SDR were aged 4 to 10 years. 4

It is important that both the child and their family are committed and motivated to have SDR because long-term physiotherapy is required following surgery.

*What does the research evidence tell us about any risks associated with SDR?*

One review looked at spinal deformities. They found that these seemed to be common after SDR. However it is not known if this can be directly linked to SDR.5

A recent study looked at whether children are more likely to become overweight or obese after SDR. It did not find any evidence to support this concern.15

NICE guidance states that the risks of any permanent harm from SDR are low, however the potential consequences are serious.1 Patients may experience deterioration in walking ability or bladder function, and later complications including spinal deformity.4

*Is Selective Dorsal Rhizotomy currently available on the NHS?*

In 2014 NHS England announced that they would be providing SDR to 140 children. This was as part of a programme to gather evidence on the effectiveness of the procedure- known as ‘Commissioning through Evaluation’. The five centres which were taking part in the SDR programme were:

* Alder Hey Children’s NHS Foundation Trust
* Great Ormond Street Hospitals NHS Foundation Trust
* Leeds Teaching Hospitals NHS Trust
* Nottingham University Hospitals NHS Trust
* University Hospitals Bristol NHS Foundation Trust

NHS England state that they will not routinely fund SDR. 16

**What do we think?**

* There is strong evidence that SDR reduces spasticity in children with cerebral palsy. However more research is needed to understand whether SDR improves overall function in the short and long-term.
* Current evidence suggests children with GMFCS II to III are most likely to benefit from SDR. The aim of the surgery should be to reduce spasticity and improve gait.
* Families considering SDR should be aware of the substantial commitment required to long-term physiotherapy following surgery.

**Signposts to other information**

NICE explain their guidance on SDR: [www.nice.org.uk/guidance/ipg373/informationforpublic](https://www.nice.org.uk/guidance/ipg373/informationforpublic)

SCOPE provide an overview of SDR: [www.scope.org.uk/support/families/therapies/sdr](http://www.scope.org.uk/support/families/therapies/sdr)

GOSH provide an overview of SDR: [www.gosh.nhs.uk/medical-information-0/procedures-and-treatments/selective-dorsal-rhizotomy](http://www.gosh.nhs.uk/medical-information-0/procedures-and-treatments/selective-dorsal-rhizotomy)

We would like to hear your feedback on this summary – please email us at pencru@exeter.ac.uk if you have any comments or questions.

**References**

1. National Institute for Health & Clinical Excellence (July 2012). Spasticity in children and young people with non-progressive brain disorders: management of spasticity and co-existing motor disorders and their early musculoskeletal complications. [Online] Available at: [www.nice.org.uk/guidance/cg145/evidence/full-guideline-186774301](https://www.nice.org.uk/guidance/cg145/evidence/full-guideline-186774301)

2. McLaughlin J., et al. (2002) Selective dorsal rhizotomy: meta-analysis of three randomized controlled trials. *Dev Med Child Neurol.* 44(1): 17-25.

3. Steinbok P. (2001) Outcomes after selective dorsal rhizotomy for spastic cerebral palsy. *Child’s Nerv Syst*. 17: 1-18.

4. National Institute for Health & Clinical Excellence. (2010) Selective dorsal rhizotomy for spasticity in cerebral palsy. NICE intervention procedure guidance IPG 373. [Online] Available at: [www.nice.org.uk/guidance/ipg373](https://www.nice.org.uk/guidance/ipg373)

5. Grunt S., et al. (2011) Long-term outcome and adverse effects of selective dorsal rhizotomy in children with cerebral palsy: a systematic review. *Dev Med Child Neurol.* 53(6): 490-8.

6. Tedroff K., et al. (2015) A prospective cohort study investigating gross motor function, pain, and health-related quality of life 17 years after selective dorsal rhizotomy in cerebral palsy. *Dev Med Child Neurol.* 57(5): 484-90.

7. Ailon T., et al. (2015) Long-term outcome after selective dorsal rhizotomy in children with spastic cerebral palsy. *Child’s Nerv Syst.* 31(3): 415-23.

8. Dudley R.W., et al. (2013) Long-term functional benefits of selective dorsal rhizotomy for spastic cerebral palsy. *J Neurosurg Pediatr.* 12(2): 142-50.

9. Josenby A.L., et al. (2015) Functional performance in self-care and mobility after selective dorsal rhizotomy: a 10-year practice-based follow-up study. *Dev Med Child Neurol.* 57(3): 286-93.

10. Bolster E.A., et al. (2013) Long-term effect of selective dorsal rhizotomy on gross motor function in ambulant children with spastic bilateral cerebral palsy, compared with reference centiles*. Dev Med Child Neurol.* 55(7): 610-6.

11. Chiu P.K., et al. (2014) Does selective dorsal rhizotomy improve bladder function in children with cerebral palsy? *Int Urol Nephrol.*  46(10): 1929-33.

12. Gigante P., et al. (2013) Reduction in upper-extremity tone after lumbar selective dorsal rhizotomy in children with spastic cerebral palsy. *J Neurosurg Pediatr.* 12(6): 588-94.

13. Grunt S., et al.(2014) Selection criteria for selective dorsal rhizotomy in children with spastic cerebral palsy: a systematic review of the literature. *Dev Med Child Neurol.* 56(4): 302-12.

14. Funk J.F., et al. (2015) Predictors for the benefit of selective dorsal rhizotomy. *Res Dev Disabil.* 37: 27-34.

15. Gutknecht S.M., et al. (2015) Ambulatory children with cerebral palsy do not exhibit unhealthy weight gain following selective dorsal rhizotomy. *Dev Med Child Neurol.* 57(11): 1070-5.

16. NHS England. Commissioning through Evaluation. [Online] Available at: [www.england.nhs.uk/commissioning/spec-services/npc-crg/comm-eval/](https://www.england.nhs.uk/commissioning/spec-services/npc-crg/comm-eval/)

Note: the views expressed here are those of the Peninsula Cerebra Research Unit (PenCRU) at the University of Exeter Medical School and do not represent the views of the Cerebra charity, or any other parties mentioned. We strongly recommend seeking medical advice before undertaking any treatments/therapies not prescribed within the NHS