

Intrathecal Baclofen Trial as a Predictor of Long-Term Outcomes After Selective Dorsal Rhizotomy in Children with Spastic Cerebral Palsy

Antonio Malaspina

Antonio.Malaspina@nyulangone.org

NYU Langone Health

Hannah Weiss

NYU Langone Health

Patricia Siegel

The Valley Hospital

Sebastián N. Anderson

Columbia University

Spencer Frome

NYU Langone Health

Owen Les

The Valley Hospital

Daniela I. Anderson

Bergen County Academies

Benjamin Konigsberg

The Valley Hospital

Alex Konigsberg

The Valley Hospital

Diana Maloney

The Valley Hospital

Caitlynn Guinto Lopes

The Valley Hospital

David Konigsberg

The Valley Hospital

Avrum Joffe

The Valley Hospital

Angela D'Alessandro

The Valley Hospital

Richard C. E. Anderson

Research Article

Keywords: Selective dorsal rhizotomy, intrathecal baclofen trial, cerebral palsy, tone reduction

Posted Date: October 18th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10844150/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Purpose

To assess whether short-term clinical changes observed during an intrathecal baclofen (ITB) trial approximate long-term outcomes following selective dorsal rhizotomy (SDR) in children with spastic cerebral palsy.

Methods

We reviewed a cohort of patients ≤ 21 years old who underwent an ITB trial followed by SDR between 2015 and 2024. Modified Ashworth Scale (MAS), passive range of motion (ROM), and Observational Gait Scale (OGS) outcomes were recorded at baseline, 2 and 4 hours after ITB injection, and at least 12 months after SDR. Time points were compared using Wilcoxon signed-rank tests, and caregivers completed a postoperative survey.

Results

Twenty-one patients were included (median follow-up, 26.2 months). Composite MAS scores decreased by 2.0 points after ITB and 2.6 points after SDR (both $p < 0.001$), with no significant difference between ITB and post-SDR assessments ($p = 0.115$). Straight leg raise improved by 10° after ITB ($p < 0.001$) and remained improved after SDR ($p = 0.003$), with no difference between ITB and post-SDR values ($p = 0.330$). Hip abduction improved after ITB ($p = 0.005$) but not long term; ankle dorsiflexion did not significantly change. OGS improved by 2.0 points after ITB ($p = 0.014$) and 2.5 points after SDR ($p < 0.001$), with no significant difference between ITB and post-SDR scores ($p = 0.151$). Caregiver reports were concordant, with most describing similar improvements after SDR and finding the ITB trial useful for expectation setting and decision-making.

Conclusion

At the cohort level, changes observed during the ITB trial approximated those measured at long-term follow-up after SDR. An ITB trial may support patient selection and expectation setting; larger studies are needed to determine individual-level predictive performance.

Introduction

Cerebral palsy is the most prevalent motor disorder of childhood, with an estimated prevalence ranging from 1.5 to 4 per 1,000 live births [16–18, 29, 31]. Spastic cerebral palsy (SCP), characterized by increased muscle tone and impaired voluntary movement, is the predominant subtype of cerebral palsy, and is the most common cause of childhood-onset, lifelong physical disability. Spasticity has a

significant impact on function and quality of life, and interferes with gait, causes discomfort, and impairs functional independence [8]. Without intervention, spasticity-related motor impairments persist into adulthood, frequently accompanied by musculoskeletal complications, chronic pain, and difficulty for caregivers. Selective dorsal rhizotomy (SDR), where the operator identifies and transects afferent sensory nerve rootlets at the lumbosacral level while preserving motor function and sensation, is an established spasticity-reducing procedure for children with moderate to severe SCP [22, 26]. While SDR reliably reduces tone, improvements in range of motion, gait, and overall mobility vary significantly between patients, making optimal surgical selection for SDR a persistent clinical challenge [9, 19, 25].

Several studies have evaluated the use of preoperative assessments, such as motor function scales, gait analysis, and neuroimaging, to assess baseline function and predict outcomes following SDR [20, 28, 30]. However, these tools often fail to predict individual post-SDR outcomes. Alternatively, short duration intrathecal baclofen (ITB) trials, which temporarily reduce spasticity via modulation of spinal motor circuitry [10], offer a reversible, real-time opportunity to evaluate the magnitude and functional impact of tone reduction. Yet, the utility of ITB trials to help predict post-SDR functional changes remains largely unknown.

In this study, we evaluated children with SCP who underwent an ITB trial followed by SDR at a single tertiary pediatric center. We aimed to determine whether changes in tone, ROM, and gait during the ITB trial correlated with outcomes at least one year after SDR. Additionally, we assessed caregiver perceptions of the ITB trial's role in shaping expectations and influencing the decision to proceed with surgery. We hypothesized that the direction and magnitude of changes during the ITB trial would be similar to those observed after SDR and provide predictive value to both clinicians and families.

Methods

We conducted a retrospective review of a prospectively collected cohort of pediatric patients with spastic cerebral palsy who underwent an ITB trial followed by selective dorsal rhizotomy (SDR) at a single tertiary care center between 2015 and 2024. Outcome measures were obtained at standardized time points: baseline (pre-trial), during the ITB trial (2 and 4 hours post-injection), and at ≥ 12 -month follow-up after SDR (Fig. 1). Eligible patients were ≤ 21 years of age, carried a diagnosis of spastic cerebral palsy, completed a standardized preoperative ITB trial, and subsequently underwent SDR with at least 12 months of postoperative follow-up. Patients were excluded if outcome data were incomplete.

ITB Trial Protocol

The ITB trial was performed in the pediatric intensive care unit under intravenous sedation. A single bolus of 50 μg baclofen in 1 mL was delivered intrathecally via lumbar puncture. Outcome assessments were performed at 2 and 4 hours post-injection using the same standardized instruments applied at postoperative follow-up. The 4-hour evaluation was used for all trial analyses.

Surgical Procedure

SDR was performed through a single-level laminectomy at the level of the conus medullaris as previously described [12, 21]. Intraoperative neurophysiological monitoring and intraoperative manual muscle palpation by the physical and occupational therapy team were used to identify dorsal rootlets contributing most to spasticity, which were selectively sectioned while preserving motor rootlets. Approximately two-thirds of the most spastic dorsal rootlets were lesioned at each level.

Baseline and Outcome Measures

Spasticity was scored bilaterally for the hamstrings, plantarflexors, and hip adductors. A composite Modified Ashworth Scale (MAS) score was calculated as the average across all six muscle groups.

Passive range of motion (ROM) was measured using a goniometer for straight leg raise (SLR), ankle dorsiflexion with the knee extended, and hip abduction, all performed in supine position [4, 15].

In ambulatory patients ($n = 12$), gait was recorded on video and scored using the Observational Gait Scale (OGS) [2].

Clinically Meaningful Improvement

Responder thresholds were defined as follows:

- MAS: ≥ 1 -point average decrease across all six muscle groups
- ROM: $\geq 10^\circ$ increase in SLR or dorsiflexion, or $\geq 5^\circ$ increase in hip abduction
- Gait: ≥ 1 -point increase in OGS

Caregiver Survey

A 16-item postoperative survey was administered at ≥ 12 -month follow-up.

Questions 1–8 (Perceived Benefit): Compared perceived changes during the ITB trial with changes after SDR across tone, ROM, motor function, ADLs, and comfort. Responses were scored as + 1 (“greater during trial”), 0 (“same”), or – 1 (“less during trial”). A sum score was calculated. For each item, the proportion reporting outcomes “equal to SDR” (score = 0) was recorded.

Questions 9–16 (Expectation Setting): Assessed whether the ITB trial helped set expectations and inform decision-making, rated on a 5-point Likert scale (5 = strongly agree to 1 = strongly disagree). Agreement was defined as a score ≥ 4 .

Statistical Analysis

Descriptive statistics were reported as medians with ranges or interquartile ranges (IQRs) for continuous variables and as counts/percentages for categorical variables. Paired comparisons between time points (baseline vs ITB trial, baseline vs post-SDR, and ITB trial vs post-SDR) were performed using the Wilcoxon signed-rank test. Only patients with complete follow-up for a given domain were included in its analysis. All tests were two-tailed with $p < 0.05$ considered significant. These analyses evaluated cohort-level differences between time points; they were not designed to test individual-level prediction or formal equivalence.

Results

Cohort Characteristics

Twenty-one patients with SCP who underwent SDR were included. The median age at SDR was 9 years (range: 3–21). 52.4% ($n = 11$) were male and 47.6% ($n = 10$) were female. GMFCS levels at baseline were available for 20 patients: Level 1: 20%, Level 2: 15%, Level 3: 35%, Level 4: 25%, Level 5: 5%. Median baseline MAS composite score was 3.0 (range: 1.2–4.0); median SLR was 45°, ankle dorsiflexion – 3.8°, hip abduction 41°, and median OGS score 10.0. Median time from ITB trial to SDR was 3.4 months (range: 1.1–36.4). Median follow-up was 26.2 months (range: 12–103.9) (Table 1). Analyses were performed for each domain at ≥ 12 -month follow-up, with complete data for 16 patients for MAS, 15 for ROM, and 12 ambulatory patients for OGS (Fig. 1). There were no postoperative complications after either the ITB trial or SDR.

Table 1
Cohort demographics and baseline clinical characteristics

Age at SDR (years)	9 (3–21)
Sex, n (%)	Male: 11 (52.4%) Female: 10 (47.6%)
Baseline GMFCS, n (%)	
Level 1	4 (20.0%)
Level 2	3 (15.0%)
Level 3	7 (35.0%)
Level 4	5 (25.0%)
Level 5	1 (5.0%)
Baseline MAS	
Hamstrings	3.0 (1–4)
Plantarflexors	3.0 (1–4)
Adductors	2.5 (1–4)
Baseline ROM	
SLR (°)	45 (0–75)
Ankle dorsiflexion (°)	– 3.8 (– 17–30)
Hip abduction (°)	41 (2.5–45)
Baseline OGS	10.0 (4.0–14.5)

Table 1. Data are presented as median (range) unless otherwise indicated. GMFCS, Gross Motor Function Classification System; MAS, Modified Ashworth Scale; ROM, range of motion; SLR, straight leg raise; OGS, Observational Gait Scale; SDR, selective dorsal rhizotomy; ITB, intrathecal baclofen.

Spasticity Outcomes

Composite MAS scores decreased by a median of 2.0 points during the ITB trial and 2.6 points from baseline to ≥ 12 months after SDR ($p < 0.001$ for both comparisons). The additional change between the trial and post-SDR assessments was small (median 0.6 points) and not statistically significant ($p = 0.115$) (Table 2; Fig. 2).

Range of Motion

Composite ROM scores improved during the ITB trial ($p < 0.001$) and remained significantly improved at ≥ 12 months after SDR compared with baseline ($p < 0.001$), with no significant difference between ITB

trial and post-SDR assessments ($p = 0.328$). Among individual measures, SLR improved by a median of 10° during the ITB trial ($p < 0.001$) and remained improved at ≥ 12 months after SDR ($p = 0.003$). Hip abduction increased modestly during the trial (median 4° , $p = 0.005$), without sustained postoperative improvement relative to baseline ($p = 0.398$). Ankle dorsiflexion did not demonstrate a significant change at any time point. Differences between ITB trial and post-SDR assessments were small and not statistically significant across all ROM measures (SLR: $p = 0.330$, ankle dorsiflexion: $p = 0.058$, hip abduction: $p = 0.414$) (Table 2; Fig. 2).

Gait Function

OGS scores improved by a median of 2.0 points during the ITB trial ($p = 0.014$) and by 2.5 points from baseline to post-SDR ($p < 0.001$). The additional improvement between the trial and post-SDR assessments was modest (median 1.2 points) and not statistically significant ($p = 0.151$) (Table 2; Fig. 2).

Table 2
Objective outcome measures across study time points

Outcome Measure	Baseline	Trial	Post-SDR	p Trial vs Baseline	p Post-SDR vs Baseline	p Trial vs Post-SDR
MAS Composite (points);	3.0 (1–4)	1.0 (0–2.3)	0.4 (0–3.0)	$p < 0.001$	$p < 0.001$	$p = 0.115$
Hamstrings MAS (points)	3.0 (1–4)	1.0 (0–2.0)	0.25 (0–3.0)	$p < 0.001$	$p < 0.001$	$p = 0.393$
Plantarflexors MAS (points)	3.0 (1–4)	1.0 (0–3.0);	1.0 (0–3.0)	$p < 0.001$	$p < 0.001$	$p = 0.245$
Adductors MAS (points)	2.5 (1–4)	1.0 (0–2.0)	0 (0–3.0)	$p < 0.001$	$p < 0.001$	$p = 0.262$
ROM Composite ($^\circ$)	26.6 (-0.8–45.0)	33.8 (4.2–60.0)	36.7 (17.0–49.8)	$p < 0.001$	$p < 0.001$	$p = 0.328$
SLR ($^\circ$)	45 (0–75)	55.0 (0–70.0)	60.0 (0–74.5)	$p < 0.001$	$p = 0.003$	$p = 0.330$
Ankle Dorsiflexion ($^\circ$)	-3.8 (-17.0–30.5)	6.2 (-8.0–30.0)	11.2 (-7.5–30.0)	$p = 0.171$	$p = 0.724$	$p = 0.058$
Hip Abduction ($^\circ$)	41.0 (2.5–45.0)	45.0 (15.0–45.0)	45.0 (20.0–45.0)	$p = 0.005$	$p = 0.398$	$p = 0.414$
OGS (points)	10.0 (4.0–14.5)	11.0 (1.0–16.5)	13.0 (6.0–21.0)	$p = 0.014$	$p < 0.001$	$p = 0.151$

Caregiver Survey Results

All caregivers (n = 21) completed the postoperative survey. For the perceived benefit items (Q1–Q8), many caregivers reported that the improvements seen during the ITB trial were comparable to those observed after SDR across multiple domains, including tone, ROM, function, ADLs, and comfort.

For expectation-setting items (Q9–Q16), most caregivers agreed that the trial helped them understand the likely magnitude of postoperative improvement and informed their decision-making. The majority (83.3%) indicated they would recommend the ITB trial to other families considering SDR (Table 3).

Table 3. Caregiver-reported perceptions of ITB trial and SDR outcomes

A. Perceived benefit (Q1–Q8)

Proportion reporting ITB trial outcomes equal to post-SDR outcomes.

Domain	% Equal to SDR
Lower extremity tone	72.7%
Upper extremity tone	29.4%
Lower extremity ROM	70.0%
Upper extremity ROM	59.9%
Lower extremity function	80.0%
Upper extremity function	37.5%
Activities of daily living	61.5%
Pain / Comfort	46.2%

B. Expectation setting (Q9–Q16)

Proportion agreeing that the ITB trial helped set expectations (Likert score ≥ 4).

Table 3
 Caregiver-reported perceptions of ITB trial and SDR outcomes. Agreement was defined as a Likert score ≥ 4 . ROM, range of motion; ADLs, activities of daily living; SDR, selective dorsal rhizotomy; ITB, intrathecal baclofen.

Domain	% Agreement
Tone	88.9%
ROM	88.9%
Function	77.8%
ADLs	66.7%
Pain / Comfort	55.6%
Informed decision to proceed with SDR	83.3%
Would recommend ITB trial	83.3%

Discussion

In this small study, we have demonstrated that the direction and magnitude of cohort-level changes observed during the ITB trial closely reflected those seen at ≥ 1 year follow-up after SDR across all domains assessed. Most gains occurred during the ITB trial and were maintained at long-term follow-up, with minimal change between the trial and post-SDR assessments. These findings suggest that the ITB trial may provide a clinically useful approximation of the effects of tone reduction at the group level.

The functional impairment in SCP is multifactorial, with spasticity representing only one component of a broader neuromuscular disorder. In addition to hypertonia, deficits in motor control and planning, muscle weakness, and progressive musculoskeletal deformities contribute substantially to functional limitation and variability in treatment response. These factors help explain why reductions in tone alone do not uniformly translate into improvements in gait or overall mobility [1, 27].

Both ITB and SDR are well-established interventions for reducing spasticity in children with SCP and have demonstrated to be useful interventions to improve tone and mobility [3, 5, 7, 10, 11, 13, 14, 24]. Other focal spasticity treatments, including botulinum toxin combined with rehabilitation, may also improve lower-extremity tone and gait [6, 23]. However, functional outcomes after SDR vary widely, even among children with similar baseline presentations, highlighting the need for more individualized preoperative assessment [5, 11, 14, 24]. Because an ITB trial produces an immediate, temporary reduction in spasticity, it provides an opportunity to evaluate the functional impact of tone reduction effects prior to proceeding with a surgical intervention with permanent clinical effects, such as SDR. This has important implications for patient selection and counseling, particularly in cases where the relative contribution of spasticity versus motor control impairment is uncertain.

Paired analyses demonstrated significant improvements from baseline during the ITB trial and at long-term follow-up after SDR, with no statistically significant differences detected between trial and post-SDR measurements. The absence of statistically significant differences should not be interpreted as formal equivalence, particularly given the modest sample size. Rather, the study did not detect a cohort-level difference between the two assessments, supporting the interpretation that early response to transient spasticity reduction reflects the magnitude of benefit achievable with permanent surgical modulation.

An important strength of this study is the incorporation of caregiver perspectives alongside objective clinical measures. Families play a central role in decision-making, and their observations often capture dimensions of comfort, function, and day-to-day mobility that are not fully reflected in formal assessments. The high level of reported concordance between trial responses and postoperative improvements underscores the trial's value not only as a predictive clinical tool, but also as a means of helping families understand and anticipate the potential benefits of SDR. Importantly, the vast majority of caregivers would recommend others to undergo an ITB trial to help make the decision whether to move forward with SDR.

These findings should be interpreted in the context of some limitations. While data were collected using standardized clinical instruments, portions of the analysis were conducted retrospectively. The short assessment window of the ITB trial may not capture longer-term functional adaptations. Caregiver responses were collected after SDR and may be subject to recall bias. Finally, the modest sample size from a single tertiary center further limits statistical power and precludes multivariable modeling. The variable interval between ITB trial and SDR may also have influenced the measured responses.

Despite these limitations, the broadly similar cohort-level changes observed during the ITB trial and after SDR support further evaluation of a standardized ITB trial within the SDR assessment pathway. Its reversible nature, low risk profile, and ability to demonstrate patient-specific functional responses make it a valuable adjunct to conventional preoperative assessment.

Conclusion

At the cohort level, changes in tone, ROM, and gait observed during the ITB trial approximated those measured at long-term follow-up after SDR, with no statistically significant differences detected between trial and postoperative measurements. Thus, an ITB trial may provide a clinically useful demonstration of the anticipated effects of SDR, facilitating expectation setting and shared decision-making. Further studies are needed to determine whether individual responses to ITB predict postoperative outcomes or improve patient selection for SDR.

Declarations

Ethics Approval:

The protocol was reviewed by the WCG Institutional Review Board and determined to be exempt from Institutional Review Board oversight under 45 CFR § 46.104(d)(4), as it involved the collection and analysis of identifiable health information regulated under 45 CFR Parts 160 and 164. The Valley Hospital accepted the applicability of WCG IRB's exemption determination. The study was conducted in accordance with applicable institutional and federal ethical standards and the principles of the Declaration of Helsinki.

Consent to participate:

Written informed consent was obtained from the parents or legal guardians of all participants.

Consent for publication:

Not applicable

Competing interests:

The authors have no relevant financial or non-financial interests to disclose.

Funding:

The authors received no funding for this work

Author Contribution

R.C.E.A.: Conceptualization, Methodology, Project administration, Supervision, and Writing – review and editing. H.W. and A.M.: Investigation, Data curation, Visualization, Writing – original draft, and Writing – review and editing. S.N.A.: Formal analysis, Review and Editing. P.S., C.G.L., S.F., O.L., D.I.A., B.K., A.K., D.M., D.K., A.J., and A.D: Investigation, Data curation, Review & Editing. All authors read and approved the final manuscript.

Acknowledgments:

Not applicable

Data Availability

The data are available from the corresponding author on reasonable request, subject to institutional approval.

References

1. Abdou A, Spector E, Sidhu S, Agrawal DK (2025) Lower extremity musculoskeletal complications of spastic cerebral palsy. *J Orthop Sports Med* 7:199–209. <https://doi.org/10.26502/josm.511500196>
2. Boyd RN, Graham HK (1999) Objective measurement of clinical findings in the use of botulinum toxin type A for the management of children with cerebral palsy. *Eur J Neurol* 6(Suppl 4):S23–S35
3. Buizer AI, Martens BHM, van Grandbois C, Schoonmade LJ, Becher JG, Vermeulen RJ (2019) Effect of continuous intrathecal baclofen therapy in children: a systematic review. *Dev Med Child Neurol* 61:128–134
4. Darrah J, Wiart L, Gorter JW, Law M (2014) Stability of serial range-of-motion measurements of the lower extremities in children with cerebral palsy: can we do better? *Phys Ther* 94:987–995
5. Davidson B, Schoen N, Sedighim S et al (2020) Intrathecal baclofen versus selective dorsal rhizotomy for children with cerebral palsy who are nonambulant: a systematic review. *J Neurosurg Pediatr* 25:69–77
6. Dimitrova R, Kim H, Meilahn J et al (2022) Efficacy and safety of onabotulinumtoxinA with standardized physiotherapy for the treatment of pediatric lower limb spasticity: a randomized, placebo-controlled, phase III clinical trial. *NeuroRehabilitation* 50:33–46
7. Gigante P, McDowell MM, Bruce SS, Chirelstein G, Chiriboga CA, Dutkowsky J, Fontana E, Hyman J, Kim H, Morgan D, Pearson TS, Roye BD, Roye DP Jr, Ryan P, Vitale M, Anderson RC (2013) Reduction in upper-extremity tone after lumbar selective dorsal rhizotomy in children with spastic cerebral palsy. *J Neurosurg Pediatr* 12:588–594. <https://doi.org/10.3171/2013.9.PEDS12591>
8. Graham HK, Rosenbaum P, Paneth N et al (2016) Cerebral palsy. *Nat Rev Dis Primers* 2:15082
9. Iorio-Morin C, Yap R, Dudley RWR et al (2020) Selective dorsal root rhizotomy for spastic cerebral palsy: a longitudinal case-control analysis of functional outcome. *Neurosurgery* 87:186–192
10. Kraus T, Gegenleitner K, Svehlik M, Novak M, Steinwender G, Singer G (2017) Long-term therapy with intrathecal baclofen improves quality of life in children with severe spastic cerebral palsy. *Eur J Paediatr Neurol* 21:565–569
11. Kudva A, Abraham ME, Gold J et al (2021) Intrathecal baclofen, selective dorsal rhizotomy, and extracorporeal shockwave therapy for the treatment of spasticity in cerebral palsy: a systematic review. *Neurosurg Rev* 44:3209–3228
12. Makoshi Z, Islam M, McKinney J, Leonard J (2024) Postoperative outcomes and stimulation responses for sectioned nerve roots during selective dorsal rhizotomy in cerebral palsy. *Acta Neurochir (Wien)* 166:308
13. Mandigo CE, Anderson RC (2006) Management of childhood spasticity: a neurosurgical perspective. *Pediatr Ann* 35:354–362. <https://doi.org/10.3928/0090-4481-20060501-07>
14. Mansur A, Morgan B, Lavigne A et al (2022) Comparison of intrathecal baclofen pump insertion and selective dorsal rhizotomy for nonambulatory children with predominantly spastic cerebral palsy. *J Neurosurg Pediatr* 30:217–223

15. Marsico P, Tal-Akabi A, Van Hedel HJA (2016) Reliability and practicability of the straight leg raise test in children with cerebral palsy. *Dev Med Child Neurol* 58:173–179
16. Morgan C, Fethers L, Adde L et al (2021) Early intervention for children aged 0 to 2 years with or at high risk of cerebral palsy: international clinical practice guideline based on systematic reviews. *JAMA Pediatr* 175:846–858
17. Noritz G, Davidson L, Steingass K, Council on Children With Disabilities, American Academy for Cerebral Palsy and Developmental Medicine (2022) Executive summary: providing a primary care medical home for children and youth with cerebral palsy. *Pediatrics* 150:e2022060056. <https://doi.org/10.1542/peds.2022-060056>
18. Novak I, Morgan C, Adde L et al (2017) Early, accurate diagnosis and early intervention in cerebral palsy: advances in diagnosis and treatment. *JAMA Pediatr* 171:897–907
19. O'Sullivan R, Leonard J, Quinn A, Kiernan D (2019) The short-term effects of selective dorsal rhizotomy on gait compared to matched cerebral palsy control groups. *PLoS ONE* 14:e0220119
20. Oudenhoven LM, van der Krogt MM, Romei M et al (2019) Factors associated with long-term improvement of gait after selective dorsal rhizotomy. *Arch Phys Med Rehabil* 100:474–480
21. Park TS, Johnston JM (2006) Surgical techniques of selective dorsal rhizotomy for spastic cerebral palsy: technical note. *Neurosurg Focus* 21:E7. <https://doi.org/10.3171/foc.2006.21.2.8>
22. Pasquali C, Deletis V, Sala F (2020) Selective dorsal rhizotomy: functional anatomy of the conus-cauda and essentials of intraoperative neurophysiology. *Childs Nerv Syst* 36:1907–1918
23. Pyrzanowska W, Chrościńska-Krawczyk M, Bonikowski M (2025) Long-term improvement of gait kinematics in young children with cerebral palsy treated with botulinum toxin injections and integrated/intensive rehabilitation: a 5-year retrospective observational study. *Toxins (Basel)* 17:142. <https://doi.org/10.3390/toxins17030142>
24. Ruggiero C, Porzio M, Tengattini F, Cinalli G, Spennato P (2024) Selective dorsal rhizotomy after baclofen intrathecal pump removal: a single-center experience and review of the literature. *Childs Nerv Syst* 40:4089–4094
25. Sargut TA, Haberl H, Wolter S et al (2021) Motor and functional outcome of selective dorsal rhizotomy in children with spastic diplegia at 12 and 24 months of follow-up. *Acta Neurochir (Wien)* 163:2837–2844
26. Steinbok P (2007) Selective dorsal rhizotomy for spastic cerebral palsy: a review. *Childs Nerv Syst* 23:981–990
27. Theis N, Korff T, Kairon H, Mohagheghi AA (2013) Does acute passive stretching increase muscle length in children with cerebral palsy? *Clin Biomech (Bristol Avon)* 28:1061–1067
28. Verduzco-Gutierrez M, Raghavan P, Pruenste J et al (2024) AAPM&R consensus guidance on spasticity assessment and management. *PM R* 16:864–887
29. Vitrikas K, Dalton H, Breish D (2020) Cerebral palsy: an overview. *Am Fam Physician* 101:213–220

30. Weinbrecht-Mischkewitz M, Wittmack E, Hentschel F et al (2025) Predictors of outcome in patients with cerebral palsy following selective dorsal rhizotomy. *Early Hum Dev* 200:106154

31. YeARGIN-Allsopp M, Van Naarden Braun K, Doernberg NS, Benedict RE, Kirby RS, Durkin MS (2008) Prevalence of cerebral palsy in 8-year-old children in three areas of the United States in 2002: a multisite collaboration. *Pediatrics* 121:547–554

Figures

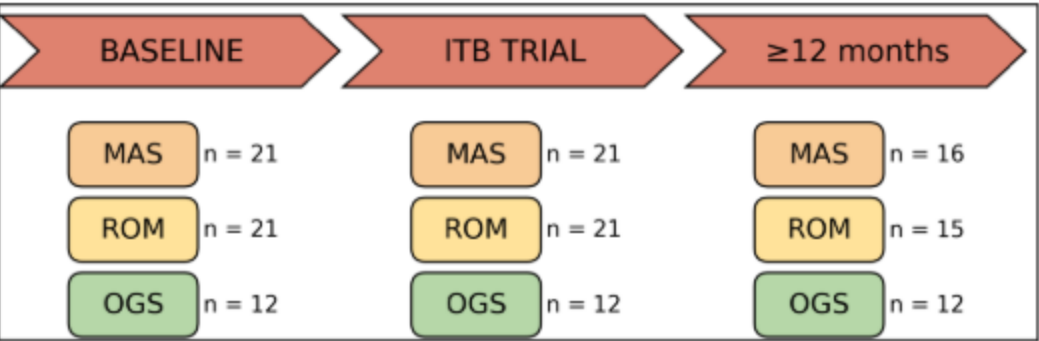


Figure 1

Flow diagram showing the number of patients contributing outcome data at baseline, during the intrathecal baclofen (ITB) trial, and at ≥12-month follow-up after selective dorsal rhizotomy (SDR). MAS and ROM data were available for 21 patients at baseline and during the trial and for 16 and 15 patients, respectively, after SDR. OGS data were available for 12 ambulatory patients at all three time points. MAS, Modified Ashworth Scale; ROM, range of motion; OGS, Observational Gait Scale

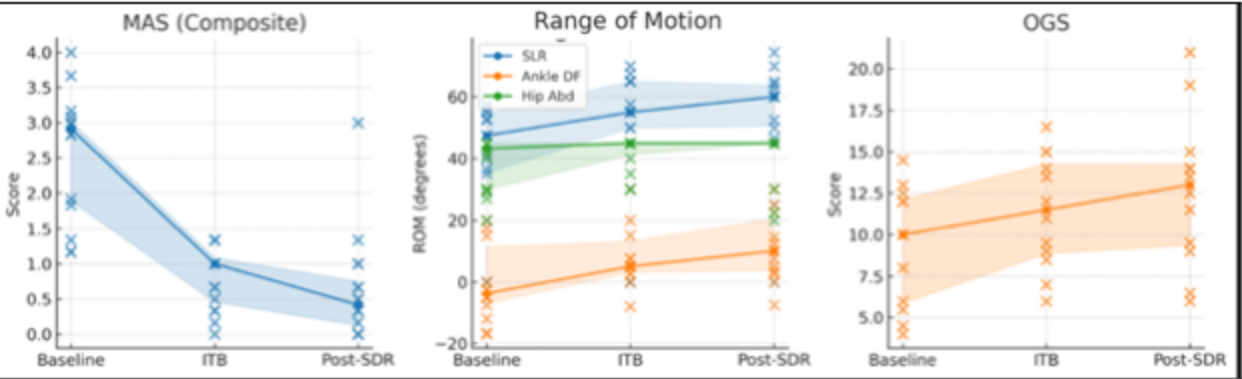


Figure 2

Within-patient changes in Modified Ashworth Scale (MAS) composite scores, passive range of motion (ROM; composite), and Observational Gait Scale (OGS) scores at baseline, during intrathecal baclofen (ITB) trial, and at ≥12-month follow-up after selective dorsal rhizotomy (SDR). For each outcome, solid lines represent median values across stages, shaded regions indicate interquartile ranges (IQRs), and “x” markers denote individual participant measurements. MAS composite scores improved significantly

during the ITB trial and remained improved after SDR (baseline vs ITB: $p < 0.001$; baseline vs post-SDR: $p < 0.001$), with no significant difference between ITB trial and post-SDR assessments ($p = 0.115$). OGS scores improved during the ITB trial ($p = 0.014$) and after SDR (baseline vs post-SDR: $p < 0.001$), with no significant difference between ITB trial and post-SDR assessments ($p = 0.151$). ROM outcomes showed no significant differences between ITB trial and post-SDR assessments for any measure (SLR: $p = 0.330$, ankle dorsiflexion: $p = 0.058$, hip abduction: $p = 0.414$).