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## Case report

# Long-term benefits from selective dorsal rhizotomy in a young patient with cerebral palsy

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## ABSTRACT

**Introduction:** Spasticity is considered to be one of the most important factors hampering functional abilities among patients with a cerebral palsy (CP).

**Aim:** The aim of the study was to present results of the selective dorsal rhizotomy (SDR) procedure combined with the physiotherapy process in a 3 year follow-up study, presented from a functional and structural perspective.

**Case study:** After the diagnosis of CP in the form of spastic diplegia, the 2-years-old patient (GMFCS 4) was directed for a comprehensive rehabilitation. After clinical examination and family consultation, spasticity was found to be important factor limiting patient functional abilities.

**Results and discussion:** The patient was directed to SDR operation. The patient was evaluated four times: before the SDR, and then 1, 2 and 3 years after the SDR surgery. The spasticity was assessed using the modified Tardieu scale. A functional assessment was done using the gross motor function measure (GMFM) scale, 6-min walk test and functional assessment questionnaire (FAQ-10). A muscle tension remained decreased throughout the 3 years of the follow up period. The achieved reduction in muscle tone was accompanied by a change in a range of motion, an improvement in GMFM total score result, an increased distance in 6-min walk test and in the FAQ-10 questionnaire.

**Conclusions:** SDR procedure combined with comprehensive rehabilitation programs leads to short- and long-term reduction in the spasticity of a 5-year-old boy with a spastic diplegia. Decreased level of spasticity was accompanied by an increased gross motor functioning and mobility.

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## 1. Introduction

One of the most common motor disorders and consequently the main cause of functional limitation in cerebral palsy (CP) is spasticity.<sup>1,2</sup> This physical disability is affecting about 2 of every 1000 live births.<sup>3,4</sup> CP is a non-progressive condition characterized by a wide spectrum of motor deficits resulting from damages that mainly affect the supratentorial corticospinal tracts and the basal ganglia.<sup>5,6</sup> Patients often develop debilitating fixed muscle contractures that restrict their normal range of motions around joints, and thus limit their mobility. Contractured muscles have been shown to be shorter and stiffer as a result of both stiffer fibers and stiffening of the extracellular matrix.<sup>7</sup> Therefore more effective treatment strategies and clinical care are highly desirable for those patients.<sup>4</sup> Nowadays we are gaining more and more evidence regarding prevention and treatment options for CP. It is already known that cooling prevents the brain in birth asphyxia and due to better management the number and the severity of patients with CP is declining. Therefore, we should seek for more interventions that may help in the management of the disturbances that occur in patients with CP.<sup>4,8-10</sup> Therefore, we should seek for interventions that may help in the management of the disturbances that occur in patients with CP. Spasticity may be reduced by rehabilitation programs and/or pharmacological interventions.<sup>11</sup>

Severe involvement of spasticity suggests a multi-professional consultation for a surgical treatment.<sup>12,13</sup> Selective dorsal rhizotomy (SDR) is an example of such treatment. With its over 100 years of history, SDR has become accepted as a standard neurosurgical procedure for the treatment of spasticity associated with CP.<sup>14-16</sup> It is used primarily to treat children with a lower-extremity spasticity. In those cases, the primary goal of the surgical intervention is to improve lower-extremity function by reducing spasticity.<sup>17</sup> It is important to note that although the primary insult to upper motor neurons in CP is not progressive, the secondary dysfunction of the musculoskeletal system often progresses. The decline depends, among others factors, on the amount a faulty afferentation of affected muscles. By decreasing the excitatory afferent input from the dorsal roots, the amount of excitation experienced by the lower motor neurons can be reduced, and therefore reducing spasticity.<sup>18</sup>

Nevertheless, controversy surrounds the question of whether the loss of spasticity in patients with CP really matters.<sup>19</sup> Potential benefits of therapy chosen for patients with CP should be considered on structure and activity as well as on participation levels.<sup>14</sup> Question still remain whether therapeutic interventions, including SDR, performed during childhood have long-term functional benefits for a patient, his family and patient's functioning in the society.<sup>20</sup> To answer those questions the study was undertaken.

## 2. Aim

The aim of the study was to present results of the SDR procedure combined with the physiotherapy process in a 3-year

follow-up study, presented from a functional and structural perspective.

## 3. Case study

The participant was recruited into this study after obtaining age-appropriate assent from both a child and parents. History of his disorder has been analyzed first. The patient was born at week 39 of gestation. His gestational age was evaluated according to Dubowitz classification<sup>21</sup> for 33 weeks. Apgar score in 1st, 3rd and 5th minute was evaluated respectively for 8, 7, and 8 points. Motor milestones like rolling, creeping and crawl were achieved approximately at age of 12 months. Independent sitting, standing next to furniture were achieved at approximately 2 years of age. Computed tomography scanning did not reveal presence of damage to the basal ganglia. After the diagnosis of CP in the form of spastic diplegia, the 2-years-old patient was directed for a comprehensive rehabilitation. The patient's at-home rehabilitation program had been carried out systematically three times a week for 1 h per day. The patient participated also in a 3-week long rehabilitation in hospital stays, twice a year for 4 h therapy per day. The rehabilitation programs, at home and hospital, were based on individually tailored therapeutic goals and conducted using neurophysiological methods. Generally, the home-based therapy was focused on gait parameters improvement. On rehabilitation stays at hospital, despite individual therapy for 1 h, the patient also undergo additional exercises and training for 3 h a day. The following therapy procedures were used: progressive strength training (30 min), aquatic exercises (45 min), balance training using virtual reality game-based therapy (30 min), group therapy focused on mobility using competition approach (45 min) and stretching (30 min).

At the age of 4 years, functional status of the patient was classified at level 4 according to gross motor function (GMF) classification system (GMFCS). The patient was able to support his full weight on feet using a walker. After the SDR procedure a spasticity in lower limbs, measured by modified Tardieu scale, was reduced in plantar flexors, knee flexors, hip flexors and hip adductors from 2 (clear catch at a precise angle, followed by release) to 0 (no increase in muscle tone).<sup>22</sup> After clinical examination and family consultation, spasticity was found to be important factor limiting patient functional abilities. Therapeutic team introduced the SDR procedure and its treatment goals were explained to the patient and his family. Proposed therapy matched current needs and expectations of the patient, family and the therapeutic team as well (increase mobility and independence in everyday life). The patient was directed to SDR operation according to Park technique,<sup>23</sup> combined with gastrocnemius muscle and gracilis tendon lengthening procedure. The operation took place at the 5 years of patient's age. After the operation, patient returned to his rehabilitation programs as described above.

## 4. Results

The patient was evaluated four times: before the SDR, and then 1, 2 and 3 years after the SDR surgery. The spasticity was

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