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Interventions and Management

1. Cochrane Database Syst Rev. 2012 Feb 15;2:CD008624.

Interventions for drooling in children with cerebral palsy.

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BACKGROUND: Drooling is a common problem for children with cerebral palsy (CP). This can be distressing for these children as well as for their parents and caregivers. The consequences of drooling include risk of social rejection, damp and soiled clothing, unpleasant odour, irritated chapped skin, mouth infections, dehydration, interference with speech, damage to books, communication aids, computers, and the risk of social isolation (Blasco 1992; Van der Burg 2006). A range of interventions exist that aim to reduce or eliminate drooling. There is a lack of consensus regarding which interventions are most effective for children with CP. **OBJECTIVES:** (1) To evaluate the effectiveness and safety of interventions aimed at reducing or eliminating drooling in children with cerebral palsy. (2) To provide the best available evidence to inform clinical practice. (3) To assist with future research planning. **SEARCH METHODS:** We searched the following databases from inception to December 2010 : Cochrane Central Register of Controlled Trials (CENTRAL); Medline via Ovid; EMBASE; CINAHL; ERIC; Psych INFO; Web of Science; Web of Knowledge; AMED; SCOPUS; Dissertations. We searched for ongoing clinical trials in the Clinical Trials web site (<http://clinicaltrials.gov>) and in the Current Controlled Trials web site (<http://www.controlled-trials.com/>). We hand searched a range of relevant journals and conference proceedings. **SELECTION CRITERIA:** Only randomised controlled trials (RCTs) and controlled clinical trials (CCTs) were included. **DATA COLLECTION AND ANALYSIS:** Data were extracted independently by MW, MS and LP and differences resolved through discussion. **MAIN RESULTS:** Six studies were eligible for inclusion in the review. Four of these studies were trials using botulinum toxin-A (BoNT-A) and two were trials on the pharmacological interventions, benzotropine and glycopyrrolate. No RCTs or CCTs were retrieved on surgery, physical, oro-motor and oro-sensory therapies, behavioural interventions, intra-oral appliances or acupuncture. In the studies eligible for review, there was considerable heterogeneity within and across interventions and a meta-analysis was not possible. A descriptive summary of each study is provided. All studies showed some statistically significant change for treatment groups up to 1 month post intervention. However, there were methodological flaws associated with all six studies. **AUTHORS' CONCLUSIONS:** It was not possible to reach a conclusion on the effectiveness and safety of either BoNT-A or the pharmaceutical interventions, benzotropine and glycopyrrolate. There is insufficient evidence to inform clinical practice on interventions for drooling in children with CP. Directions for future research are provided.

[PMID: 22336850](#) [PubMed - in process]

2. BMC Pediatr. 2012 Feb 15;12(1):15. [Epub ahead of print]

Study protocol: an early intervention program to improve motor outcome in preterm infants: a randomized controlled trial and a qualitative study of physiotherapy performance and parental experiences.

Oberg GK, Campbell SK, Girolami GL, Ustad T, Jorgensen L, Kaaresen PI.

BACKGROUND: Knowledge about early physiotherapy to preterm infants is sparse, given the risk of delayed motor development and cerebral palsy. **METHODS:** A pragmatic randomized controlled study has been designed to assess the effect of a preventative physiotherapy program carried out in the neonatal intensive care unit. Moreover, a qualitative study is carried out to assess the physiotherapy performance and parents' experiences with the intervention. The aim of the physiotherapy program is to improve motor development i.e. postural control and selective movements in these infants. 150 infants will be included and randomized to either intervention or standard follow-up. The infants in the intervention group will be given specific stimulation to facilitate movements based on the individual infant's development, behavior and needs. The physiotherapist teaches the parents how to do the intervention and the parents receive a booklet with photos and descriptions of the intervention. Intervention is carried out twice a day for three weeks (week 34, 35, 36 postmenstrual age). Standardized tests are carried out at baseline, term age and at three, six, 12 and 24 months corrected age. In addition eight triads (infant, parent and physiotherapist) are observed and videotaped in four clinical encounters each to assess the process of physiotherapy performance. The parents are also interviewed on their experiences with the intervention and how it influences on the parent-child relationship. Eight parents from the follow up group are interviewed about their experience. The interviews are performed according to the same schedule as the standardized measurements. Primary outcome is at two years corrected age. **DISCUSSION:** The paper presents the protocol for a randomized controlled trial designed to study the effect of physiotherapy to preterm infants at neonatal intensive care units. It also studies physiotherapy performance and the parent's experiences with the intervention. Trial registration ClinicalTrials.gov NCT01089296.

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3. Disabil Rehabil. 2012 Feb 12. [Epub ahead of print]

Community-based study of health-related quality of life in spinal cord injury, muscular dystrophy, multiple sclerosis, and cerebral palsy.

Jovanović M, Lakićević M, Stevanović D, Milić-Rasić V, Slavnić S.

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Purpose: To assess health-related quality of life (HRQOL) in adults with spinal cord injury (SCI), muscular dystrophy (MD), multiple sclerosis (MS), and cerebral palsy (CP). **Methods:** This is a multicenter, community-based, cross-sectional study of adults diagnosed with CP (94), MD (99), MS (98), SCI (99), and healthy adults (105). The WHOQOL-BREF and WHOQOL-DIS questionnaire were used. **Results:** Significant differences in physical functioning between adults with CP and SCI and adults with MS ($p=0.003$ and $p < 0.001$, respectively), as well as between adults with SCI and MD ($p=0.001$) were found. Univariate tests revealed significant psychological functioning differences between adults with SCI and MD ($p=0.02$) and SCI and MS ($p=0.001$). There was a significant difference in physical functioning between controls and adults with SCI ($p=0.049$) and a significant difference in psychological functioning between controls and adults with MS ($p=0.039$). No statistically significant differences were found between the groups in social and environmental domains. **Conclusions:** Physical and physiological functioning were affected to various degrees in the studied neurodisabilities, while all groups reported similar levels of functioning and well-being in social and environmental domains.

[PMID: 22324446](#) [PubMed - as supplied by publisher]

4. Disabil Rehabil. 2012 Feb 11. [Epub ahead of print]**Personal and environmental factors contributing to participation in romantic relationships and sexual activity of young adults with cerebral palsy.**

Wiegerink DJ, Stam HJ, Ketelaar M, Cohen-Kettenis PT, Roebroek ME, The Transition Research Group South West Netherlands.

Erasmus MC, Department of Rehabilitation Medicine , Rotterdam.

Purpose: To study determinants of romantic relationships and sexual activity of young adults with cerebral palsy (CP), focusing on personal and environmental factors. **Method:** A cohort study was performed with 74 young adults (46 men; 28 women) aged 20-25 years (SD 1.4) with CP (49% unilateral CP, 76% GMFCS level I, 85% MACS level I). All participants were of normal intelligence. Romantic relationships, sexual activity (outcome measures), personal and environmental factors (associated factors) were assessed. Associations were analyzed using logistic regression analyses. **Results:** More females than males with CP were in a current romantic relationship. Self-esteem, sexual esteem and feelings of competence regarding self-efficacy contributed positively to having current romantic relationships. A negative parenting style contributed negatively. Age and gross motor functioning explained 20% of the variance in experience with intercourse. In addition, sexual esteem and taking initiative contributed significantly to intercourse experience. **Conclusions:** For young adults with CP personal factors (20-35% explained variances) seem to contribute more than environmental factors (9-12% explained variances) to current romantic relationships and sexual experiences. We advice parents and professionals to focus on self-efficacy, self-esteem and sexual self-esteem in development of young adults with CP.

[PMID: 22324562](#) [PubMed - as supplied by publisher]

5. Neurorehabil Neural Repair. 2012 Feb 13. [Epub ahead of print]**Motor Learning Characterizes Habilitation of Children With Hemiplegic Cerebral Palsy.**

Krebs HI, Fasoli SE, Dipietro L, Fragala-Pinkham M, Hughes R, Stein J, Hogan N.

BACKGROUND: This study tested in children with cerebral palsy (CP) whether motor habilitation resembles motor learning. **METHODS:** Twelve children with hemiplegic CP ages 5 to 12 years with moderate to severe motor impairments underwent a 16-session robot-mediated planar therapy program to improve upper limb reach, with a focus on shoulder and elbow movements. Participants were trained to execute point-to-point movements (with robot assistance) with the affected arm and were evaluated (without robot assistance) in trained (point-to-point) and untrained (circle-drawing) conditions. Outcomes were measured at baseline, midpoint, immediately after the program, and 1 month postcompletion. Outcome measures were the Fugl-Meyer (FM), Quality of Upper Extremity Skills Test (QUEST), and Modified Ashworth Scale (MAS) scores; parent questionnaire; and robot-based kinematic metrics. To assess whether learning best characterizes motor habilitation in CP, the authors quantified (a) improvement on trained tasks at completion of training (acquisition) and 1 month following completion (retention) and (b) quantified generalization of improvement to untrained tasks. **RESULTS:** After robotic intervention, the authors found significant gains in the FM, QUEST, and parent questionnaire. Robot-based evaluations demonstrated significant improvement in trained movements and that improvement was sustained at follow-up. Furthermore, children improved their performance in untrained movements indicating generalization. **CONCLUSIONS:** Motor habilitation in CP exhibits some traits of motor learning. Optimal treatment may not require an extensive repertoire of tasks but rather a select set to promote generalization.

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6. Eur J Paediatr Neurol. 2012 Feb 14. [Epub ahead of print]**Altered arm posture in children with cerebral palsy is related to instability during walking.**

Meyns P, Desloovere K, Van Gestel L, Massaad F, Smits-Engelsman B, Duysens J.

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1501, B-3001 Heverlee, Belgium.

BACKGROUND: Toddlers learning to walk adopt specific 'guard' arm postures to maintain their balance during forward progression. In Cerebral Palsy (CP), the cause of the altered arm postures during walking has not been studied. **AIM:** To investigate whether the altered arm posture in children with CP is a compensation for instability during walking. **METHODS:** Vertical and horizontal hand position, and upper arm elevation angle in the sagittal plane were determined in eleven children with unilateral CP, fifteen children with bilateral CP using 3D gait analysis and compared to twenty-four TD children. A correlation analysis of these measures of arm posture to step width was made to examine the relationship between arm posture and instability. **RESULTS:** The hand position of children with CP was more elevated and anterior, and their upper arm was rotated more posterior than TD children. Children with unilateral CP held their most affected hand higher than their least affected. Increasing the speed accentuated the differences between groups for hand elevation. Step width correlated positively with horizontal hand position of the least affected arm in children with CP. **CONCLUSION:** Children with CP appear to rely on 'guard' arm postures as a compensation strategy to maintain balance while walking comparable to newly walking toddlers. Importantly, this pattern is seen on the least affected side. The substantially altered arm posture on the most affected side in children with unilateral CP, however, suggests that spasticity and associated movements are also important contributing factors.

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7. Eur J Paediatr Neurol. 2012 Feb 9. [Epub ahead of print]

Botulinum neurotoxin treatment in children with cerebral palsy: A population-based study in Norway.

Elkamil AI, Andersen GL, Skranes J, Lamvik T, Vik T.

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BACKGROUND/AIM: To study proportions and characteristics of children treated and un-treated with Botulinum neurotoxin (BoNT) in a population-based cohort of children with cerebral palsy (CP). **METHODS:** All children with CP born during 1999-2003, recorded in the Norwegian CP Register were included (N=411). Gross motor function was assessed using the gross motor classification system (GMFCS). **RESULTS:** Sixty-eight percent of children with bilateral spastic, 63% with unilateral spastic and 41% with dyskinetic CP had received BoNT. The percentage of children treated increased from 62% at GMFCS level I to 88% at level IV, but was only 38% among children at level V. A similar trend was seen for fine motor function. Ninety-four percent of the children received BoNT in their lower limbs. Children without significant cognitive impairment were more often treated than children with such impairment (OR: 2.61; 95% CI: 1.49-4.58). **INTERPRETATION:** In this first population-based study, approximately 2/3 of all children with spastic CP were treated with BoNT. The results suggest preference for treatment of children with potential for functional improvement, while treatment to relieve pain and facilitate care, and of children with cognitive impairment appeared to be less common. Whether the latter groups are treated appropriately requires further studies.

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8. J Bone Joint Surg Am. 2012 Feb 15;94(4):326-34.

Adductor surgery to prevent hip displacement in children with cerebral palsy: the predictive role of the gross motor function classification system.

Shore BJ, Yu X, Desai S, Selber P, Wolfe R, Graham HK.

BACKGROUND: The purpose of this study was to evaluate the relationship between walking ability, as determined

with use of the Gross Motor Function Classification System (GMFCS), and the outcome of hip adductor surgery used to prevent hip displacement in children with cerebral palsy. **METHODS:** We performed a retrospective review of the records of all children with cerebral palsy whose index surgery, performed between January 1994 and December 2004 at one tertiary-level pediatric hospital, was bilateral hip adductor releases. All children had a hip migration percentage of $\geq 30\%$ in at least one hip prior to the adductor surgery, and the minimum duration of follow-up was twenty-four months. Kaplan-Meier survivorship curves were generated by determining the time from the index surgery to "failure," defined as either the need for subsequent surgical procedures or a migration percentage of $\geq 50\%$ in either hip. Hazard ratios were calculated for sex, migration percentage at the time of the index surgery, age at the time of the index surgery, and GMFCS level. **RESULTS:** Three hundred and thirty children were included in the study; 73% (242) were nonambulatory (GMFCS level IV or V). The mean age at the time of the index surgery was 4.2 years, the mean migration percentage was 43%, and the mean duration of postoperative follow-up was 7.1 years. Surgery consisted of open lengthening of the adductor longus and gracilis muscles in all children, with additional procedures as deemed necessary. "Success" was defined as the absence of subsequent surgical procedures during the study period and a migration percentage of $\leq 50\%$ in both hips at the time of follow-up. One hundred and six children (32%) met these criteria for success. The success rate was 94% (thirty-one of thirty-three) in children at a GMFCS level of II, 49% (twenty-seven of fifty-five) in children at a level of III, 27% (twenty-eight of 103) in children at a level of IV, and 14% (twenty of 139) in children at a level of V. **CONCLUSIONS:** Walking ability, as defined with use of the GMFCS level, is a strong predictor of success or failure after hip adductor surgery in children with cerebral palsy. The paradox of hip adductor surgery for children with cerebral palsy is that the children who are most severely affected and need the surgery the most have the poorest results.

LEVEL OF EVIDENCE: Prognostic Level II. See Instructions for Authors for a complete description of levels of evidence.

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9. J Bone Joint Surg Am. 2012 Feb 15;94(4):e271-2.

Soft-Tissue Release for Hip Subluxation in Cerebral Palsy: What Is the Role in the Nonambulatory Patient?: Commentary on an article by Benjamin J. Shore, MD, FRCSC, et al.: "Adductor Surgery to Prevent Hip Displacement in Children with Cerebral Palsy: The Predictive Role of the Gross Motor Function Classification System".

Bielski RJ.

[PMID: 22336985](#) [PubMed - in process]

10. Mayo Clin Proc. 2012 Feb 9. [Epub ahead of print]

Brain-Computer Interfaces in Medicine.

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Brain-computer interfaces (BCIs) acquire brain signals, analyze them, and translate them into commands that are relayed to output devices that carry out desired actions. BCIs do not use normal neuromuscular output pathways. The main goal of BCI is to replace or restore useful function to people disabled by neuromuscular disorders such as amyotrophic lateral sclerosis, cerebral palsy, stroke, or spinal cord injury. From initial demonstrations of electroencephalography-based spelling and single-neuron-based device control, researchers have gone on to use electroencephalographic, intracortical, electrocorticographic, and other brain signals for increasingly complex control of cursors, robotic arms, prostheses, wheelchairs, and other devices. Brain-computer interfaces may also prove useful for rehabilitation after stroke and for other disorders. In the future, they might augment the performance of surgeons or other medical professionals. Brain-computer interface technology is the focus of a rapidly growing research and development enterprise that is greatly exciting scientists, engineers, clinicians, and the public in general. Its future achievements will depend on advances in 3 crucial areas. Brain-computer interfaces need signal-acquisition hardware that is convenient, portable, safe, and able to function in all environments. Brain-

computer interface systems need to be validated in long-term studies of real-world use by people with severe disabilities, and effective and viable models for their widespread dissemination must be implemented. Finally, the day-to-day and moment-to-moment reliability of BCI performance must be improved so that it approaches the reliability of natural muscle-based function.

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11. *Skinmed*. 2012 Jan-Feb;10(1):46-7.

Unusually severe case of dermatosis neglecta.

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An 18-year-old black woman with cerebral palsy was admitted for evaluation of an intrathecal baclofen pump site infection. The dermatology service was consulted for treatment suggestions of a presumed diagnosis of chronic tinea capitis. Three courses of oral griseofulvin during the past 2 years failed to resolve the patient's chronic scalp dermatosis. Scalp lesions first began about 2 years earlier after hospitalization for placement of an intrathecal baclofen pump. The patient was unable to care for her scalp due to her cerebral palsy, and her mother interpreted the scalp condition as infectious. No routine shampoo care, scalp care, or topical treatment was performed for more than 1 1/2 years. The mother felt that touching the patient's scalp might cause pain and noted that the majority of her time was spent concentrating on more critical medical issues. Physical examination revealed coalescing hyperkeratotic plaques extending dorsally from the anterior hairline to the occipital scalp with small flecks of keratinous debris throughout the remaining hair (Figure 1). The plate-like plaques were devoid of hair, except at a few fissures where a few tufts of hair emerged. No cervical lymph nodes were appreciated on palpation. Treatment was initiated with compresses consisting of large warm water-soaked towels 4 times daily. Three times a day, a nursing staff applied 5% salicylic acid in olive oil to the scalp under a shower cap for approximately 1 hour. Over the following 2 days, a significant reduction in keratinous debris was appreciated. Within 2 weeks, the bulk of the plaques had been removed (Figure 2). At 6-week follow-up, the underlying scalp showed areas of fibrosis and possible scarring with a few emerging tufts of hair. On the basis of history and response to treatment with salicylic acid and routine scalp care, the patient was diagnosed with an unusually severe case of dermatosis neglecta.

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Prevention and Cure

12. *Ann Neurol*. 2011 Sep 2. doi: 10.1002/ana.22620. [Epub ahead of print]

Inflammation during fetal and neonatal life: Implications for neurologic and neuropsychiatric disease in children and adults.

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Inflammation is increasingly recognized as being of both physiological and pathological importance in the immature brain. The rationale of this review is to present an update on this topic with focus on long-term consequences of inflammation during childhood and in adults. The immature brain can be exposed to inflammation in connection with viral or bacterial infection during pregnancy or as a result of sterile central nervous system (CNS) insults. Through efficient anti-inflammatory and reparative processes, inflammation may resolve without any harmful effects on the

brain. Alternatively, inflammation contributes to injury or enhances CNS vulnerability. Acute inflammation can also be shifted to a chronic inflammatory state and/or adversely affect brain development. Hypothetically, microglia are the main immunocompetent cells in the immature CNS, and depending on the stimulus, molecular context, and timing, these cells will acquire various phenotypes, which will be critical regarding the CNS consequences of inflammation. Inflammation has long-term consequences and could speculatively modify the risk of a variety of neurological disorders, including cerebral palsy, autism spectrum disorders, schizophrenia, multiple sclerosis, cognitive impairment, and Parkinson disease. So far, the picture is incomplete, and data mostly experimental. Further studies are required to strengthen the associations in humans and to determine whether novel therapeutic interventions during the perinatal period can influence the occurrence of neurological disease later in life.

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13. Dev Med Child Neurol. 2012 Feb 13. doi: 10.1111/j.1469-8749.2012.04218.x. [Epub ahead of print]

Survival of individuals with cerebral palsy born in Victoria, Australia, between 1970 and 2004.

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Aim: This study used data collected prospectively since 1986 from a population-based cerebral palsy registry to explore the rates, predictors, trends, and causes of mortality for individuals born in Victoria, Australia, between 1970 and 2004. **Method:** Data were extracted for 3507 individuals (1972 males; 1535 females). The probability of survival before 31 May 2010 was determined using the Kaplan-Meier method; age-specific mortality rates were calculated per 1000 person-years and related to population rates. Using Cox proportional hazards regression, relative risks of mortality were estimated for different categories of chosen demographic and clinical variables. Causes were tabulated according to the direct cause of death. **Results:** There were 418 deaths. Crude mortality was 20% at the age of 40 years. Relative to the population, mortality was highest in children aged under 15 years and decreased to twice the population rate at the age of 35 years. The strongest independent predictor of mortality was no independent ambulation (adjusted hazard ratio 6.2 [95% confidence interval 3.3-11.8]); additional predictors were severe intellectual impairment (3.0 [1.7-5.2]), epilepsy (1.4 [1.1-1.9]), deafness (2.6 [1.4-4.7]), and term birth (1.8 [1.3-2.4]). No improvement in survival was seen over time (unadjusted hazard ratio 1.00 [95% CI 0.99-1.01]). Respiratory causes were the most common direct causes of death. **Interpretation:** Rates, predictors, and causes of death for individuals with cerebral palsy in Victoria were similar to those found in other population cohorts. Lack of improvement in survival since 1970 was an unexpected finding that warrants further investigation.

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14. Exp Brain Res. 2012 Feb 11. [Epub ahead of print]

Introduction of a method for quantitative evaluation of spontaneous motor activity development with age in infants.

Disselhorst-Klug C, Heinze F, Breitbach-Faller N, Schmitz-Rode T, Rau G.

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Coordination between perception and action is required to interact with the environment successfully. This is already trained by very young infants who perform spontaneous movements to learn how their body interacts with the environment. The strategies used by the infants for this purpose change with age. Therefore, very early

progresses in action control made by the infants can be investigated by monitoring the development of spontaneous motor activity. In this paper, an objective method is introduced, which allows the quantitative evaluation of the development of spontaneous motor activity in newborns. The introduced methodology is based on the acquisition of spontaneous movement trajectories of the feet by 3D movement analysis and subsequent calculation of specific movement parameters from them. With these movement-based parameters, it was possible to provide an objective description of age-dependent developmental steps in healthy newborns younger than 6 months. Furthermore, it has been shown that pathologies like infantile cerebral palsy influence development of motor activity significantly. Since the introduced methodology is objective and quantitative, it is suitable to monitor how newborns train their cognitive processes, which will enable them to cope with their environment by motor interaction.

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15. *Neurosci Lett.* 2012 Feb 6. [Epub ahead of print]

Diffusion tensor imaging demonstrated radiologic differences between diplegic and quadriplegic cerebral palsy.

Chang MC, Jang SH, Yoe SS, Lee E, Kim S, Lee DG, Son SM.

Department of Physical Medicine and Rehabilitation, College of Medicine, Yeungnam University, Republic of Korea.

Little information is available on the use of imaging for the classification of cerebral palsy patients. The present study examined the radiological differences between quadriplegic cerebral palsy patients (QCP), diplegic cerebral palsy patients (DCP) and normal control subjects (NC) by performing diffusion tensor imaging (DTI) of the corticospinal tract (CST) of upper and lower extremities. Twenty-three cerebral palsy patients (11 QCP, 12 DCP) and 12 NC were enrolled. DTI were scanned using a 1.5T and the CST images were analyzed using FMRIB software. We measured the fractional anisotropy (FA) and apparent diffusion coefficient (ADC) values of the CST. Compared to DCP and NC, QCP had decreased mean FA and increased mean ADC values of the CSTs of upper and lower extremities. The mean FA values of the lower extremities in DCP were significantly decreased, compared to NC; however this was not observed for the mean FA value of the upper extremities. The DTI results of the CST in QCP and DCP significantly corresponded with their typical clinical manifestation. DTI may thus be a very powerful modality to assess the state of CST in cerebral palsy patients.

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