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## Interventions and Management

**1. Front Hum Neurosci. 2014 Jun 30;8:459. doi: 10.3389/fnhum.2014.00459. eCollection 2014.**

**Precision grip in congenital and acquired hemiparesis: similarities in impairments and implications for neurorehabilitation.**

Bleyenheuft Y1, Gordon AM2.

**BACKGROUND:** Patients with congenital and acquired hemiparesis incur long-term functional deficits, among which the loss of prehension that may impact their functional independence. Identifying, understanding, and comparing the underlying mechanisms of prehension impairments represent an opportunity to better adapt neurorehabilitation. **OBJECTIVE:** The present review aims to provide a better understanding of precision grip deficits in congenital and acquired hemiparesis and to determine whether the severity and type of fine motor control impairments depend on whether or not the lesions are congenital or acquired in adulthood. **METHODS:** Using combinations of the following key words: fingertip force, grip force, precision grip, cerebral palsy, stroke, PubMed, and Scopus databases were used to search studies from 1984 to 2013. **RESULTS:** Individuals with both congenital and acquired hemiparesis were able to some extent to use anticipatory motor control in precision grip tasks, even if this control was impaired in the paretic hand. In both congenital and acquired hemiparesis, the ability to plan efficient anticipatory motor control when the less-affected hand is used provides a possibility to remediate impairments in anticipatory motor control of the paretic hand. **CONCLUSION:** Surprisingly, we observed very few differences between the results of studies in children with congenital hemiplegia and stroke patients. We suggest that the underlying specific strategies of neurorehabilitation developed for each one could benefit the other.

[PMID: 25071502](https://pubmed.ncbi.nlm.nih.gov/25071502/) [PubMed] [PMCID: PMC4074995](https://pubmed.ncbi.nlm.nih.gov/PMC4074995/) Free PMC Article

**2. Front Neurol. 2014 Jul 4;5:117. doi: 10.3389/fneur.2014.00117. eCollection 2014.**

**Upper limb function and cortical organization in youth with unilateral cerebral palsy.**

Mackey A1, Stinear C2, Stott S1, Byblow WD3.

**AIM:** To explore the relationship between motor cortical and descending motor pathway reorganization, lesion type, and upper limb function in youth with unilateral cerebral palsy (CP). **METHODS:** Twenty participants with unilateral CP (mean age 15 ± 3 years; 11 males) completed a range of upper limb functional measures. Structural MRI, diffusion-weighted, and functional MRI were conducted to determine type and extent of brain lesion, descending white matter integrity, and whole-brain activity during affected hand use. Single pulse transcranial

magnetic stimulation (TMS) (n = 12) was used to examine functional integrity of the corticospinal pathway as well as primary motor cortex intracortical and interhemispheric inhibition from motor-evoked potentials and silent periods. RESULTS: Fractional anisotropy measures within the posterior limb of the internal capsule were a predictor of upper limb function ( $R(2) = 0.41$ ,  $F = 11.3$ ,  $p = 0.004$ ). Participants with periventricular lesions tended to have better upper limb function [ $F(2, 17) = 42.48$ ,  $p < 0.0001$ ]. Five participants with evidence of cortical reorganization and functional ipsilateral projections to their affected hand had worse upper limb function. Deficits in intracortical and interhemispheric inhibitory mechanisms were found in participants with worse upper limb function (Melbourne Assessment of Unilateral Upper Limb Function: Mann Whitney  $p = 0.02$ ). CONCLUSION: Neuroimaging and TMS can provide useful information related to hand function of individuals with unilateral CP and may have potential to assist as a predictive tool and/or guide rehabilitation.

[PMID: 25071705](#) [PubMed] [PMCID: PMC4082181](#) Free PMC Article

### 3. Res Dev Disabil. 2014 Jul 29;35(11):2756-2765. doi: 10.1016/j.ridd.2014.07.013. [Epub ahead of print]

#### A descriptive analysis of the upper limb patterns during gait in individuals with cerebral palsy.

Bonnefoy-Mazure A1, Sagawa Y Jr2, Lascombes P3, De Coulon G3, Armand S4.

Patients with cerebral palsy (CP) are characterized by a large diversity of gait deviations; thus, lower limb movements during gait have been well-analyzed in the literature. However, the question of upper limb movements and, more particularly, arm movements during gait has received less attention for CP patients as a function of the disease type (Hemiplegic, HE or Diplegic, DI). Thus, the aim of this study was to investigate upper limb movements for a large group of CP patients; we used a retrospective search, including upper limb kinematic parameters and 92 CP patients (42 females and 50 males, mean±standard deviation (SD); age: 15.2±6.7 years). The diagnoses consisted of 48 HE and 44 DI. A control group of 15 subjects (7 females and 8 males, age: 18.4±8.4 years) was included in the study to provide normal gait data. For the DI patients and CG, 88 arms and 30 arms were analyzed, respectively. For the HE patients, 48 affected arms and 48 non-affected arms were analyzed. The kinematic parameters selected and analyzed were shoulder elevation angles; elbow flexion angles; thorax tilt and obliquity angles; hand vertical and anterior-posterior movements; and arm angles. Several gait parameters were also analyzed, such as the gait profile score (GPS) and normalized speed. Statistical analyses were performed to compare CG with the affected and non-affected upper limbs of HE patients and with the two upper limbs of DI patients. The results show that HE and DI patients adopt abnormal upper limb movements. However, DI patients have greater shoulder, elbow, thorax and arm angle movements compared with HE patients. However, HE patients adopt different movements between their affected and non-affected arms. Thus, the patients used their upper limbs to optimize their gait more where gait deviations were more important. These observations confirm that the upper limbs must be integrated into rehabilitation programs to improve inter-limb coordination.

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### 4. J Pediatr Orthop. 2014 Jul 29. [Epub ahead of print]

#### Pronator Teres Transfer for Forearm and Wrist Deformity in Cerebral Palsy Children.

Ho JJ1, Wang TM, Shieh JY, Wu KW, Huang SC, Kuo KN.

BACKGROUND: Forearm pronation and wrist flexion contracture can be a disability for daily living care and 2-hand function in cerebral palsy (CP) children. It may be beneficial to improve their posture and hand-grip power for better functional outcome. The purpose of our study was to investigate the outcome of pronator transfer in CP children. METHODS: Seventeen spastic CP patients (14 hemiplegic, 3 diplegic; 14 male, 3 female; mean age, 12 y 5 mo) underwent pronator teres transfer for forearm pronation and wrist flexion contractures. The mean follow-up period was 46 months. We recorded Gross Motor Function Classification System level, modified Ashworth scale, forearm and wrist range of motion, forearm resting position, grip power, and 3 basic daily living skills preoperatively and postoperatively. Paired t test was used for statistical analysis. RESULTS: The average forearm active supination gained 80.9 degrees ( $P < 0.05$ ) and the active forearm pronation lost 22 degrees ( $P < 0.05$ ), with average postoperative total active forearm range of motion 130.9 degrees ( $P < 0.05$ ). The average active wrist extension

gained 76.9 degrees ( $P<0.05$ ) and the active wrist flexion lost 31.8 degrees ( $P<0.05$ ). The average grip power gained 4.5 kg ( $P<0.05$ ). The average forearm resting position improved to 10 degrees pronation ( $P<0.05$ ). The basic daily living skills showed great improvement. **CONCLUSIONS:** Our procedure improved the functional outcome in wrist extension and decreased the forearm pronation. Therefore, significant grip-strength enhancement and better forearm posture was noted. It is an additional armamentarium in the management of upper extremity disability in CP children.

LEVEL OF EVIDENCE: Level IV-case series.

[PMID: 25075892](#) [PubMed - as supplied by publisher]

##### **5. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi. 2014 May;28(5):606-9.**

###### **Median nerve constrictive operation combined with tendon transfer to treat brain paralysis convulsive deformity of hand [Article in Chinese]**

Ma S, Zhou T.

**OBJECTIVE:** To evaluate the effectiveness of the median nerve constrictive operation combined with tendon transfer to treat the brain paralysis convulsive deformity of the hand. **METHODS:** The clinical data from 21 cases with brain paralysis convulsive deformity of the hand were analyzed retrospectively between August 2009 and April 2012. Of them, there were 13 males and 8 females with an average age of 15 years (range, 10-29 years). The causes of the convulsive cerebral palsy included preterm deliveries in 11 cases, hypoxia asphyxia in 7, traumatic brain injury in 2, and encephalitis sequela in 1. The disease duration was 2-26 years (mean, 10.6 years). All the 21 patients had cock waists, crooking fingers, and contracture of adductors pollicis, 12 had the forearm pronation deformity. According to Ashworth criteria, there were 2 cases at level I, 5 cases at level II, 8 cases at level III, 4 cases at level IV, and 2 cases at level V. All patients had no intelligence disturbances. The forearm X-ray film showed no bone architectural changes before operation. The contraction of muscle and innervation was analyzed before operation. The median nerve constrictive operation combined with tendon transfer was performed. The functional activities and deformity improvement were evaluated during follow-up. **RESULTS:** After operation, all the patients' incision healed by first intension, without muscle atrophy and ischemic spasm. All the 21 cases were followed up 1.5-4.5 years (mean, 2.3 years). No superficial sensory loss occurred. The effectiveness was excellent in 13 cases, good in 6 cases, and poor in 2 cases, with an excellent and good rate of 90.4% at last follow-up. **CONCLUSION:** The median nerve constrictive operation combined with tendon transfer to treat brain paralysis convulsive deformity of the hand can remove and prevent the recurrence of spasm, achieve the orthopedic goals, to assure the restoration of motor function and the improvement of the life quality.

[PMID: 25073282](#) [PubMed - in process]

##### **6. PLoS One. 2014 Aug 1;9(8):e103764. doi: 10.1371/journal.pone.0103764. eCollection 2014.**

###### **A brain-machine-muscle interface for restoring hindlimb locomotion after complete spinal transection in rats.**

Alam M1, Chen X2, Zhang Z1, Li Y1, He J2.

A brain-machine interface (BMI) is a neuroprosthetic device that can restore motor function of individuals with paralysis. Although the feasibility of BMI control of upper-limb neuroprostheses has been demonstrated, a BMI for the restoration of lower-limb motor functions has not yet been developed. The objective of this study was to determine if gait-related information can be captured from neural activity recorded from the primary motor cortex of rats, and if this neural information can be used to stimulate paralysed hindlimb muscles after complete spinal cord transection. Neural activity was recorded from the hindlimb area of the primary motor cortex of six female Sprague Dawley rats during treadmill locomotion before and after mid-thoracic transection. Before spinal transection there was a strong association between neural activity and the step cycle. This association decreased after spinal transection. However, the locomotive state (standing vs. walking) could still be successfully decoded from neural recordings made after spinal transection. A novel BMI device was developed that processed this neural information in real-time and used it to control electrical stimulation of paralysed hindlimb muscles. This system was able to elicit hindlimb muscle contractions that mimicked forelimb stepping. We propose this lower-limb BMI as a future

neuroprosthesis for human paraplegics.

[PMID: 25084446](#) [PubMed - in process] PMID: PMC4118921 Free PMC Article

**7. Comput Methods Biomech Biomed Engin. 2014 Aug;17 Suppl 1:104-5. doi: 10.1080/10255842.2014.931340.**

**Walking efficiency in children with cerebral palsy: relation to muscular strength and gait parameters.**

Pouliot-Laforte A1, Parent A, Ballaz L.

[PMID: 25074186](#) [PubMed - in process]

**8. Gait Posture. 2014 Jul 3. pii: S0966-6362(14)00611-0. doi: 10.1016/j.gaitpost.2014.06.011. [Epub ahead of print]**

**A data driven model for optimal orthosis selection in children with cerebral palsy.**

Ries AJ1, Novacheck TF2, Schwartz MH2.

A statistical orthosis selection model was developed using the Random Forest Algorithm (RFA). The model's performance and potential clinical benefit was evaluated. The model predicts which of five orthosis designs - solid (SAFO), posterior leaf spring (PLS), hinged (HAFO), supra-malleolar (SMO), or foot orthosis (FO) - will provide the best gait outcome for individuals with diplegic cerebral palsy (CP). Gait outcome was defined as the change in Gait Deviation Index (GDI) between walking while wearing an orthosis compared to barefoot ( $\Delta\text{GDI} = \text{GDI}_{\text{Orthosis}} - \text{GDI}_{\text{Barefoot}}$ ). Model development was carried out using retrospective data from 476 individuals who wore one of the five orthosis designs bilaterally. Clinical benefit was estimated by predicting the optimal orthosis and  $\Delta\text{GDI}$  for 1016 individuals (age: 12.6 (6.7) years), 540 of whom did not have an existing orthosis prescription. Among limbs with an orthosis, the model agreed with the prescription only 14% of the time. For 56% of limbs without an orthosis, the model agreed that no orthosis was expected to provide benefit. Using the current standard of care orthosis (i.e. existing orthosis prescriptions),  $\Delta\text{GDI}$  is only +0.4 points on average. Using the orthosis prediction model, average  $\Delta\text{GDI}$  for orthosis users was estimated to improve to +5.6 points. The results of this study suggest that an orthosis selection model derived from the RFA can significantly improve outcomes from orthosis use for the diplegic CP population. Further validation of the model is warranted using data from other centers and a prospective study.

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**9. J Neurosurg Pediatr. 2014 Aug 1:1-5. [Epub ahead of print]**

**Indwelling intrathecal catheter with subcutaneous abdominal reservoir: a viable baclofen delivery system in severely cachectic patients.**

Waqar M1, Ellenbogen JR, Kumar R, Sneade C, Zebian B, Williams D, Pettorini BL.

Intrathecal baclofen (ITB) is a reversible treatment that reduces muscle tone to ameliorate spasticity and dystonia in patients with cerebral palsy (CP). The resulting decrease in energy expenditure allows patients to gain much-needed weight, albeit temporarily. Modern techniques require sufficient abdominal musculature and subcutaneous fat to permit the implantation of an indwelling pump. In patients with extremely low muscle bulk, visceral pumps may be impractical or impossible, with increased risks of dehiscence and infection. The authors describe a variation of the classical procedure in a young patient with severe cachexia. A 10-year-old boy with spastic-dystonic quadriplegic CP was admitted to the neuromedical unit. Numerous drug trials had failed, and surgical intervention was deemed necessary but was complicated by his cachectic body habitus. The authors inserted a lumbar intrathecal catheter and subcutaneously tunneled it to the anterolateral abdomen, where it was connected to a subcutaneous injection port. Baclofen was continuously infused into the subcutaneous port using a noncoring needle connected to an external pump. The needle and line were changed every 5 days to minimize the risk of

sepsis. Although other techniques, such as intraventricular baclofen delivery, have been described, these are largely dependent upon sufficient musculature to support a visceral pump. A subcutaneous injection port system represents an alternative approach that reduces the risk of sepsis and may be better tolerated in cachectic patients.

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#### 10. Asian Pac J Trop Med. 2014 Jun;7(6):492-5. doi: 10.1016/S1995-7645(14)60081-X.

##### **Effect of acupuncture on inflammatory cytokines expression of spastic cerebral palsy rats.**

Qi YC1, Xiao XJ1, Duan RS1, Yue YH1, Zhang XL1, Li JT1, Li YZ2.

**OBJECTIVE:** To investigate the effect of acupuncture on the tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), interleukin-6 (IL-6), C-reactive protein (CRP), nitric oxide synthase (NOS) content and muscular tension of spastic cerebral palsy rat model. **METHODS:** The rats with spastic cerebral palsy were randomly divided into the control group, model group and acupuncture group. After successful modeling, the muscular tension and the content of TNF- $\alpha$ , IL-6, CRP, NOS were measured. **RESULTS:** The serum TNF- $\alpha$ , IL-6, CRP, NOS content were significantly decreased in the acupuncture group ( $P < 0.05$ ). The low and high shear viscosity of whole blood of the acupuncture group were significantly lower than the control group and the model group ( $P < 0.05$ ). The erythrocyte electrophoresis indexes in the acupuncture group were significantly lower than that in the model group and the control group ( $P < 0.05$ ). Acupuncture significantly reduced the muscular tension of spastic cerebral palsy rat and increased the active extent in the paralytic extremity ( $P < 0.05$ ), but it could not be restored to normal level. Compared with the control group, the difference had significant ( $P < 0.05$ ). **CONCLUSIONS:** Acupuncture treatment can inhibit the release of inflammatory cells after brain injury, then reduce immune injury, relieve muscle spasms and reduce muscular tension.

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#### 11. Clin Rehabil. 2014 Jul 31. pii: 0269215514542355. [Epub ahead of print]

##### **A randomized controlled trial studying efficacy and tolerance of a knee-ankle-foot orthosis used to prevent equinus in children with spastic cerebral palsy.**

Maas J1, Dallmeijer A1, Huijijng P2, Brunstrom-Hernandez J3, van Kampen P4, Bolster E1, Dunn C3, Herndon K3, Jaspers R2, Becher J5.

**OBJECTIVE:** To examine whether using a knee-ankle-foot orthosis helps maintain ankle-foot dorsiflexion range of motion over time. **DESIGN:** A multicentre randomized controlled trial. **SETTING:** Two hospitals and one rehabilitation centre in the Netherlands and the USA. **SUBJECTS:** Children (4-16 years old) with spastic cerebral palsy who were able to walk. **INTERVENTION:** Use of a knee-ankle-foot orthosis, equipped with an Ultraflex® ankle power unit, for at least 6 hours every other night for one year. **MAIN MEASURES:** Primary outcome measure: ankle-foot dorsiflexion range of motion. Secondary outcome measures: ankle-foot and knee angle in gait and gross motor function. Wearing time was also measured. Measurements were taken at baseline and at 3, 6, 9 and 12 months. **RESULTS:** 28 children (experimental group:  $n=15$ , control group:  $n=13$ ) participated in the study. 11 participants (experimental:  $n=4$ , control:  $n=7$ ) did not complete all five measurements, as they needed additional treatment. No significant difference was found in the decrease of ankle-foot dorsiflexion range of motion between the experimental and control groups (difference:  $-1.05^\circ$ , 95% confidence interval:  $-4.71^\circ - 2.61^\circ$ ). In addition, secondary outcome measures did not show differences between groups. Despite good motivation, knee-ankle-foot orthosis wearing time was limited to a mean $\pm$ SD of  $3.2\pm 1.9$  hours per prescribed night due to discomfort. **CONCLUSIONS:** Knee-ankle-foot orthosis with dynamic ankle and fixed knee are poorly tolerated and are not beneficial in preventing a reduction in ankle-foot dorsiflexion range of motion in children with spastic cerebral palsy, at least with limited use.

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**12. J Pediatr Orthop. 2014 Jul 29. [Epub ahead of print]****Neurological Complications After Supracondylar Femoral Osteotomy in Cerebral Palsy.**

Inan M1, Sarikaya IA, Yildirim E, Güven MF.

**BACKGROUND:** Knee flexion contracture in children with cerebral palsy (CP) is very common and functional impairment leads to a crouch gait. Correction of the knee flexion contracture and improvement of the gait pattern by supracondylar femoral extension osteotomy seems to be a more effective method than distal hamstring procedures in long-standing severe crouch. Only a small number of publications reported the neurological complications of this surgical technique. This study was planned to identify the risk factors leading to neurological complications after supracondylar femoral extension osteotomy in patients with CP. **METHODS:** Supracondylar femoral osteotomies performed for a primary diagnosis of CP with rigid knee flexion deformity of 10 to 30 degrees were included in the study. Supracondylar femoral extension osteotomy was performed in 28 patients (total: 48 cases). Neurological complication was not detected in 43 cases (group 1) and detected in 5 cases (group 2). Previous surgical operation, concomitant operations on the same extremity, application of a brace or long leg cast after operation, preoperative and postoperative popliteal angle, amount of correction, radiologic correction, tourniquet time, level of malnutrition, and emotional state were reviewed. **RESULTS:** There were 18 boys and 10 girls. The mean age was 12±4 years in group 1 and 13±1 years in group 2. Except 6 patients, all patients had concomitant operations (38 cases in group 1 and 4 cases in group 2). Postoperatively, long leg cast was used in 38 cases and brace in 10 cases. In group 1 mean correction was 23±3.8 degrees and in group 2 it was 19±5.7 degrees. **CONCLUSIONS:** Correlation was not found between the incidence of neurological complications and amount of correction and deformity. After supracondylar femoral extension osteotomy, all patients must be suspected of neurological complication, and measures taken to alleviate the stretch at once if nerve palsy is diagnosed.

LEVEL OF EVIDENCE: Level IV.

[PMID: 25075896](#) [PubMed - as supplied by publisher]**13. Laser Ther. 2014 Jul 1;23(2):121-8. doi: 10.5978/islsm.14-OR-10.****Investigation regarding prevention of insufficiency fractures in children with severe cerebral palsy by Light-Emitting Diode (LED) irradiation.**

Asagai Y1, Yamamoto K2, Ohshiro T3, Ohshiro T4.

Bone metabolism in children with severe fractures was examined, risk factors for fractures were characterized, and effects of LED (light-emitting diode) irradiation on the risk factors for fractures were investigated. Since insufficiency fracture in children with severe cerebral palsy can be caused without obvious external force in daily care, it is sometimes handled as a medical accident and can lead to a lawsuit. It is very important to explain the possibility of an insufficiency fracture to guardians before a fracture is caused. However, risk factors for fractures in bone metabolism has not been well investigated and preventive treatment of fractures have also not been established. Risk factors in bone metabolism were investigated in 14 cases of insufficiency fracture in children with severe cerebral palsy accompanied by akathisia in this study. Fractures were likely caused around 8 years old when children grew rapidly, and either IGF-1 or BAP showed low values in all cases. A group with LED irradiation consisting of 25 cases indicated a normal value of IGF-1 related to bone growth, BAP related to bone density and NTX/Cr. A case irradiated to LED for more than one month clearly showed normal bone metabolism compared with the change within a non irradiated group after one year. LED irradiation increased bone density and femur cortical bone thickness, and improved bone age. Adequate effects were not seen in two children at 14 years of age. The commercially available LED light bulbs that we used have a peak at 446-477 nm in the blue wave length, but also have second peaks at 574 nm in green, at 590 nm in yellow, and even 612 nm in orange and 660 nm in red are included. Although it is thought that such a variety of wave lengths might have a good influence on bone metabolism; exposure time and distance, number of regions, and time period irradiated to LED are important factors, since the LED power density is low (0.9 mW/m<sup>2</sup>) with a 30 cm distance). Our results suggest that LED irradiation can be a phototherapy to activate human homeostasis.

[PMID: 25071311](#) [PubMed] [PMCID: PMC4112281](#) [Available on 2015/1/1]

**14. J Pediatr Orthop. 2014 Jul 29. [Epub ahead of print]****Recurrence of Equinus Foot Deformity After Tendo-Achilles Lengthening in Patients With Cerebral Palsy.**

Chung CY1, Sung KH, Lee KM, Lee SY, Choi IH, Cho TJ, Yoo WJ, Park MS.

**BACKGROUND:** Recurrence of equinus deformity after surgery is common in patients with cerebral palsy. This retrospective study was undertaken to estimate the recurrence rate of the equinus deformity after tendo-Achilles lengthening (TAL) in patients with cerebral palsy and to investigate the risk factors associated with the recurrence. **METHODS:** Two-hundred forty three ambulatory patients with cerebral palsy, who underwent TAL for equinus foot deformity since 1995, and had undergone a preoperative and postoperative 3-dimensional gait analysis, were included. Cox proportional hazards model was used to determine the significant contributing factor for the recurrence of equinus foot deformity. **RESULTS:** The mean patient age at surgery was  $7.8 \pm 2.7$  years and the mean follow-up duration was  $8.1 \pm 3.4$  years. Equinus deformity recurred in 22 of the 243 patients (9.1%) and the Kaplan-Meier survival estimate was shown to be 89.4% at 10 years not needing repeat surgery. According to the multivariate analysis using the Cox proportional hazard model, preoperative ankle dorsiflexion at initial contact ( $P=0.016$ ) was the only significant factor for recurrence of equinus deformity after surgery. Age at surgery and the type of limb involvement were not associated with the recurrence ( $P=0.433$  and  $0.269$ ). The cutoff values of preoperative gait kinematics between the nonrecurrence and recurrence groups were  $-19$  degrees of ankle dorsiflexion at initial contact ( $P=0.018$ ). **CONCLUSIONS:** This study showed that the severity of preoperative equinus deformity was a risk factor associated with recurrence after TAL in patients with cerebral palsy. Therefore, surgeons should consider the recurrence and later revision surgery for the patients with severe equinus foot deformity.

LEVEL OF EVIDENCE: Therapeutic level III.

[PMID: 25075893](#) [PubMed - as supplied by publisher]

**15. Pediatr Neurol. 2014 Aug;51(2):252-4. doi: 10.1016/j.pediatrneurol.2014.03.015. Epub 2014 Mar 26.****Acute Onset Rhythmic Hiccup-Like Respirations Secondary to Oral Baclofen Toxicity.**

Srivastava S1, Hoon A2, Ogborn J3, Johnston M2.

**OBJECTIVE:** Baclofen toxicity has been associated with seizures, coma, apnea, autonomic disturbances, and cardiac conduction abnormalities. It has not been associated with rhythmic hiccup-like respirations. **METHOD:** We report a patient with suspected baclofen toxicity. **RESULTS:** Our patient is a 19-year-old girl with cerebral palsy secondary to prematurity and repaired tetralogy of Fallot who had started oral baclofen 8 months before to diminish spasticity. Her main concern was the acute onset of rhythmic, deep, continual, hiccup-like breaths every few seconds, increasing in frequency with exhaustion, and disappearing in sleep. The night after her evaluation, her symptoms significantly worsened. She presented at the Johns Hopkins pediatric emergency room where her symptoms were only somewhat responsive to a benzodiazepine; she was discharged without a clear etiology. After discussion the next day, her baclofen dose was reduced. Within 12 hours, her abnormal respirations disappeared without recurrence. **CONCLUSIONS:** Respiration involves glutamatergic excitatory synaptic input to medullary inspiratory  $\gamma$ -aminobutyric acid-mediated pacemaker neurons. Baclofen acts on presynaptic  $\gamma$ -aminobutyric acid B receptors on glutamate axons; derangement of this system may explain the irregular respirations in our patient in a dose-dependent fashion.

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[PMID: 25079574](#) [PubMed - in process]

**16. Disabil Rehabil. 2014 Jul 28:1. [Epub ahead of print]****Muscle size and strength in children with cerebral palsy.**

Wiwanitkit V.

[PMID: 25066070](#) [PubMed - as supplied by publisher]

**17. Front Neuroeng. 2014 Jul 9;7:20. doi: 10.3389/fneng.2014.00020. eCollection 2014.**

**Exploration of the neural correlates of cerebral palsy for sensorimotor BCI control.**

Daly I1, Faller J2, Scherer R3, Sweeney-Reed CM4, Nasuto SJ5, Billinger M2, Müller-Putz GR2.

Cerebral palsy (CP) includes a broad range of disorders, which can result in impairment of posture and movement control. Brain-computer interfaces (BCIs) have been proposed as assistive devices for individuals with CP. Better understanding of the neural processing underlying motor control in affected individuals could lead to more targeted BCI rehabilitation and treatment options. We have explored well-known neural correlates of movement, including event-related desynchronization (ERD), phase synchrony, and a recently-introduced measure of phase dynamics, in participants with CP and healthy control participants. Although present, significantly less ERD and phase locking were found in the group with CP. Additionally, inter-group differences in phase dynamics were also significant. Taken together these findings suggest that users with CP exhibit lower levels of motor cortex activation during motor imagery, as reflected in lower levels of ongoing mu suppression and less functional connectivity. These differences indicate that development of BCIs for individuals with CP may pose additional challenges beyond those faced in providing BCIs to healthy individuals.

[PMID: 25071544](#) [PubMed] [PMCID: PMC4088187](#) Free PMC Article

**18. Gait Posture. 2014 Jul 9. pii: S0966-6362(14)00619-5. doi: 10.1016/j.gaitpost.2014.07.003. [Epub ahead of print]**

**Overground versus self-paced treadmill walking in a virtual environment in children with cerebral palsy.**

van der Krogt MM1, Sloot LH2, Harlaar J2.

Treadmill walking offers several advantages for clinical gait analysis and gait training, but may affect gait parameters. We compared walking on a self-paced treadmill in a virtual environment (TM+) with overground walking in a conventional gait lab (CGL), and with natural walking (NW) outside a lab environment on a GaitRite measurement mat, for 11 typically developing (TD) children and 9 children with cerebral palsy (CP). Spatiotemporal parameters and subjective scores on similarity to normal walking were compared between all three conditions, while kinematic parameters and Gait and Motion Analysis Profile Scores (GPS and MAP) were compared between CGL and TM+. Subjects walked slower and with shorter strides in both lab conditions compared to NW. Stride width was 3-4cm wider in TM+ than in CGL and NW. Mean kinematic curves showed a few differences between CGL and TM+: on the treadmill children with CP walked with on average 2° more pelvic tilt, 7° more knee flexion at initial contact, and more deviating knee and ankle kinematics as indicated by the MAP scores. These differences may in part be due to increased fatigue in TM+ as a result of longer continuous walking time. Our results indicate that differences between self-paced treadmill walking in a VR and walking in a conventional gait lab are generally small, but need to be taken into account when performing gait analysis on a treadmill.

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**19. Arch Phys Med Rehabil. 2014 Jun 2. pii: S0003-9993(14)00406-7. doi: 10.1016/j.apmr.2014.05.011. [Epub ahead of print]**

**Can a Lifestyle Intervention Improve Physical Fitness in Adolescents and Young Adults With Spastic Cerebral Palsy? A Randomized Controlled Trial.**

Slaman J1, Roebroek M2, van der Slot W3, Twisk J4, Wensink A5, Stam H2, van den Berg-Emons R2; LEARN 2 MOVE Research Group.

OBJECTIVE: To evaluate both the short- and long-term effectiveness of a lifestyle intervention on physical fitness in

adolescents and young adults with cerebral palsy (CP). DESIGN: Single-blind, randomized controlled trial. SETTING: University hospitals and rehabilitation clinics. PARTICIPANTS: Adolescents and young adults (N=57) with spastic CP classified in Gross Motor Function Classification System levels I through IV; of these, 42 completed the study. INTERVENTION: A 6-month lifestyle intervention consisting of physical fitness training combined with counseling sessions focused on physical behavior and sports participation. MAIN OUTCOME MEASURES: Physical fitness, including measures of cardiopulmonary fitness, muscle strength, and body composition. RESULTS: Favorable short- and medium-term effects were found for peak oxygen consumption, oxygen consumption, and load on the anaerobic threshold and waist circumference. Favorable long-term effects were found for sum of skinfolds, systolic blood pressure, and total cholesterol. CONCLUSIONS: This exploratory study showed that the lifestyle intervention was effective in improving cardiopulmonary fitness and body composition. Effects of body composition were maintained in the long term. However, the intervention needs to be optimized to increase muscle strength and for long-term retention of effects on aerobic capacity.

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## 20. BMC Pediatr. 2014 Jul 27;14(1):192. [Epub ahead of print]

### **Pain, motor function and health-related quality of life in children with cerebral palsy as reported by their physiotherapists.**

Badia M, Riquelme I, Orgaz B, Acevedo R, Longo E, Montoya P.

BACKGROUND: Children and adolescents with cerebral palsy suffer from higher levels of pain than their peers without disability. The aim of this study was to explore the impact of pain on health-related quality of life and motor function in individuals with cerebral palsy as reported by health professionals. METHODS: Cross-sectional study carried out in Associations for Care of Individuals with Cerebral Palsy and Related Disabilities (ASPACE) in Balearic Islands and Castile Leon (Spain). Thirty-five physiotherapists rated pain, health-related quality of life and motor function in 91 children and adolescents with cerebral palsy [8-19y]. A semi-structured interview was used to collect demographic and clinical data according with the Study of Participation of Children with Cerebral Palsy Living in Europe (SPARCLE). RESULTS: Physiotherapists reported that 51% of individuals with cerebral palsy suffered from pain. Physiotherapists also perceived that pain in individuals with cerebral palsy was responsible for reductions of psychological but not physical domains of health-related quality of life. According with physiotherapists' estimations, motor impairment scores were not correlated with pain scores in individuals with cerebral palsy, but they were significantly associated with physical and autonomy domains of health-related quality of life. CONCLUSIONS: These findings highlighted the importance of assessing and providing interventions for pain relief in persons with cerebral palsy even at an early age.

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## 21. Rev Chil Pediatr. 2014 Feb;85(1):22-30. doi: 10.4067/S0370-41062014000100003.

### **Alternatives to estimate stature during nutritional assessment of children with cerebral palsy [Article in Spanish]**

Amezquita G MV, Hodgson B MI.

INTRODUCTION: The assessment of nutritional status plays a critical role in comprehensive child care, however, in children with cerebral palsy (CP) is difficult to meet some reliable anthropometric measures, particularly height. OBJECTIVE: To determine if the equations to estimate stature, developed and validated in CP populations of other countries, apply to our reality. PATIENTS AND METHOD: An anthropometric assessment in 60 children with cerebral palsy that included measurement of weight, height and body segments like tibia length (TL) and knee height (KH) was performed. The height was estimated using the above described segments and the Stevenson et al.<sup>1</sup> equations. The correlation and agreement between the measured and the estimated stature were evaluated. RESULTS: Height could be reliably measured in 36 individuals and in all cases height was estimated. The correlation between the measured and the estimated lengths for TL and KH was 0.975 and 0.981 respectively ( $p < 0.001$ ). The analysis of agreement between the estimated and measured lengths showed on average a significant

level of agreement, with an error of -2.96 cm for TL and 0.21 cm for KH. **CONCLUSIONS:** The equations to estimate stature from the body segments, tibia length and knee height, are valid and useful to assess the linear growth in children with CP in our population.

[PMID: 25079180](#) [PubMed - in process] Free full text

**22. J Commun Disord. 2014 Jul 12. pii: S0021-9924(14)00058-6. doi: 10.1016/j.jcomdis.2014.06.007. [Epub ahead of print]**

**Construct-related validity of the TOCS measures: Comparison of intelligibility and speaking rate scores in children with and without speech disorders.**

Hodge MM1, Gotzke CL2.

This study evaluated construct-related validity of the Test of Children's Speech (TOCS). Intelligibility scores obtained using open-set word identification tasks (orthographic transcription) for the TOCS word and sentence tests and rate scores for the TOCS sentence test (words per minute or WPM and intelligible words per minute or IWPM) were compared for a group of 15 adults (18-30 years of age) with normal speech production and three groups of children: 48 3-6 year-olds with typical speech development and neurological histories (TDS), 48 3-6 year-olds with a speech sound disorder of unknown origin and no identified neurological impairment (SSD-UNK), and 22 3-10 year-olds with dysarthria and cerebral palsy (DYS). As expected, mean intelligibility scores and rates increased with age in the TDS group. However, word test intelligibility, WPM and IWPM scores for the 6 year-olds in the TDS group were significantly lower than those for the adults. The DYS group had significantly lower word and sentence test intelligibility and WPM and IWPM scores than the TDS and SSD-UNK groups. Compared to the TDS group, the SSD-UNK group also had significantly lower intelligibility scores for the word and sentence tests, and significantly lower IWPM, but not WPM scores on the sentence test. The results support the construct-related validity of TOCS as a tool for obtaining intelligibility and rate scores that are sensitive to group differences in 3-6 year-old children, with and without speech sound disorders, and to 3+ year-old children with speech disorders, with and without dysarthria. **LEARNING OUTCOMES:** Readers will learn about the word and sentence intelligibility and speaking rate performance of children with typically developing speech at age levels of 3, 4, 5 and 6 years, as measured by the Test of Children's Speech, and how these compare with adult speakers and two groups of children with speech disorders. They will also learn what measures on this test differentiate children with speech sound disorders of unknown origin from children with cerebral palsy and dysarthria.

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**23. Child Care Health Dev. 2014 Jul 31. doi: 10.1111/cch.12183. [Epub ahead of print]**

**Evaluation of family-centred services from parents of Chinese children with cerebral palsy with the Measure of Processes of Care.**

Wang M1, Petrini MA, Guan Q.

**BACKGROUND:** Family-centred service (FCS) has become essential to parents of children with cerebral palsy (CP) and professionals in Chinese paediatric rehabilitation services. FCS practice meets the unique needs of the child and family, through facilitation of optimal service provision delivered by professionals, and ensures service systems to be flexible, appropriate and actively responsive to the family needs. Parents used the Measure of Processes of Care 20 (MPOC-20) questionnaire to evaluate and verify the efficacy of use in China. The aims of the present study were twofold: to assess the validity and reliability of the Chinese MPOC-20, and investigate the range of parents' satisfaction with service provision in an FCS practice using the MPOC-20. **METHODS:** The Chinese MPOC-20 was selected to assess parent satisfaction with service provision of professionals in FCS practice. Participants were parents of children under 8 years of age with CP, who had received rehabilitation services between May 2012 and May 2013, and were receiving rehabilitation services in May 2013 at a hospital outpatient department and a rehabilitation centre. **RESULTS:** The reliability and validity of the Chinese MPOC-20 were confirmed. Parents evaluated FCS practice with the MPOC-20 survey. Respectful and supportive care was rated with the highest score and providing general information the lowest. Parents according to the data were dissatisfied

with the lack of information. **CONCLUSIONS:** Parents fairly evaluated service provision of professionals in FCS practice with the Chinese MPOC-20. Professionals received feedback reports of parents, summaries of the inadequacy of service delivery, and developed and implemented ameliorated measures in the FCS policy to strive to provide exemplary service.

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## Prevention and Cure

### 24. *J Neuroinflammation*. 2014 Aug 1;11(1):131. [Epub ahead of print]

#### **Complex pattern of interaction between in utero hypoxia-ischemia and intra-amniotic inflammation disrupts brain development and motor function.**

Jantzie LL, Corbett CJ, Berglass J, Firl DJ, Flores J, Mannix R, Robinson S.

**BACKGROUND:** Infants born preterm commonly suffer from a combination of hypoxia-ischemia (HI) and infectious perinatal inflammatory insults that lead to cerebral palsy, cognitive delay, behavioral issues and epilepsy. Using a novel rat model of combined late gestation HI and lipopolysaccharide (LPS)-induced inflammation, we tested our hypothesis that inflammation from HI and LPS differentially affects gliosis, white matter development and motor impairment during the first postnatal month. **METHODS:** Pregnant rats underwent laparotomy on embryonic day 18 and transient systemic HI (TSHI) and/or intra-amniotic LPS injection. Shams received laparotomy and anesthesia only. Pups were born at term. Immunohistochemistry with stereological estimates was performed to assess regional glial loads, and western blots were performed for protein expression. Erythropoietin ligand and receptor levels were quantified using quantitative PCR. Digigait analysis detected gait deficits. Statistical analysis was performed with one-way analysis of variance and post-hoc Bonferonni correction. **RESULTS:** Microglial and astroglial immunolabeling are elevated in TSHI + LPS fimbria at postnatal day 2 compared to sham (both  $P < 0.03$ ). At postnatal day 15, myelin basic protein expression is reduced by 31% in TSHI + LPS pups compared to shams ( $P < 0.05$ ). By postnatal day 28, white matter injury shifts from the acute injury pattern to a chronic injury pattern in TSHI pups only. Both myelin basic protein expression ( $P < 0.01$ ) and the phosphoneurofilament/neurofilament ratio, a marker of axonal dysfunction, are reduced in postnatal day 28 TSHI pups ( $P < 0.001$ ). Erythropoietin ligand to receptor ratios differ between brains exposed to TSHI and LPS. Gait analyses reveal that all groups (TSHI, LPS and TSHI + LPS) are ataxic with deficits in stride, paw placement, gait consistency and coordination (all  $P < 0.001$ ). **CONCLUSIONS:** Prenatal TSHI and TSHI + LPS lead to different patterns of injury with respect to myelination, axon integrity and gait deficits. Dual injury leads to acute alterations in glial response and cellular inflammation, while TSHI alone causes more prominent chronic white matter and axonal injury. Both injuries cause significant gait deficits. Further study will contribute to stratification of injury mechanisms in preterm infants, and guide the use of promising therapeutic interventions.

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### 25. *Arch Gynecol Obstet*. 2014 Aug 1. [Epub ahead of print]

#### **The significance of fetal inflammatory response syndrome in early and later adaptation of premature infants.**

Pilypienė I1, Drazdienė N, Dumalakiene I, Vezbergienė N, Bartkevičienė D, Silkūnas M, Bumbulienė Z.

**PURPOSE:** Intrauterine infection may induce the fetal inflammatory response syndrome (FIRS) and may cause cerebral palsy and bronchopulmonary dysplasia in newborns. The aim of the study was to evaluate the importance of FIRS for the early and later adaptation of preterms. **METHODS:** Hundred and fifty-eight preterm infants, born at 22-34 weeks of gestation, were investigated at Vilnius University Children hospital in 2007-2009. The data were evaluated at the first week after birth and at 36-37 weeks of post conceptual age. The levels of IL-6, tTNF- $\alpha$  (total),

tVEGF-A (total), aTNF- $\alpha$  (active) and aVEGF-A (active) were determined. RESULTS: Correlation between IL-6 and tTNF- $\alpha$  from umbilical blood and the degree of respiratory distress syndrome (RDS) was found ( $p < 0.001$ ). The concentration of tTNF- $\alpha$   $>345$  pg/ml and IL-6  $>12.7$  pg/ml was determined allowing to predict the lethal outcome. CONCLUSIONS: The correlation between the concentration of the inflammatory markers IL-6 and tTNF- $\alpha$  in umbilical cord blood at 22-34 weeks of gestation and acute RDS, and the death of preterms was determined. Significant values of umbilical cord blood IL-6 and tTNF- $\alpha$  concentration for predicting the lethal outcome in the later adaptation of preterms were determined.

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**26. Arch Pediatr. 2014 Jul 28. pii: S0929-693X(14)00289-9. doi: 10.1016/j.arcped.2014.06.012. [Epub ahead of print]**

### **Hypoxic-ischemia and encephalopathy in at-term newborn [Article in French]**

Marret S1, Jadas V2, Kieffer A2, Chollat C2, Rondeau S2, Chadie A2.

Criteria defining the involvement of severe perinatal anoxia in neonatal encephalopathy in at-term newborns at birth are stringent and are rarely all present. The simultaneous action of pre- and intrapartum factors preceding neonatal hypoxic-ischemic encephalopathy are often observed. Cooling is recommended as there is evidence that it reduces mortality without increasing major disability in survivors. It must be conducted following strict clinical and electroencephalographic criteria. Other strategies for brain protection remain difficult to establish. Follow-up must be long enough to detect cognitive deficiencies, which are frequent, even if cerebral palsy is not observed.

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**27. J Virol. 2014 Jul 30. pii: JVI.00867-14. [Epub ahead of print]**

### **Toll-like receptor 9-mediated protection of enterovirus 71 infection in mice is due to the release of danger-associated molecular patterns.**

Hsiao HB1, Chou AH1, Lin SI1, Chen IH1, Lien SP1, Liu CC1, Chong P2, Liu SJ3.

Enterovirus 71 (EV71), a positive-stranded RNA virus, is the major cause of hand, foot and mouth disease (HFMD) with severe neurological symptoms. Anti-viral type I interferon responses initiated from innate receptor signaling are inhibited by EV71-encoded proteases. It is less understood whether EV71-induced apoptosis provides a signal to activate type I interferon (IFN $\alpha/\beta$ ) responses as a host defensive mechanism. In this report, we found that EV71 alone cannot activate toll-like receptor 9 (TLR9) signaling, but supernatant from EV71-infected cells is capable of activating TLR9. We hypothesized that TLR9-activating signaling from pDCs may contribute to host defense mechanisms. To test our hypothesis, Flt3 ligand-cultured DCs (Flt3L-DCs) from both wild-type (WT) and TLR9 knockout (TLR9KO) mice were infected with EV71. More viral particles were produced in TLR9KO mice than WT mice. In contrast, interferon-alpha (IFN- $\alpha$ ), monocyte chemoattractant protein 1 (MCP-1), tumor necrosis factor-alpha (TNF- $\alpha$ ), IFN- $\gamma$ , interleukin 6 (IL-6) and IL-10 levels were increased in Flt3L-DCs from WT mice infected with EV71 compared with TLR9KO mice. Seven-day-old TLR9KO mice infected with a non-mouse adapted EV71 strain develop neurological lesion-related symptoms, including hindlimb paralysis, slowness, ataxia and lethargy, but WT mice did not present with these symptoms. Lung, brain, small intestine, forelimb and hindlimb tissue collected from TLR9KO mice exhibit significantly higher viral loads than equivalent tissues collected from WT mice.

Histopathologic damage was observed in brain, small intestine, forelimb and hindlimb tissues collected from TLR9KO mice infected with EV71. Our findings demonstrate that TLR9 is an important host defense molecule during EV71 infection. IMPORTANCE: The host innate immune system is equipped with pattern recognition receptors (PRRs), which are useful for defending the host against invading pathogens. During EV71 infection, the innate immune system is activated by pathogen-associated molecular patterns (PAMPs), which include viral RNA or DNA, and these PAMPs are recognized by PRRs. Toll-like receptor 3 (TLR3) and TLR7/8 recognize viral nucleic acids, and TLR9 senses unmethylated CpG DNA or pathogen-derived DNA. These PRRs stimulate the production of type I IFNs to counteract viral infection, and they are the major source of anti-viral IFN- $\alpha$  production in pDCs, which can produce 200- to 1000-fold more IFN- $\alpha$  than any other immune cell type. In addition to PAMPs, danger-

associated molecular patterns (DAMPs) are known to be potent activators of innate immune signaling, including TLR9. We found that EV71 induces cellular apoptosis, resulting in tissue damage; the endogenous DNA from dead cells may activate the innate immune system through TLR9. Therefore, our study provides new insights into EV71-induced apoptosis, which stimulates TLR9 in EV71-associated infections.

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**28. Korean J Pediatr. 2014 Jun;57(6):251-6. doi: 10.3345/kjp.2014.57.6.251. Epub 2014 Jun 30.**

**Mesenchymal stem cells transplantation for neuroprotection in preterm infants with severe intraventricular hemorrhage.**

Ahn SY, Chang YS, Park WS.

Severe intraventricular hemorrhaging (IVH) in premature infants and subsequent posthemorrhagic hydrocephalus (PHH) causes significant mortality and life-long neurological complications, including seizures, cerebral palsy, and developmental retardation. However, there are currently no effective therapies for neonatal IVH. The pathogenesis of PHH has been mainly explained by inflammation within the subarachnoid spaces due to the hemolysis of extravasated blood after IVH. Obliterative arachnoiditis, induced by inflammatory responses, impairs cerebrospinal fluid (CSF) resorption and subsequently leads to the development of PHH with ensuing brain damage. Increasing evidence has demonstrated potent immunomodulating abilities of mesenchymal stem cells (MSCs) in various brain injury models. Recent reports of MSC transplantation in an IVH model of newborn rats demonstrated that intraventricular transplantation of MSCs downregulated the inflammatory cytokines in CSF and attenuated progressive PHH. In addition, MSC transplantation mitigated the brain damages that ensue after IVH and PHH, including reactive gliosis, cell death, delayed myelination, and impaired behavioral functions. These findings suggest that MSCs are promising therapeutic agents for neuroprotection in preterm infants with severe IVH.

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**29. Pediatrics. 2014 Aug;134(2):e444-53. doi: 10.1542/peds.2013-2336.**

**Brain injury and altered brain growth in preterm infants: predictors and prognosis.**

Kidokoro H1, Anderson PJ2, Doyle LW3, Woodward LJ4, Neil JJ5, Inder TE6.

**BACKGROUND:** To define the nature and frequency of brain injury and brain growth impairment in very preterm (VPT) infants by using MRI at term-equivalent age and to relate these findings to perinatal risk factors and 2-year neurodevelopmental outcomes. **METHODS:** MRI scans at term-equivalent age from 3 VPT cohorts (n = 325) were reviewed. The severity of brain injury, including periventricular leukomalacia and intraventricular and cerebellar hemorrhage, was graded. Brain growth was assessed by using measures of biparietal width (BPW) and interhemispheric distance. Neurodevelopmental outcome at age 2 years was assessed across all cohorts (n = 297) by using the Bayley Scales of Infant Development, Second Edition (BSID-II) or Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III), and evaluation for cerebral palsy. **RESULTS:** Of 325 infants, 107 (33%) had some grade of brain injury and 33 (10%) had severe injury. Severe brain injury was more common in infants with lower Apgar scores, necrotizing enterocolitis, inotropic support, and patent ductus arteriosus. Severe brain injury was associated with delayed cognitive and motor development and cerebral palsy. Decreased BPW was related to lower gestational age, inotropic support, patent ductus arteriosus, necrotizing enterocolitis, prolonged parenteral nutrition, and oxygen at 36 weeks and was associated with delayed cognitive development. In contrast, increased interhemispheric distance was related to male gender, dexamethasone use, and severe brain injury. It was also associated with reduced cognitive development, independent of BPW. **CONCLUSIONS:** At term-equivalent age, VPT infants showed both brain injury and impaired brain growth on MRI. Severe brain injury and impaired brain growth patterns were independently associated with perinatal risk factors and delayed cognitive development.

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**30. Iran Red Crescent Med J. 2014 Jun;16(6):e17965. doi: 10.5812/ircmj.17965. Epub 2014 Jun 5.**

**Long-term neurodevelopmental outcomes after preterm birth.**

Soleimani F1, Zaheri F2, Abdi F3.

CONTEXT: All over the the world, preterm birth is a major cause of death and important neurodevelopmental disorders. Approximately 9.6% (12.9 million) births worldwide are preterm. EVIDENCE ACQUISITION: In this review, databases such as PubMed, EMBASE, ISI, Scopus, Google Scholar and Iranian databases including Iranmedex, and SID were researched to review relevant literature. A comprehensive search was performed using combinations of various keywords. RESULTS: Cerebral palsy especially spastic diplegia, intellectual disability, visual (retinopathy of prematurity) and hearing impairments are the main neurodevelopmental disorders associated with prematurity. CONCLUSIONS: The increased survival of preterm infants was not associated with lower complications. There is now increasing evidence of sustained adverse outcomes into school age and adolescence, for preterm infants.

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