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## Interventions and Management

### 1. Dev Med Child Neurol. 2016 Jul 6. doi: 10.1111/dmcn.13176. [Epub ahead of print]

Botulinum neurotoxin treatment in children with cerebral palsy: validation of a needle placement protocol using passive muscle stretching and relaxing.

Warnink-Kavelaars J, Vermeulen RJ, Buizer AI, Becher JG.

**AIM:** To validate a detailed intramuscular needle placement protocol using passive muscle stretching and relaxing for botulinum neurotoxin type A (BoNT-A) treatment in the lower extremity of children with spastic cerebral palsy (CP), with verification by electrical stimulation. **METHOD:** A prospective observational study was performed in 75 children with spastic CP who received regular BoNT-A treatment under general anaesthesia (52 males, 23 females; mean age 8y 9mo, SD 3y 7mo, range 4-18y; mean body mass index 16.2, SD 3.7, range 7.7-26.7). A total of 1084 intramuscular needle placements using passive muscle stretching and relaxing were verified by electrical stimulation. Primary outcome was the positive predictive value. **RESULTS:** Intramuscular needle placement in the muscles adductor brevis, adductor longus, gracilis, semimembranosus, semitendinosus, biceps femoris, rectus femoris, and lateral and medial heads of the gastrocnemius and soleus had a positive predictive value ranging from 85.7% to 100% (95% confidence interval ranging from 71.5-89.9% to 91.4-100%). **INTERPRETATION:** This validated detailed protocol for intramuscular needle placement using passive muscle stretching and relaxing for BoNT-A treatment in the lower extremity of children with spastic CP is reliable and has a high positive predictive value.

[PMID: 27381267](#)

### 2. Dev Med Child Neurol. 2016 Jul 4. doi: 10.1111/dmcn.13179. [Epub ahead of print]

Quantifying passive muscle stiffness in children with and without cerebral palsy using ultrasound shear wave elastography.

Brandenburg JE, Eby SF, Song P, Kingsley-Berg S, Bamlet W, Sieck GC, An KN.

**AIM:** The aim of this study was to compare passive muscle stiffness in children with cerebral palsy (CP) and children with typical development using a novel ultrasound technique: ultrasound shear wave elastography (SWE). **METHOD:** We conducted a prospective study of 13 children with CP (six females and seven males, median age 5y 1mo [interquartile range 4y 4mo-7y 8mo]) and 13 children with typical development (six females and seven males, median age 5y 3mo [interquartile range 4y 4mo-9y 4mo]). Demographic information and physical exam measurements were obtained in addition to shear modulus measurements (passive muscle stiffness) of the lateral gastrocnemius muscle at 20° plantar flexion, 10° plantar flexion, and 0° plantar flexion using SWE. **RESULTS:** Children with CP had significantly greater shear modulus measurements at all three foot positions ( $p < 0.050$ ). When the shear modulus values were normalized to the baseline value for each child, there was no significant difference between the two groups. **INTERPRETATION:** Passive muscle stiffness,

measured without the influence of spasticity, is greater in children with CP than in children with typical development when a muscle is at slack and at stretch. When shear modulus was normalized, the results indicate that muscle in children in both groups responds similarly to passive stretch. Further work includes evaluating effect of botulinum toxin on passive muscle properties.

[PMID: 27374483](#)

### **3. Hand Clin. 2016 Aug;32(3):423-30. doi: 10.1016/j.hcl.2016.03.010. Epub 2016 May 21.**

Cerebral Palsy Tendon Transfers: Flexor Carpi Ulnaris to Extensor Carpi Radialis Brevis and Extensor Pollicis Longus Reroutement.

Bansal A, Wall LB, Goldfarb CA.

The flexor carpi ulnaris to extensor carpi radialis brevis transfer and extensor pollicis longus rerouting combined with thenar release are 2 successful surgical interventions for children with spastic cerebral palsy. The goal of both procedures is to improve quality of life for patients who have previously failed conservative management, and the degree of expected improvement is predicated on several patient variables, making careful patient selection crucial for ensuring successful outcomes. Here, surgical technique is described; risk factors are discussed, and outcomes related to both procedures are presented.

[PMID: 27387086](#)

### **4. Hand Clin. 2016 Aug;32(3):283-9. doi: 10.1016/j.hcl.2016.03.001. Epub 2016 May 2.**

Principles of Tendon Transfer.

Wilbur D, Hammert WC.

Tendon transfers provide a substitute, either temporary or permanent, when function is lost due to neurologic injury in stroke, cerebral palsy or central nervous system lesions, peripheral nerve injuries, or injuries to the musculotendinous unit itself. This article reviews the basic principles of tendon transfer, which are important when planning surgery and essential for an optimal outcome. In addition, concepts for coapting the tendons during surgery and general principles to be followed during the rehabilitation process are discussed.

[PMID: 27387072](#)

### **5. J Pediatr Orthop. 2016 Jul 2. [Epub ahead of print]**

Comparison of Allograft and Bovine Xenograft in Calcaneal Lengthening Osteotomy for Flatfoot Deformity in Cerebral Palsy.

Rhodes J, Mansour A, Frickman A, Pritchard B, Flynn K, Pan Z, Chang F, Miller N.

**BACKGROUND:** The Evan's calcaneal lengthening osteotomy is a treatment method for spastic flatfoot deformity in patients with cerebral palsy that fail nonoperative measures. Autograft and allograft have been reported as potential graft choices. Bovine xenograft has been introduced as an alternative, but limited human data exists supporting its efficacy. This study compares the long-term results of allograft versus xenograft in isolated Evan's procedure performed for correction of flexible spastic flatfoot deformity. **METHODS:** This retrospective study accessed charts of 4- to 18-year-olds diagnosed with cerebral palsy who received an Evan's procedure. Preoperative and postoperative radiographic measurements (lateral calcaneal pitch, lateral talocalcaneal, lateral talo-first metatarsal, anteroposterior talonavicular coverage, anteroposterior talo-first metatarsal), graft incorporation, recurrence, secondary procedures, and complications were recorded and analyzed between graft types. **RESULTS:** Sixty-three feet (34 allograft and 29 xenograft) in 36 patients (mean age 9.3 y) were included. Gross Motor Function Classification System between groups was significant ( $P=0.001$ ). Mean time for preoperative x-rays was 5.3 months before day of surgery (DOS) for allograft and 3.6 months for xenograft. Mean time of first and last postoperative x-ray for allograft was 3.6 and 39.5 months, respectively; for xenograft, 1.8 and 35.1 months, respectively. There was a significant difference in timing of preoperative x-ray to DOS and DOS to first postoperative x-ray ( $P=0.012, 0.006$ , respectively). Radiographically, xenograft retained postoperative improvement better than allograft, yet allograft had a higher grade 4

incorporation rate ( $P=0.036$ ). The allograft group experienced significantly more cast pressure ulcers ( $P=0.006$ ), but no other differences in complications between groups, and no infections were reported in either group. **CONCLUSIONS:** Allograft incorporated better than xenograft, likely with a greater potential to reach grade 5 incorporation, yet both groups retained postoperative improvement. Results indicate both grafts are appropriate; yet incorporation rate could affect correction maintenance, and should be considered during graft selection for Evan's procedure.

[PMID: 27379788](#)

## 6. *J Pediatr Orthop.* 2016 Jul 2. [Epub ahead of print]

Treatment of the Dislocated Hip in Infants With Spasticity.

Refakis CA, Baldwin KD, Spiegel DA, Sankar WN.

**BACKGROUND:** Although many studies have separately investigated the treatment of developmental dysplasia of the hip and spastic hip disease, little data exist regarding the treatment of infants with dislocated hips and underlying spasticity. The purpose of this study was to review our results after the surgical treatment of these infants. **METHODS:** We retrospectively reviewed all children below 3 years of age who underwent hip reconstruction for dislocated hips in the setting of cerebral palsy or other spastic/high-tone neuromuscular disease. Medical records were reviewed for clinical data including treatment course, complications, and need for further surgery. Preoperative and postoperative radiographs were used to determine International Hip Dysplasia Institute (IHDI) grade of dislocation, acetabular index, migration percentage, and presence of avascular necrosis according to the Salter criteria. **RESULTS:** Eleven patients with 15 hips met our inclusion criteria with a mean age of  $20\pm 8$  (range, 6 to 34) months. Preoperatively, 12 of 15 hips (80%) were IHDI grade 4 and 3 of 15 (20%) were IHDI grade 3. Mean acetabular index was  $29\pm 8$  (range, 19 to 46) degrees. Patients underwent open reduction (15 hips), adductor tenotomy (14 hips), femoral osteotomy (10 hips), and pelvic osteotomy (12 hips). At a mean follow-up of  $40\pm 16$  (range, 13 to 71) months, 13 of 15 hips were IHDI grade 1 (86.7%), 1 was IHDI grade 2 (6.7%), and 1 hip was IHDI grade 3 (6.7%). The mean postoperative migration index was  $7\pm 24\%$  (range, -30% to 46%); the mean acetabular index was  $22\pm 8$  (range, 9 to 38) degrees. No patients developed radiographically significant osteonecrosis. Complications included 2 femur fractures (13.3%) and 1 symptomatic implant that required early removal. One patient underwent further reconstructive hip surgery. **CONCLUSIONS:** In this series of infants with hip dislocations and underlying spasticity, open reduction±pelvic osteotomy and/or femoral osteotomy has a nearly 90% success rate in achieving and maintaining adequate hip reduction at intermediate-term follow-up. In the unique population of infants with dislocated hips and underlying spasticity, comprehensive hip reconstruction is largely successful with an acceptable rate of complications.

[PMID: 27379781](#)

## 7. *J Pediatr Orthop B.* 2016 Jul 7. [Epub ahead of print]

The effectiveness of posterior knee capsulotomies and knee extension osteotomies in crouched gait in children with cerebral palsy.

Taylor D, Connor J, Church C, Lennon N, Henley J, Niiler T, Miller F.

Crouched gait is common in children with cerebral palsy (CP), and there are various treatment options. This study evaluated the effectiveness of single-event multilevel surgery including posterior knee capsulotomy or distal femoral extension osteotomy to correct knee flexion contracture in children with CP. Gait analyses were carried out to evaluate gait preoperatively and postoperatively. Significant improvements were found in physical examination and kinematic measures, which showed that children with CP and crouched gait who develop knee flexion contractures can be treated effectively using single-event multilevel surgery including a posterior knee capsulotomy or distal femoral extension osteotomy.

[PMID: 27392300](#)

**8. J Phys Ther Sci. 2016 Jun;28(6):1949-52. doi: 10.1589/jpts.28.1949. Epub 2016 Jun 28.**

Clinical usefulness of Adeli suit therapy for improving gait function in children with spastic cerebral palsy: a case study.  
Lee BH.

[Purpose] The purpose of this study was to determine the effects of Adeli suit therapy (AST) on gross motor function and gait function in children with cerebral palsy. [Subjects and Methods] Two participants with spastic cerebral palsy were recruited to undergo AST. AST was applied in 60-minute sessions, five times per week, with 20 sessions total over 4 weeks. Assessments of gross motor function, spatiotemporal parameters, and functional ambulation performance for gait were conducted. [Results] Gross motor function, cadence, and functional ambulation performance improved after the intervention in both cases. [Conclusion] Although additional follow-up studies are required, the results demonstrated improved gross motor function and functional ambulation performance in the children with cerebral palsy. These findings suggest a variety of applications for conservative therapeutic methods that require future clinical trials in children with cerebral palsy.

[PMID: 27390453](#)

**9. J Phys Ther Sci. 2016 Jun;28(6):1888-91. doi: 10.1589/jpts.28.1888. Epub 2016 Jun 28.**

Effect of physical therapy frequency on gross motor function in children with cerebral palsy.

Park EY.

[Purpose] This study attempted to investigate the effect of physical therapy frequency based on neurodevelopmental therapy on gross motor function in children with cerebral palsy. [Subjects and Methods] The study sample included 161 children with cerebral palsy who attended a convalescent or rehabilitation center for disabled individuals or a special school for children with physical disabilities in South Korea. Gross Motor Function Measure data were collected according to physical therapy frequency based on neurodevelopmental therapy for a period of 1 year. [Results] The correlation between physical therapy frequency and Gross Motor Function Measure scores for crawling and kneeling, standing, walking, running and jumping, and rolling, and the Gross Motor Function Measure total score was significant. The differences in gross motor function according to physical therapy frequency were significant for crawling, kneeling, standing, and Gross Motor Function Measure total score. The differences in gross motor function according to frequency of physical therapy were significant for standing in Gross Motor Function Classification System Level V. [Conclusion] Intensive physical therapy was more effective for improving gross motor function in children with cerebral palsy. In particular, crawling and kneeling, and standing ability showed greater increases with intensive physical therapy.

[PMID: 27390440](#)

**10. J Phys Ther Sci. 2016 Jun;28(6):1868-71. doi: 10.1589/jpts.28.1868. Epub 2016 Jun 28.**

Relation of selective voluntary motor control of the lower extremity and extensor strength of the knee joint in children with spastic diplegia.

Kusumoto Y, Takaki K, Matsuda T, Nitta O.

[Purpose] The aim of this study was to investigate differences in selective voluntary motor control of the lower extremities by objective assessment and determine the relationship between selective voluntary motor control and knee extensor strength in children with spastic diplegia. [Subjects and Methods] Forty individuals who had spastic cerebral palsy, with Gross Motor Function Classification System levels ranging from I to III, were assessed using the Selective Control Assessment of the Lower Extremity and by testing the maximum knee extensor strength. The unaffected side was defined as the lower limb with the higher score, and the affected side was defined as the lower limb with the lower score. [Results] The Selective Control Assessment of the Lower Extremity score on the affected side had a lower average than that on the unaffected side. The scores showed a significant inverse correlation with the maximum knee extensor strength. [Conclusion] There was bilateral difference in the selective voluntary motor control of the lower extremities in children with spastic diplegia, and the selective voluntary motor control of the lower extremity was related to maximum knee extensor strength.

[PMID: 27390436](#)

**11. J Phys Ther Sci. 2016 Jun;28(6):1696-700. doi: 10.1589/jpts.28.1696. Epub 2016 Jun 28.**

The effect of postural control and balance on femoral anteversion in children with spastic cerebral palsy.

Karabıcak GO, Balcı NC, Gulsen M, Ozturk B, Cetin N.

[Purpose] The aim of the study was to investigate the relationships between femoral anteversion and functional balance and postural control in children with spastic cerebral palsy. [Subjects and Methods] Twenty children with spastic cerebral palsy (mean age=12.4 ± 4.5) with gross motor functional classification system levels I, II, and III were recruited for this study. Functional balance was evaluated using the Pediatric Balance Scale, postural control was evaluated using the Trunk Control Measurement Scale, and femoral anteversion was assessed with a handheld goniometer using the great trochanter prominence method. [Results] The results indicated that there was significant correlation between femoral anteversion and Trunk Control Measurement Scale dynamic reaching score. There were no significant correlation between femoral anteversion and the Trunk Control Measurement Scale static sitting balance, Trunk Control Measurement Scale selective movement control, total Trunk Control Measurement Scale and Pediatric Balance Scale results. [Conclusion] Increased femoral anteversion has not correlation with functional balance, static sitting, and selective control of the trunk. Femoral anteversion is related to dynamic reaching activities of the trunk, and this may be the result of excessive internal pelvic rotation. It is important for the health professionals to understand that increased femoral anteversion needs to be corrected because in addition to leading to femoral internal rotation during walking, it also effects dynamic reaching activities of spastic children with cerebral palsy.

[PMID: 27390397](#)

**12. Neuropsychiatr Dis Treat. 2016 Jun 17;12:1445-56. doi: 10.2147/NDT.S98260. eCollection 2016.**

Altered lower leg muscle activation patterns in patients with cerebral palsy during cycling on an ergometer.

Alves-Pinto A, Blumenstein T, Turova V, Lampe R.

**OBJECTIVE:** Cycling on a recumbent ergometer constitutes one of the most popular rehabilitation exercises in cerebral palsy (CP). However, no control is performed on how muscles are being used during training. Given that patients with CP present altered muscular activity patterns during cycling or walking, it is possible that an incorrect pattern of muscle activation is being promoted during rehabilitation cycling. This study investigated patterns of muscular activation during cycling on a recumbent ergometer in patients with CP and whether those patterns are determined by the degree of spasticity and of mobility.

**METHODS:** Electromyographic (EMG) recordings of lower leg muscle activation during cycling on a recumbent ergometer were performed in 14 adult patients diagnosed with CP and five adult healthy participants. EMG recordings were done with an eight-channel EMG system built in the laboratory. The activity of the following muscles was recorded: Musculus rectus femoris, Musculus biceps femoris, Musculus tibialis anterior, and Musculus gastrocnemius. The degree of muscle spasticity and mobility was assessed using the Modified Ashworth Scale and the Gross Motor Function Classification System, respectively. Muscle activation patterns were described in terms of onset and duration of activation as well as duration of cocontractions. **RESULTS:** Muscle activation in CP was characterized by earlier onsets, longer periods of activation, a higher occurrence of agonist-antagonist cocontractions, and a more variable cycling tempo in comparison to healthy participants. The degree of altered muscle activation pattern correlated significantly with the degree of spasticity. **CONCLUSION:** This study confirmed the occurrence of altered lower leg muscle activation patterns in patients with CP during cycling on a recumbent ergometer. There is a need to develop feedback systems that can inform patients and therapists of an incorrect muscle activation during cycling and support the training of a more physiological activation pattern.

[PMID: 27382287](#)

**13. Iran J Child Neurol. 2016 Summer;10(3):28-34.**

Effects of Abnormal Oral Reflexes on Speech Articulation in Persian Speaking Children with Spastic Cerebral Palsy.

Dadgar H, Hadian MR, Lira OA.

**OBJECTIVE:** The purpose of this study was to investigate the relationship between the presence of abnormal oral reflexes and speech sound production in children with severe cerebral palsy. **MATERIALS & METHODS:** Seven oral reflexes such as, rooting, mouth-opening, biting, chewing, lip, tongue, and suckling were examined in 52 Persian-speaking monolingual children with spastic cerebral palsy (ages 5-10 yr). Phonetic information tests were administered to investigate their ability for

articulation of the speech sounds. RESULTS: A significant relationship between three (i.e. the chewing, lip, and biting reflexes) out of the seven abnormal oral reflexes and the speech articulation was noticed. The presence of the chewing reflex was associated with deficits in production of /s, z, š,ž/ sounds. The lip reflex was associated with deficits in the production of /p, m, r, j, f, č/ sounds. The biting reflex was associated with deficits in the production of /z, l, y and š/ sounds. No significant relationship was found between the rooting, mouth-opening, tongue, and suckling reflexes and sound articulation. CONCLUSION: The presence of abnormal reflexes in the children with spastic cerebral palsy would suggest a correlation between these reflexes and sound articulation in Iranian children with spastic cerebral palsy. Hence, these observations might suggest some disturbances in normal speech development.

[PMID: 27375753](#)

#### **14. Scand J Occup Ther. 2016 Jul 8:1-9. [Epub ahead of print]**

Self-rating of daily time management in children: psychometric properties of the Time-S.

Sköld A, Janeslätt GK.

BACKGROUND: Impaired ability to manage time has been shown in several diagnoses common in childhood. Impaired ability involves activities and participation domain (daily time management, DTM) and body function and structure domain (time-processing ability, TPA). DTM needs to be evaluated from an individual's own perspective. To date, there has been a lack of self-rating instruments for children that focus on DTM. AIM: The aim of this study is to describe psychometric properties of Time-S when used in children aged 10-17 years with a diagnosis of ADHD, Autism, CP or mild ID. Further, to test whether TPA correlates with self-rated DTM. MATERIAL AND METHODS: Eighty-three children aged 10-17 years participated in the study. Rasch analysis was used to assess psychometric properties. Correlation analysis was performed between Time-S and a measure of TPA. RESULTS: The 21 items of the Time-S questionnaire fit into a unitary construct measuring self-perceived daily management of an individual's time. A non-significant, small correlation was found between TPA and DTM. CONCLUSION AND SIGNIFICANCE: The results indicate good psychometric properties for the questionnaire. The questionnaire is potentially useful in intervention planning and evaluation.

[PMID: 27387553](#)

## Prevention and Cure

### 15. *Early Hum Dev.* 2016 Jun 30;99:7-12. doi: 10.1016/j.earlhumdev.2016.05.014. [Epub ahead of print]

Assessment of general movements and heart rate variability in prediction of neurodevelopmental outcome in preterm infants.

Dimitrijević L, Bjelaković B, Čolović H, Mikov A, Živković V, Kocić M, Lukić S.

**BACKGROUND:** Adverse neurologic outcome in preterm infants could be associated with abnormal heart rate (HR) characteristics as well as with abnormal general movements (GMs) in the 1st month of life. **AIMS:** To demonstrate to what extent GMs assessment can predict neurological outcome in preterm infants in our clinical setting; and to assess the clinical usefulness of time-domain indices of heart rate variability (HRV) in improving predictive value of poor repertoire (PR) GMs in writhing period. **STUDY DESIGN:** Qualitative assessment of GMs at 1 and 3 months corrected age; 24h electrocardiography (ECG) recordings and analyzing HRV at 1 month corrected age. **SUBJECTS:** Seventy nine premature infants at risk of neurodevelopmental impairments were included prospectively. **OUTCOME MEASURES:** Neurodevelopmental outcome was assessed at the age of 2 years corrected. Children were classified as having normal neurodevelopmental status, minor neurologic dysfunction (MND), or cerebral palsy (CP). **RESULTS:** We found that GMs in writhing period (1 month corrected age) predicted CP at 2 years with sensitivity of 100%, and specificity of 72.1%. Our results demonstrated the excellent predictive value of cramped synchronized (CS) GMs, but not of PR pattern. Analyzing separately a group of infants with PR GMs we found significantly lower values of HRV parameters in infants who later developed CP or MND vs. infants with PR GMs who had normal outcome. **CONCLUSIONS:** The quality of GMs was predictive for neurodevelopmental outcome at 2 years. Prediction of PR GMs was significantly enhanced with analyzing HRV parameters.

[PMID: 27372636](#)

### 16. *J Control Release.* 2016 Jul 1. pii: S0168-3659(16)30423-0. doi: 10.1016/j.jconrel.2016.06.046. [Epub ahead of print]

Surface functionality affects the biodistribution and microglia-targeting of intra-amniotically delivered dendrimers.

Zhang F, Nance E, Zhang Z, Jasty V, Kambhampati SP, Mishra MK, Burd I, Romero R, Kannan S, Kannan RM.

Cerebral Palsy (CP) is a chronic childhood disorder with limited therapeutic options. Maternal intrauterine inflammation/infection is a major risk factor in the pathogenesis of CP. In pre-clinical models, dendrimer-based therapies are viable in postnatal period, attenuating inflammation and improving motor function in vivo. However, treatment to the mother, at prenatal period, may provide the possibility of preventing/resolving inflammation at early stage. Towards this goal, we used a maternal intrauterine-inflammation induced rabbit model of CP to study fetal-maternal transport and neuroinflammation targeting of intra-amniotically administered dendrimers with neutral/anionic surface functionality. Our study suggested both hydroxyl-terminated 'neutral' (D-OH) and carboxyl-terminated 'anionic' (D-COOH) Polyamidoamine (PAMAM) dendrimers were absorbed by fetuses and demonstrated bi-directional transport between fetuses and mother. D-OH was more effective in crossing the fetal blood-brain barrier, and targeting activated microglia. However, the cell-specific targeting was associated with the activation status of microglia. This study demonstrated intra-amniotically administered hydroxyl PAMAM dendrimers could be an effective drug delivery vehicle for targeting fetal inflammation and preventing subsequent neurologic injury associated with chorioamnionitis.

[PMID: 27378700](#)

### 17. *Springerplus.* 2016 Jun 17;5(1):764. doi: 10.1186/s40064-016-2437-5. eCollection 2016.

Effects of permissive hypercapnia on pulmonary and neurodevelopmental sequelae in extremely low birth weight infants: a meta-analysis.

Ma J, Ye H.

**OBJECTIVES:** To perform a systematic review and meta-analysis of the efficacy and safety of permissive hypercapnia in extremely low birth weight infants. **METHODS:** A systematic search of MEDLINE, EMBASE, the Cochrane Database of randomized trials. Eligibility and quality of trials were assessed, and data on study design, patient characteristics, and relevant outcomes were extracted. **RESULTS:** Four studies that enrolled a total of 693 participants were selected. Meta-analysis revealed no effect of permissive hypercapnia on decreasing rates of bronchopulmonary dysplasia (BPD). Permissive

hypercapnia also had no significant effect on mortality, intraventricular haemorrhage (IVH), IVH (grade 3-4), periventricular leukomalacia (PVL), necrotising enterocolitis (NEC), retinopathy of prematurity (ROP) or air leaks in extremely low birth weight infants. Neurodevelopmental outcomes were comparable at 18-22 months' corrected age in two studies. permissive hypercapnia did not increase the risk of cerebral palsy, Mental Developmental Index <70, Psychomotor Developmental Index <70, visual deficit, or hearing deficit. CONCLUSIONS: Permissive hypercapnia did not reduce the rate of BPD in extremely low birth weight infants. The rates of mortality, IVH, PVL, NEC, ROP and neurodevelopmental outcomes did not differ between these two groups. These results suggest that permissive hypercapnia does not bring extra benefits in extremely low birth weight infants.

[PMID: 27386250](#)