
Beckers L, van der Burg J, Janssen-Potten Y, Rameckers E, Aarts P, Smeets R.


BACKGROUND: As part of the COAD-study two home-based bimanual training programs for young children with unilateral Cerebral Palsy (uCP) have been developed, both consisting of a preparation phase and a home-based training phase. Parents are coached to use either an explicit or implicit motor learning approach while teaching bimanual activities to their child. A process evaluation of these complex interventions is crucial in order to draw accurate conclusions and provide recommendations for implementation in clinical practice and further research. The aim of the process evaluation is to systematically assess fidelity of the home-based training programs, to examine the mechanisms that contribute to their effects on child-related and parent-related outcomes, and to explore the influence of contextual factors. METHODS: A mixed methods embedded design is used that emerges from a pragmatism paradigm. The qualitative strand involves a generic qualitative approach. The process evaluation components fidelity (quality), dose delivered (completeness), dose received (exposure and satisfaction), recruitment and context will be investigated. Data collection includes registration of attendance of therapists and remedial educationalists to a course regarding the home-based training programs; a questionnaire to evaluate this course by the instructor; a report form concerning the preparation phase to be completed by the therapist; registration and video analyses of the home-based training; interviews with parents and questionnaires to be filled out by the therapist and remedial educationalists regarding the process of training; and focus groups with therapists and remedial educationalists as well as registration of drop-out rates and reasons, to evaluate the overall home-based training programs. Inductive thematic analysis will be used to analyse qualitative data. Qualitative and quantitative findings are merged through meta-inference. DISCUSSION: So far, effects of home-based training programs in paediatric rehabilitation have been studied without an extensive process evaluation. The findings of this process evaluation will have implications for clinical practice and further research regarding development and application of home-based bimanual training programs, executed by parents and aimed at improving activity performance and participation of children with uCP.

PMID: 29699533

2. The Effect of Kinesio Taping on Handgrip and Active Range of Motion of Hand in Children with Cerebral Palsy.

Ghaheri A, Maroufizadeh S.


PMID: 29696055
3. Self-reported upper limb functioning of pupils with cerebral palsy by the International Classification of Functioning, Disability, and Health.

Lénárt Z, Szabó-Szeményei E, Tóth AA, Kullmann L.


International Classification of Functioning, Disability, and Health: Children and Youth Version has shown an increasing role in the assessment of children with cerebral palsy (CP), but just a few researchers use it for individuals' self-assessment. In this study, we present the self-assessment of functioning of students with CP and changes by the end of a school year. Thirty-seven pupils with spastic CP involving upper limbs, 24 pupils with typical development, and 20 pupils with speech and language disorders were studied by International Classification of Functioning, Disability, and Health core sets for CP. The CP group reported limitations in sensory functions (P<0.05), movement-related functions (P<0.001), and mobility (P<0.001) as well as products and technology and support and relationships as supportive (P<0.05). Correlation between expert and self-evaluation was weak to moderate. The CP core set may appropriately serve in the self-assessment of pupils' functioning in longitudinal studies.

PMID: 29664754


AIM: To evaluate the relationship between the movement abnormalities of the impaired upper limb in children with unilateral cerebral palsy (CP) and bimanual performance. METHOD: Twenty-three children with unilateral CP (mean age 11y 10mo [SD 2y 8mo]) underwent evaluation of bimanual performance (Assisting Hand Assessment [AHA]) and a three-dimensional movement analysis to measure deviations in the movement of their affected upper limb, and compared with 23 typically developing children (TDC) (mean age 11y 11mo [SD 2y 5mo]). Kinematic indices, such as the Global Arm Profile Score (APS), which summarizes the global movement deviation of the upper limb from the norm, and the Global Arm Variable Score (AVS), which represent movement deviations for a given joint, were calculated and correlated to AHA. RESULTS: Values of kinematic indices were significantly higher in children with unilateral CP than in TDC. A strong correlation between Global-APS and AHA score (r=−0.75) was found. Other significant correlations were found with Global-AVS, especially in distal joints. INTERPRETATION: Children with unilateral CP had more movement deviations than TDC. The global movement deviation of the impaired upper limb was strongly correlated with bimanual performance. The influence of distal abnormalities confirms the importance of considering these limitations in therapeutics. WHAT THIS PAPER ADDS: Children with unilateral cerebral palsy had more movement deviations than typically developing children in unimanual tasks. A strong relationship was found between movement deviations of the impaired upper limb and bimanual performance.

PMID: 29701242

5. Discriminant ability and criterion validity of the Trunk Impairment Scale for cerebral palsy.

Pavão SL, Maeda DA, Corsi C, Santos MMD, Costa CSND, de Campos AC, Rocha NACF.


AIMS: To compare the performance of children with mild and moderate-to-severe cerebral palsy (CP) on the Trunk Impairment Scale (TIS), Gross Motor Function Measure (GMFM), and on center-of-pressure variables; to establish the discriminant ability of these tools to predict severity of motor impairment in CP; and to investigate the criterion validity of the TIS. METHODS: Children with mild (n = 18, 11 males, 7 females, mean age = 9.5 ± 2.9 years), Gross Motor Function Classification System I-II) and moderate-to-severe (n = 18, 11 males, 7 females, mean age = 9.2 ± 229, Gross Motor Function Classification System III-IV) CP were tested using the TIS and the GMFM, and during static sitting on force-plate. RESULTS: Children with mild CP showed better trunk (median; 95% confidence interval = 22.5; 21.29-22.59 vs. 13; 11.97-14.8; p < 0.001) and gross motor (60; 57.73-59.3 vs. 40; 38.96-46.25; p < 0.001) scores, and better postural control (lower center of pressure (CoP) displacement [anterior-posterior: (0.42; 0.32-1.11 vs. 0.89; 0.70-1.65; p = 0.022); medial-lateral: (0.42; 0.31-1.08 vs. 0.91; 0.65-1.17; p = 0.044)], and lower area of sway, (0.05; -0.15-0.97 vs. 0.44; 0.23-0.90; p = 0.008) than the moderate-to-severe group. Trunk control and gross motor function explained 81.5% of the variance in the severity of motor condition. Correlations between the TIS and the GMFM were excellent (ρ = 0.944, p < 0.001); correlations between the TIS and CoP variables were low (anterior-posterior displacement: ρ = -0.411, p < 0.05; medial-lateral displacement: ρ = -0.327, p < 0.05); area of sway: ρ = -0.430, p < 0.05; velocity of sway: ρ = -0.308, p < 0.05). CONCLUSIONS: The TIS is able to differentiate levels of trunk control across various levels of motor impairments in CP. It is a valid tool to assess trunk control,
showing very high concurrent validity with the GMFM sitting dimension. Implications for Rehabilitation Trunk Impairment Scale (TIS) can be used by rehabilitation professionals to differentiate levels of trunk control across levels of motor impairment. TIS showed concurrent validity with Gross Motor Function Measure and should be used to assess trunk control in children with cerebral palsy (CP) in clinical settings. The use of TIS allows a reliable assessment of postural control in children with CP in clinical settings.

PMID: 29663838

6. Correlation between physical examination and three-dimensional gait analysis in the assessment of rotational abnormalities in children with cerebral palsy.

[Article in English, Portuguese]


Objective To evaluate the correlation between physical examination data concerning hip rotation and tibial torsion with transverse plane kinematics in children with cerebral palsy; and to determine which time points and events of the gait cycle present higher correlation with physical examination findings. Methods A total of 195 children with cerebral palsy seen at two gait laboratories from 2008 and 2016 were included in this study. Physical examination measurements included internal hip rotation, external hip rotation, mid-point hip rotation and the transmalleolar axis angle. Six kinematic parameters were selected for each segment to assess hip rotation and shank-based foot rotation. Correlations between physical examination and kinematic measures were analyzed by Spearman correlation coefficients, and a significance level of 5% was considered.

Results Comparing physical examination measurements of hip rotation and hip kinematics, we found moderate to strong correlations for all variables (p<0.001). The highest coefficients were seen between the mid-point hip rotation on physical examination and hip rotation kinematics (rho range: 0.48-0.61). Moderate correlations were also found between the transmalleolar axis angle measurement on physical examination and foot rotation kinematics (rho range 0.44-0.56; p<0.001).

Conclusion These findings may have clinical implications in the assessment and management of transverse plane gait deviations in children with cerebral palsy.

PMID: 29694621

7. Selective dorsal rhizotomy: current state of practice and the role of imaging.


Spastic diplegic cerebral palsy (CP) is the most common form of CP. A specific goal-oriented approach, tailored to the child, is essential to management in all forms of CP. Selective dorsal rhizotomy (SDR) is a neurosurgical procedure that permanently reduces lower limb spasticity in children with spastic diplegic CP. The current technique is performed through a single level laminectomy at the level of the conus and, with the aid of intraoperative electromyography (EMG), allows selective division of the afferent lumbosacral nerve roots. In carefully selected children, reduction in spasticity has positive effects on the growing child. SDR is associated with minimal complications and good long-term outcomes. This article describes the surgical technique and patient selection, including the importance of medical imaging, and discusses the long-term outcomes of SDR.

PMID: 29675362


The purpose of this study was to retrospectively investigate changes in gait patterns after single-event multilevel surgery in children and adolescents with bilateral cerebral palsy. Three-dimensional instrumented pre- and postoperative gait data of 12 patients were compared to data of 12 healthy control subjects using principal component analysis to reduce the dimensionality of kinematic and kinetic gait data and detect gait differences. The differences between pre- and postoperative data and between
postoperative data and data of control subjects were calculated using a linear mixed model. The results revealed 14 significant effects for pre- and postoperative waveforms and 11 significant effects for postoperative and control waveforms. Patients after single-event multilevel surgery walked with smaller internal foot progression angle throughout the gait cycle, lower knee flexion at initial swing, and earlier knee extension during terminal swing. Retained gait deviations included excessive pelvic tilt and internally rotated and flexed hips over the entire gait cycle. Contrary to our hypothesis, postoperative waveforms in the sagittal plane differed more from control waveforms than from preoperative waveforms. These results emphasize the importance of carefully planning further conservative therapy 2 years after single-event multilevel surgery.

PMID: 29683017


Kleiner AFR, Pacifici I, Condoluci C, Sforza C, Galli M.


BACKGROUND: A slip occurs when the required friction (RCOF) to prevent slipping at the foot/floor interfaces exceeds the available friction. The RCOF is dependent upon the biomechanics features of individuals and their gait. On the other hand, the available friction depends on environmental features. Once individuals with crouch gait have their biomechanics of gait completely altered, how do they interact with a supporting surface? The aim was to quantify the RCOF in children with bilateral spastic cerebral palsy (BSCP) and crouch gait. METHODS: 11 children with crouch gait and 11 healthy age-matched children were instructed to walk barefoot at self-selected speed over a force platform. The RCOF curve was obtained as the ratio between the tangential forces (FT), and the vertical ground reaction force (FZ). Three points were extracted by the RCOF, FT and FZ curves at the loading response, midstance and push-off phases. FINDINGS: Children with BSCP presented higher values of RCOF in all support phase and lower gait velocity relative to the healthy controls. For BSCP group no correlation between FT and FZ were found, indicating that this group is not able to negotiate the forces during the support phase. INTERPRETATION: Children with BSCP and crouch gait are not able to negotiate the forces applied on the ground in support phase, so to avoid the fall, their strategy is to reduce the gait velocity.

PMID: 29679933


Bjornson KF, Moreau N, Bodkin AW.


PURPOSE: To examine the effect of short-burst interval locomotor treadmill training (SBLTT) on walking capacity and performance in cerebral palsy (CP). METHODS: Twelve children with spastic diplegic CP (average 8.6 years) across Gross Motor Function Classification System levels II (8) and III (4) were randomized to 20 SBLTT sessions over 4 or 10 weeks. SBLTT consisted of alternating 30 seconds of slow and fast walking for 30 minutes/session. Outcomes included the 10 m walk test, one-minute walk test (1MWT), and timed-up-and go (TUG) (capacity) and StepWatch (performance) collected at baseline, post, and 6 weeks post. RESULTS: Fast speed (+.11, p = .04; +.11 m/s, p = .006), 1MWT (+11.2; +11.7 m, p = .006) and TUG (-1.7; -1.9 seconds, p = .006) improved post SBLTT and 6 weeks, respectively. Walking performance increased: average strides/day (+948; +1712, p < .001) and percent time in high strides rates (+0.4, p = .007; +0.2, p = .008). CONCLUSIONS: Pilot study suggests SBLTT may improve short-term walking capacity and performance.

PMID: 29658831

11. Activity training on the ground in children with cerebral palsy: Systematic review and meta-analysis.

Bania T, Chiu HC, Billis E.


PURPOSE: To systematically review the evidence about whether activity training on the ground is effective on activity or participation in children with cerebral palsy. METHODS: Randomized controlled trials (RCTs) were searched in databases using relevant keywords. RCTs were included with children (<18 years) with cerebral palsy who received activity training on the ground only or activity training on the ground combined with another type of physiotherapy. Outcome measures classified as measures of activity or participation according to the International Classification of Functioning, Disability, and Health were analyzed. RESULTS: Nine RCTs (257 participants) were included in this review. Individual studies resulted in conflicting
results when activity training on the ground was compared to no intervention. Based on meta-analysis, activity training on the ground was not more effective than no intervention (standardized mean difference [SMD]: 0.18; confidence interval [CI]: -1.49 to 1.86) or other therapies (SMD: -0.09; CI: -0.86 to 0.69) (I² > 75%) on improving activity or participation. Results from a single study demonstrated that activity training on the ground combined with other physiotherapy intervention was not more effective than no intervention (SMD: -0.18 CI: -0.89 to 0.54). CONCLUSIONS: The available evidence shows little effect of activity training on the ground on activity or participation in children with cerebral palsy, suggesting that rigorous trials with larger samples and larger "dosage" of activity training on the ground are needed in the future.

PMID: 29659303

12. Effects of ultrasound-guided botulinum toxin type-A injections with a specific approach in spastic cerebral palsy.

Büyükavcı R, Büyükavcı MA.


The aim of this study was to detect effects of ultrasound-guided botulinum toxin type-A (US-guided BoNT-A) injections prepared according to lower extremity innervation zones on spasticity and motor function in 3-16 years children with diplegic and hemiplegic spastic cerebral palsy. This study included 25 patients between 3 and 16 years of age who admitted to our clinic in 2017, were being followed in our clinic with a diagnosis of cerebral palsy, had BoNT-A injections due to lower extremity spasticity. The US-guided BoNT-A injections were administered into the spastic muscles using a specific approach according to innervation zones of muscle. Modified Ashworth Scale (MAS) and Gross Motor Functional Classification System (GMFCS) were assessed at the baseline, and 4 and 12 weeks after the BoNT-A injections. Minimum and maximum ages of the patients were 45 and 192 months, and gender distribution was 8 females and 17 males. Significant decreases in the MAS scores of the knee and ankle tones were measured 4 and 12 weeks after the BoNT-A injection when compared to the baseline scores (p < 0.025). Hip muscle tonus only decreased 12 weeks after the injection (p < 0.025). In parallel with a reduction in spasticity GMFCS improved from 3 to 2 in the 4th and 12th weeks. US-guided BoNT-A injections with Euro-musculus approach is a practical and effective method to perform injections into proper points of proper muscles in children with spastic cerebral palsy.

PMID: 29694645

13. Analgesic Effects of Botulinum Toxin in Children with CP.

Sandahl Michelsen J, Normann G, Wong C.


Experiencing pain is the greatest contributor to a reduced quality of life in children with cerebral palsy (CP). The presence of pain is quite common (~60%) and increases with age. This leads to missed school days, less participation, and reduced ambulation. Despite these alarming consequences, strategies to relieve the pain are absent and poorly studied. Moreover, it is difficult to evaluate pain in this group of children, especially in cases of children with cognitive deficits, and tools for pain evaluation are often inadequate. Botulinum toxin has been shown to alleviate pain in a variety of disorders and could potentially have an analgesic effect in children with CP as well. Even though most of the studies presented here show promising results, many also have limitations in their methodology as it is unlikely to capture all dimensions of pain in this heterogeneous group using only one assessment tool. In this review, we present a new way of examining the analgesic effect of botulinum toxin in children with CP using a variety of pain scores.

PMID: 29671771


Kane KJ, Lanovaz JL, Musselman KE.


AIMS: To examine how physical therapists (PTs) use evaluation measures to guide prescription and re-assessment of ankle-foot orthoses (AFOs) for children with CP. METHODS: PTs in Canada who work with children with CP were invited to complete an online survey. Survey questions examined PT evaluation and interpretation of findings at initial AFO prescription and re-assessment. Closed-ended responses were analyzed using descriptive statistics, and a conventional content analysis
examined responses to open-ended questions. RESULTS: Sixty responses from ten provinces were analyzed. Three themes emerged from the open-ended responses, which were supported by closed-ended responses. (1) Focus on impairment-level measures. Although evaluation primarily involved observational, non-standardized measures of impairments and gait pattern, most respondents also considered participation-level constructs. (2) Lack of confidence/knowledge. Respondents reported a moderate level of confidence concerning decision-making about AFO type and characteristics. 3) Inconsistent practices between therapists, possibly reflecting the paucity of available evidence or individualization of the prescription. CONCLUSIONS: Non-standardized, observational assessment methods, and impairment-level constructs appear to guide AFO prescription decisions. Integrating current knowledge into practice, developing best practice guidelines, and developing standardized tools to assess the effects of AFOs on participation may promote confidence, consistency, and improved outcomes.

PMID: 29702012


Lip SZL, Chillingworth A, Wright CM.

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We aimed to compare rates of under and overweight in children with different neurodevelopmental disorders (NDD) by measuring weight, height/length, arm-to-leg bioelectrical impedance (BIA) and subcapular and triceps skinfolds in 146 children aged 4-16 years attending special schools. Z scores were calculated and skinfolds and lean mass Z scores were further adjusted for height. Underweight was found in 9% (14) children (body mass index (BMI) < 2nd) but only 3% (4) had skinfolds < 5th centile. Overweight was much commoner, with 41% (58) children having BMI > 95th and 20% (14) had skinfolds > 95th centile. Children with cerebral palsy were very short with low BMI and lean mass, but only 8% (3) had skinfolds < 5th centile. The children with Down syndrome were also very short and once adjusted for height, half had skinfolds > 95th centile. We conclude that overweight and raised body fat is now common in children with NDD, even when the BMI is low.

PMID: 29695762


Jahan I, Muhit M, Karim T, Smithers-Sheedy H, Novak I, Jones C, Badawi N, Khandaker G.


PURPOSE: To assess the nutritional status and underlying risk factors for malnutrition among children with cerebral palsy in rural Bangladesh. MATERIALS AND METHODS: We used data from the Bangladesh Cerebral Palsy Register; a prospective population based surveillance of children with cerebral palsy aged 0-18 years in a rural subdistrict of Bangladesh (i.e., Shahjadpur). Socio-demographic, clinical and anthropometric measurements were collected using Bangladesh Cerebral Palsy Register record form. Z scores were calculated using World Health Organization Anthro and World Health Organization AnthroPlus software. RESULTS: A total of 726 children with cerebral palsy were registered into the Bangladesh Cerebral Palsy Register (mean age 7.6 years, standard deviation 4.5, 38.1% female) between January 2015 and December 2016. More than two-thirds of children were underweight (70.0%) and stunted (73.1%). Mean z score for weight for age, height for age and weight for height were -2.8 (standard deviation 1.8), -3.1 (standard deviation 2.2) and -1.2 (standard deviation 2.3) respectively. Moderate to severe undernutrition (i.e., both underweight and stunting) were significantly associated with age, monthly family income, gross motor functional classification system and neurological type of cerebral palsy. CONCLUSIONS: The burden of undernutrition is high among children with cerebral palsy in rural Bangladesh which is augmented by both poverty and clinical severity. Enhancing clinical nutritional services for children with cerebral palsy should be a public health priority in Bangladesh. Implications for Rehabilitation Population-based surveillance data on nutritional status of children with cerebral palsy in Bangladesh indicates substantially high burden of malnutrition among children with CP in rural Bangladesh. Children with severe form of cerebral palsy, for example, higher Gross Motor Function Classification System (GMFCS) level, tri/tri quadriplegic cerebral palsy presents the highest proportion of severe malnutrition; hence, these vulnerable groups should be focused in designing nutrition intervention and rehabilitation programs. Disability inclusive and focused nutrition intervention programme need to be kept as priority in national nutrition policies and nutrition action plans specially in low- and middle-income countries. Community-based management of malnutrition has the potential to overcome this poor nutritional scenario of children with disability (i.e., cerebral palsy). The global leaders such as World Health Organization, national and international organizations should take this in account and conduct further research to develop nutritional guidelines for this vulnerable group of population.

PMID: 29658318

Tschirren L, Bauer S, Hanser C, Marsico P, Sellers D, van Hedel HJA.


AIM: As there is little evidence for concurrent validity of the Eating and Drinking Ability Classification System (EDACS), this study aimed to determine its concurrent validity and reliability in children and adolescents with cerebral palsy (CP). METHOD: After an extensive translation procedure, we applied the German language version to 52 participants with CP (30 males, 22 females, mean age 9y 7mo [SD 4y 2mo]). We correlated (Kendall's tau or Kappa) the EDACS levels with the Bogenhausener Dysphagiescore (BODS), and the EDACS level of assistance with the Manual Ability Classification System (MACS) and the item 'eating' of the Functional Independence Measure for Children (WeeFIM). We further quantified the interrater reliability between speech and language therapists (SaLTs) and between SaLTs and parents with Kappa (κ). RESULTS: The EDACS levels correlated highly with the BODS (K =0.79), and the EDACS level of assistance correlated highly with the MACS (K =0.73) and WeeFIM eating item (K =0.80). Interrater reliability proved almost perfect between SaLTs (EDACS: K=0.94; EDACS level of assistance: K=0.89) and SaLTs and parents (EDACS: K=0.82; EDACS level of assistance: K=0.89). INTERPRETATION: The EDACS levels and level of assistance seem valid and showed almost perfect interrater reliability when classifying eating and drinking problems in children and adolescents with CP.

WHAT THIS PAPER ADDS: The Eating and Drinking Ability Classification System (EDACS) correlates well with a dysphagia score. The EDACS level of assistance proves valid. The German version of EDACS is highly reliable. EDACS correlates moderately to highly with other classification systems.

PMID: 29656386


Gaberova K, Pacheva I, Ivanov I.


RATIONALE: Functional magnetic resonance imaging (fMRI) is used widely to study reorganization after early brain injuries. Unilateral cerebral palsy (UCP) is an appealing model for studying brain plasticity by fMRI. AIM: To summarize the results of task-related fMRI studies in UCP in order to get better understanding of the mechanism of neuroplasticity of the developing brain and its reorganization potential and better translation of this knowledge to clinical practice. METHODS: A systematic search was conducted on the PubMed database by keywords: "cerebral palsy", "congenital hemiparesis", "unilateral", "Magnetic resonance imaging", "fMRI", "reorganization", and "plasticity" The exclusion criteria were as follows: case reports; reviews; studies exploring non-UCP patients; and studies with results of rehabilitation. RESULTS: We found 7 articles investigated sensory tasks; 9 studies-motor tasks; 12 studies-speech tasks. Ipsilesional reorganization is dominant in sensory tasks (in 74/77 patients), contralesional-in only 3/77. In motor tasks, bilateral activation is found in 64/83, only contralesional in 11/83, and only ipsilesional-8/83. Speech perception is bilateral in 35/51, only or dominantly ipsilesional (left-sided) in 8/51, and dominantly contralesional (right-sided) in 8/51. Speech production is only or dominantly contralesional (right-sided) in 88/130, bilateral-26/130, and only or dominantly ipsilesional (left-sided)-in 16/130. DISCUSSION: The sensory system is the most "rigid" to reorganization probably due to absence of ipsilateral (contralesional) primary somatosensory representation. The motor system is more "flexible" due to ipsilateral (contralesional) motor pathways. The speech perception and production show greater flexibility resulting in more bilateral or contralateral activation. CONCLUSIONS: The models of reorganization are variable, depending on the development and function of each neural system and the extent and timing of the damage. The plasticity patterns may guide therapeutic intervention and prognostics, thus proving the fruitiness of the translational approach in neurosciences.

PMID: 29700896


NeuroRehabilitation. 2018 Apr 7. doi: 10.3233/NRE-172340. [Epub ahead of print]

BACKGROUND: The prognosis for mobility function by Gross Motor Function Classification System (GMFCS) level is vital as a guide for rehabilitation for people with cerebral palsy. OBJECTIVE: This study sought to investigate change in mobility function and its causes in adults with cerebral palsy by GMFCS level. METHODS: We conducted a cross-sectional questionnaire study. RESULTS: A total of 386 participants (26 y 8m, SD 5 y 10m) with cerebral palsy were analyzed.
Participant numbers by GMFCS level were: I (53), II (139), III (74) and IV (120). The median age of participants with peak mobility function in GMFCS level III was younger than that in the other levels. 48% had experienced a decline in mobility. A Kaplan-Meier plot showed the risk of mobility decline increased in GMFCS level III; the hazard ratio was 1.97 (95% CI, 1.20-3.23) compared with level I. The frequently reported causes of mobility decline were changes in environment, and illness and injury in GMFCS level III, stiffness and deformity in level IV, and reduced physical activity in level II and III.

CONCLUSIONS: Peak mobility function and mobility decline occurred at a younger age in GMFCS level III, with the cause of mobility decline differing by GMFCS level.

PMID: 29660955


Espín-Tello SM, Dickinson HO, Bueno-Lozano M, Jiménez-Bernadó MT, Caballero-Navarro AL.


OBJECTIVE: We assessed whether functional capacity predicts self-esteem in people with cerebral palsy (CP). METHOD: We conducted a cross-sectional observational study of 108 people with CP, ages 16-65 yr, who were residents of Spain. Self-esteem was captured using the Rosenberg Self-Esteem Scale (RSES), and functional capacity using the Barthel Index (BI). Sociodemographic characteristics were recorded. The relationship between the RSES score and the BI score was analyzed using linear regression. RESULTS: RSES scores increased significantly as BI scores increased (regression coefficient = 0.047, 95% confidence interval [0.017, 0.078], p = .003). People with a higher level of education, active employment, and independent living arrangements tended to have better functional capacity and higher self-esteem. CONCLUSION: Greater functional capacity predicted higher self-esteem; this effect is probably partly mediated by education, employment, and living arrangements.

PMID: 29689181


Park EY.


BACKGROUND: Measures of health-related quality of life may predict the future status of individuals with illnesses, and could therefore be a good indicator in children with cerebral palsy (CP). This study examines the causal relationship between spasticity, weakness, gross motor function, and health-related quality of life (QOL) in school-aged children with spastic CP and tests models of functional outcome mediated by gross motor function. METHODS: A total of 62 children (44 males, 18 females) with spastic CP were recruited. Strength was assessed with the Manual Muscle Test, spasticity with the Modified Ashworth Scale, and the Gross Motor Function Measure was also employed. Health-related QOL was assessed using the Korean version of the Childhood Health Assessment Questionnaire. Physical therapists interviewed the parents and assessed the children. RESULTS: The proposed path model showed good fit indices. The direct effects were significant between spasticity and gross motor function, strength and gross motor function, gross motor function and health-related QOL, and strength and health-related quality of life. Spasticity had a significant positive indirect effect and strength a significant negative indirect effect on health-related QOL through gross motor function. CONCLUSION: This is an initial study of the causal relationship between strength, spasticity, gross motor function, and health-related QOL.

PMID: 29673348

22. Cerebral palsy, non-communicable diseases, and lifespan care.

Murphy KP.


This commentary is on the review by Ryan et al.

PMID: 29671872

Ozkan Y.


Objective To evaluate the child's quality of life (QoL), mother's burden, and correlation between these parameters in children with spastic cerebral palsy (CP). Methods: Children with spastic CP (n = 120; mean age: 8.64 ± 3.45 years; range: 2-17 years) were classified into three groups of diplegia, hemiplegia, and quadriplegia based on topographical classification. The Pediatric Quality of Life Inventory and Zarit Burden Interview were used to determine the child's QoL and the mother's burden scores, respectively. Results: Children's QoL scores were lower in the quadriplegia group than in the hemiplegia and diplegia groups (except for emotional functioning). The mother's burden was lower in the quadriplegia group than in the other groups, and it was lower in the diplegia group than in the hemiplegia group. Increases in children's QoL scores were associated with decreases in the mothers' burden scores. Conclusion: Children's QoL is associated with the mother's burden in spastic CP, and quadriplegic children and their mothers are more affected. The burden of mothers ranked the highest in the quadriplegia group, followed by the diplegia group and the hemiplegia group. Topographical classification is a good indicator for children's QoL and the mother's burden in spastic CP.

PMID: 29690795


Reid SM, Meehan EM, Arnup SJ, Reddihough DS.


AIM: A population-based observational study design was used to describe the epidemiology of intellectual disability in cerebral palsy (CP) in terms of clinical and neuroimaging associations, and to report the impact of intellectual disability on utilization of health services and length of survival. METHOD: Population CP registry data were used to retrospectively assess the frequency of intellectual disability and strength of associations between intellectual disability and mobility, epilepsy, vision, hearing, communication, and neuroimaging patterns (n=1141). Data linkage was undertaken to assess usage of hospital inpatient and emergency department services. Survival analysis was performed in a 30-year birth cohort (n=3248). RESULTS: Intellectual disability, present in 45% of the cohort, was associated with non-ambulation (47% vs 8%), later walking (mean 2y 7mo vs 1y 9mo), hypotonic (8% vs 1%) or dyskinetic (9% vs 5%) CP, a quadriplegic pattern of motor impairment (42% vs 5%), epilepsy (52% vs 12%), more emergency and multi-day hospital admissions, and reduced 35-year survival (96% vs 71%). Grey matter injuries (13% vs 6%), malformations (18% vs 6%), and miscellaneous neuroimaging patterns (12% vs 4%) were more common in people with intellectual disability. INTERPRETATION: Intellectual disability adds substantially to the overall medical complexity in CP and may increase health and mortality disparities. WHAT THIS STUDY ADDS: Cerebral maldevelopments and grey matter injuries are associated with higher intellectual disability rates. Health care is more 'crisis-driven' and 'reactive' in children with co-occurring intellectual disability. Length of survival is reduced in individuals with CP and co-occurring intellectual disability.

PMID: 29667705


Auld ML, Johnston LM.


BACKGROUND: Tactile impairments are common in children with cerebral palsy (CP), however assessment is not routinely carried out by therapists. We investigated a multi-faceted Knowledge Translation intervention to improve Knowledge, remove Barriers and enhance Practice of tactile assessments by paediatric therapists. METHOD: Twelve therapists from a state-wide service for children with CP (seven physiotherapists, five occupational therapists; 12 female) received: written information, demonstration videos, a face-to-face workshop, equipment provision, and on-call mentoring. Therapists completed pre-post-intervention questionnaires reporting their perceived tactile assessment Knowledge, current Practices and implementation Barriers. RESULTS: Following intervention, therapists improved Knowledge of correct (1) tactile impairment prevalence in children with CP (pre 3/12; post 9/12), (2) tactile assessment items (e.g. Registration - pre 1/12; post 9/12; Localisation - pre 2/12; post 10/12), and (3) equipment choice (e.g. Monofilaments - pre 1/12; post 10/12). Tactile assessment Practice improved slightly. All major clinician-level implementation Barriers were resolved and less obvious organisational-level Barriers were identified for follow-up. CONCLUSION: A 12-month multi-faceted Knowledge Translation intervention can improve tactile assessment Knowledge, resolve major clinician-level implementation Barriers, and identify less obvious organisational-level
Barriers to be addressed to achieve maximum Practice improvement. Ongoing multi-faceted knowledge translation processes are essential for high-performing organisations. Implications for rehabilitation A multi-faceted knowledge translation intervention significantly improved paediatric therapists' knowledge of the items and equipment necessary for tactile assessment. A 12-month intervention can address clinician-level barriers of knowledge, confidence, and access to equipment and assist in the identification of less obvious organisational-level barriers. Consideration of motivational readiness for change, intervention timelines, monitoring of emergent barriers, and fitting tactile assessment into a broader assessment framework are critical for improving uptake of tactile assessment in practice.

PMID: 29693473

Prevention and Cure


Okur SC, Erdoğan S, Demir CS, Günel G, Karaöz E.


BACKGROUND: Cerebral Palsy (CP) is the most common motor disability reason of childhood that occurs secondarily to non-progressive damage in the brain whose development is still ongoing. METHODS: 6-year-old dystonic-spastic male CP patient received allogenic mesenchymal stem cells treatment four times as $1 \times 10^6$/kg in intrathecal and intravenous administration of Umbilical Cord-derived mesenchymal stem cells (UC-MSCs) ways. Before and after the treatment, the patient was followed-up with FIM (Functional Independent Measurement), GMFCS (Gross Motor Function Classification System 88), Tardieu Scale, TCMS (Trunk Control Measurement Scale), MACS (Manual Ability Classification Scale), CFSS (Communication Function Classification System) for 18 months and received intensive rehabilitation. RESULTS: Improvements were observed especially in functional scales except for the Tardieu Scale, and no adverse effects were detected aside from a slight pain in the back. CONCLUSION: Wider future case studies on UC-MSCs will enable us to assess the efficacy of UC-MSCs which have positive impacts especially on functional scales.

PMID: 29699386

27. Analysis of 182 cerebral palsy transcriptomes points to dysregulation of trophic signalling pathways and overlap with autism.


Cerebral palsy (CP) is the most common motor disability of childhood. It is characterised by permanent, non-progressive but not unchanging problems with movement, posture and motor function, with a highly heterogeneous clinical spectrum and frequent neurodevelopmental comorbidities. The aetiology of CP is poorly understood, despite recent reports of a genetic contribution in some cases. Here we demonstrate transcriptional dysregulation of trophic signalling pathways in patient-derived cell lines from an unselected cohort of 182 CP-affected individuals using both differential expression analysis and weighted gene co-expression network analysis (WGCNA). We also show that genes differentially expressed in CP, as well as network modules significantly correlated with CP status, are enriched for genes associated with ASD. Combining transcriptome and whole exome sequencing (WES) data for this CP cohort likely resolves an additional 5% of cases separated to the 14% we have previously reported as resolved by WES. Collectively, these results support a convergent molecular abnormality in CP and ASD.

PMID: 29681622
There was significant negative correlation between age and 25-hydroxyvitamin D levels. Regarding 25-hydroxyvitamin D deficiency (<20 ng/ml), there was no significant difference in 25-hydroxyvitamin D levels between boys and girls, CP types and use of antiepileptics in case group.


Polyamidoamine (PAMAM) dendrimers are multifunctional nanoparticles with tunable physicochemical features, making them promising candidates for targeted drug delivery in the central nervous system (CNS). Systemically administered dendrimers have been shown to localize in activated glial cells, which mediate neuroinflammation in the CNS. These dendrimers delivered drugs specifically to activated microglia, producing significant neurological improvements in multiple brain injury models, including in a neonatal rabbit model of cerebral palsy. To gain further insight into the mechanism of dendrimer cell uptake, we utilized an in vitro model of primary glial cells isolated from newborn rabbits to assess the differences in hydroxyl-terminated generation 4 PAMAM dendrimer (D4-OH) uptake by activated and non-activated glial cells. We used fluorescently-labelled D4-OH (D-Cy5) as a tool for investigating the mechanism of dendrimer uptake. D4-OH PAMAM dendrimer uptake was determined by fluorescence quantification using confocal microscopy and flow cytometry. Our results indicate that although microglial cells in the mixed cell population demonstrate early uptake of dendrimers in this in vitro system, activated microglia take up more dendrimer compared to resting microglia. Astrocytes showed delayed and limited uptake. We also illustrated the differences in mechanism of uptake between resting and activated microglia using different pathway inhibitors. Both resting and activated microglia primarily employed endocytotic pathways, which are enhanced in activated microglial cells. Additionally, we demonstrated that hydroxyl terminated dendrimers are taken up by primary microglia using other mechanisms including pinocytosis, caveolae, and aquaporin channels for dendrimer uptake.

PMID: 29702566

29. Therapeutic potential to reduce brain injury in growth restricted newborns.

Wixey JA, Chand KK, Pham L, Colditz PB, Bjorkman ST.


Brain injury in intrauterine growth restriction (IUGR) infants is a major contributing factor to morbidity and mortality worldwide. Adverse outcomes range from mild learning difficulties, to attention difficulties, neurobehavioral issues, cerebral palsy, epilepsy, and other cognitive and psychiatric disorders. While the use of medication to ameliorate neurological deficits in IUGR neonates have been identified as warranting urgent research for several years, few trials have been reported. This review summarises clinical trials focusing on brain protection in the IUGR newborn as well as therapeutic interventions trialled in animal models of IUGR. Therapeutically targeting mechanisms of brain injury in the IUGR neonate is fundamental to improving long-term neurodevelopmental outcomes. Inflammation is a key mechanism in neonatal brain injury; and therefore an appealing target. Ibuprofen, an anti-inflammatory drug currently used in the preterm neonate, may be a potential therapeutic candidate to treat brain injury in the IUGR neonate. To better understand the potential of ibuprofen and other therapeutic agents to be neuroprotective in the IUGR neonate, long-term follow up information of neurodevelopmental outcomes must be studied. Where agents are shown to be effective, have a good safety profile and are relatively inexpensive, such as ibuprofen, they can be widely adopted and lead to improved outcomes. This article is protected by copyright. All rights reserved.

PMID: 29700828

30. Prevalence of Vitamin D Deficiency and Associated Risk Factors in Cerebral Palsy A study in North-West of Iran.

Toopchizadeh V, Barzegar M, Masoumi S, Jahanjoo F.


OBJECTIVE: This study aimed to compare the prevalence of 25-hydroxyvitamin D deficiency in cerebral palsied (CP) with healthy control children and evaluate possible correlations between 25-hydroxyvitamin D and severity of CP and motor function. MATERIALS & METHODS: In this case-control study, serum levels of 25-hydroxyvitamin D were evaluated in 64 children with CP and compared with 65 healthy children referred to Tabriz Pediatric Hospital, Tabriz, northwestern Iran in 2015. Blood samples were taken to measure levels of 25-hydroxyvitamin D, calcium, phosphorus and alkaline phosphatase. Regarding 25-hydroxyvitamin D levels, patients were classified as sufficient (≥30 ng/ml), insufficient (20-30 ng/ml) and deficient (<20 ng/ml). RESULTS: Mean 25-hydroxyvitamin D levels were 28.03±24.2 ng/ml in patients and 30±1.94 ng/ml in control group. 25-hydroxyvitamin D deficiency was seen in 44.6% of CP and 18.5% of healthy children. There was no significant difference in 25-hydroxyvitamin D levels between boys and girls, CP types and use of antiepileptics in case group. There was significant negative correlation between age and 25-hydroxyvitamin D levels (P=0.007). The correlation between 25
-hydroxyvitamin D and Gross Motor Function Classification System was not significant. CONCLUSION: 25-hydroxyvitamin D deficiency is common in children with CP in comparison with healthy children. There was significant negative correlation between age and 25-hydroxyvitamin D levels. Routine measurement of 25-hydroxyvitamin D levels and its proper treatment is recommended to prevent its deficiency and subsequent consequences.

PMID: 29696043


Intracranial hemorrhage is an important cause of brain injury in the neonatal population and bedside percutaneous needle aspiration has emerged as an alternative due to the major risks that can be caused by standard neurosurgical decompression. We aimed to assess the effectiveness of this minimally invasive bedside technique and conducted a retrospective analysis of all newborn infants with a large extra-axial hemorrhage associated with a parenchymal hemorrhage causing a midline shift, managed at three academic centers over a 15-year period. Collected data included clinical history, laboratory results, review of all imaging studies performed, and neurodevelopmental follow-up. Eight infants (3 preterm and 5 full-term) presented on day 1 to 2 with seizures (n = 6) and apneas (n = 5), signs of increased intracranial pressure (n = 4), and coning (n = 1). Risk factors were present in six. Cranial ultrasound and computed tomography showed a midline shift in all; two infants showed status epilepticus on amplitude-integrated electroencephalography with complete resolution after the procedure. Between 7 and 34 mL could be aspirated associated with a decrease in the midline shift as seen by ultrasonography performed during the puncture. No complications were seen related to the procedure and none of the infants required further acute neurosurgical intervention. On follow-up, three had mild sequelae, including motor coordination problems (n = 1) and hemianopia (n = 2); none developed cerebral palsy or postneonatal epilepsy. Neonates, presenting with severe symptoms, can be managed successfully using ultrasound-guided needle aspiration and this minimally invasive bedside method should be kept in mind before performing neurosurgical decompression.

PMID: 29689584

32. White Matter Damage in 4,725 Term-Born Infants Is Determined by Head Circumference at Birth: The Missing Link.

Jensen A, Holmer B.


BACKGROUND: White matter damage (WMD) is a prime risk factor for cerebral palsy, in part occurring unexplained. Though primarily a problem of preterm infants, there is growing evidence that in large newborns cephalopelvic disproportion and prolonged labor are involved. OBJECTIVE: To explore both incidence of and morphometric risk factors for WMD in term-born infants. STUDY DESIGN: We related growth variables and risk factors of term-born infants to WMD (61/4,725) using odds ratios of z-score bands. RESULTS: The key result is the novel observation that head circumference is a prime and unique index for WMD in term-born neonates over the whole range of centiles (U-shaped; WMD (%) = 3.1168 - 0.12797 × HC (centile) + 0.0014741 × HC^2; p < 0.0001). This suggests different mechanisms for WMD in the lowest and highest z-score band. In the latter, cephalic pressure gradients and prolonged labor with preserved neonatal vitality prevail, whereas in the previous one, acute and chronic oxygen deprivation with reduced vitality predominate. CONCLUSIONS: The fact that seemingly healthy term-born neonates are not screened by head imaging, in spite of both large head circumference and prolonged labor, is considered to be the missing link between the insult that escapes diagnosis and the development of unexplained developmental delay and cerebral palsy in childhood.

PMID: 29681945
33. Loss of myogenic potential and fusion capacity of muscle stem cells isolated from contractured muscle in children with cerebral palsy.

Domenighetti AA, Mathewson MA, Pichrika R, Sibley LA, Zhao L, Chambers HG,Lieber RL.  
Cerebral palsy (CP) is the most common cause of pediatric neurodevelopmental and physical disability in the United States. It is defined as a group of motor disorders caused by a non-progressive perinatal insult to the brain. While the brain lesion is non-progressive, there is a progressive, lifelong impact on skeletal muscles, which are shorter, spastic, and may develop debilitating contractures. Satellite cells are resident muscle stem cells that are indispensable for postnatal growth and regeneration of skeletal muscles. Here we measured the myogenic potential of satellite cells isolated from contractured muscles in children with CP. When compared to typically developing (TD) children, satellite cell-derived myoblasts from CP differentiated more slowly (Slope: 0.013 [plus minus]0.013 CP vs. 0.091 [plus minus]0.024 TD over 24 hours, P<0.001) and fused less (Fusion Index: 21.3 [plus minus]8.6 CP vs. 81.3 [plus minus]7.7 TD after 48 hours, P<0.001) after exposure to low-serum conditions that stimulated myotube formation. This impairment was associated with downregulation of several markers important for myoblast fusion and myotube formation, including DNA methylation-dependent inhibition of pro-myogenic Integrin Beta 1D (ITGB1D) protein expression levels (~50% at 42 hours), and ~25% loss of integrin-mediated FAK kinase phosphorylation. The cytidine analog 5-Azacytidine (5-AZA), a demethylating agent, restored ITGB1D levels and promoted myogenesis in CP cultures. Our data demonstrate that muscle contractures in CP are associated with loss of satellite cell myogenic potential that is dependent on DNA methylation patterns affecting expression of genetic programs associated with muscle stem cell differentiation and muscle fiber formation.  
PMID: 29694232

34. Pediatric Oral Formulation of Dendrimer-N-acetyl-L-cysteine Conjugates for the Treatment of Neuroinflammation.  
Yellepeddi VK, Mohammadpour R, Kambhampati SP, Sayre C, Mishra MK, Kannan RM, Ghandehari H.  
N-acetyl-L-cysteine (NAC) commonly used as an antidote in acetaminophen poisoning has shown promise in the treatment of neurological disorders such as cerebral palsy (CP). However, NAC suffers from drawbacks such as poor oral bioavailability and suboptimal blood-brain-barrier (BBB) permeability limiting its clinical success. It was previously demonstrated that intravenous administration of dendrimer-NAC (D-NAC) conjugates have shown significant promise in the targeted treatment of neuroinflammation, in multiple preclinical models. Development of an oral formulation of D-NAC may open new administrative routes for this compound. Here, we report the gastrointestinal stability, in vitro transepithelial permeability, and in vivo oral absorption and pharmacokinetics in rats of a pediatric formulation of D-NAC containing Capmul MCM (glycerol monocaprylate) as a penetration enhancer. D-NAC was stable for 6 hours in all five simulated gastrointestinal fluids with no signs of chemical degradation. The apparent permeability (Papp) of D-NAC increased 9-fold in the formulation containing Capmul. The area under the curve [AUC]0-∞ of D-NAC with Capmul increased by 47% when compared to D-NAC alone. These results indicate that an oral pediatric formulation containing D-NAC and Capmul can be an effective option for the treatment of neuroinflammation.  
PMID: 29680280

OBJECTIVES: To determine the trends in mortality and the prevalence of abnormal neurodevelopmental outcomes among preterm Japanese infants. STUDY DESIGN: A retrospective multicenter cohort of 30,793 preterm infants born at a gestational age ≤32 weeks, between 2003 and 2012, in the Neonatal Research Network, Japan, was evaluated in the primary analysis. Finally, 13,661 infants were followed-up until 3 years of age and evaluated for neurodevelopmental outcomes, including cerebral palsy (CP), home oxygen therapy (HOT) use, and visual, hearing, and cognitive impairments. Multivariable logistic regression analysis was performed to determine the risk-adjusted trends in mortality and long-term neurodevelopmental outcomes. RESULTS: The trends in overall mortality (adjusted odds ratio, (AOR): 0.92; 95% confidence interval, (CI): 0.89-0.94), the prevalence of CP (AOR: 0.95; 95% CI: 0.92-0.98), HOT use (AOR: 0.84; 95% CI: 0.75-0.93), and visual (AOR: 0.84; 95% CI: 0.81-0.87) and hearing impairments (AOR: 0.78; 95% CI: 0.63-0.97) showed a significant downward trend, while cognitive impairment showed no significant changes (AOR: 1.02; 95% CI: 0.99-1.05). Intravenous hyperalimentation
was significantly correlated with visual impairment (AOR 0.74, 95% CI 0.59-0.91). Early establishment of enteral feeding was associated with improved long-term outcomes. CONCLUSIONS: Mortality was improved, and this did not lead to increased risks for abnormal neurodevelopmental outcomes. Nutritional support might improve long-term neurodevelopmental outcomes.

PMID: 29679045


OBJECTIVES: Evaluate the spectrum of neurodevelopmental outcome in a contemporary cohort of extremely preterm infants. We hypothesize that the rate of severe neurodevelopmental impairment (NDI) decreases over time. METHODS: Retrospective analysis of neurodevelopmental outcome of preterm infants ≤27 weeks' gestational age (GA) from a Neonatal Research Network center that completed neurodevelopmental follow-up assessments between April 1, 2011, and January 1, 2015. The Bayley Scales of Infant Development-III (BSID III) and a standardized neurosensory examination were performed between 18 and 26 months' adjusted age. Outcome measures were neurologic examination diagnoses, BSID III cognitive and motor scores, sensory impairment, and the composite outcome of NDI, based on the BSID III cognitive score (analyzed by using a cutoff of <85 or <70), BSID III motor score of <70, moderate or severe cerebral palsy (CP), bilateral blindness, and hearing impairment. RESULTS: Two thousand one hundred and thirteen infants with a mean GA of 25.0 ± 1.0 weeks and mean birth weight of 760 ± 154 g were evaluated. The 11% lost to follow-up were less likely to have private insurance, late-onset sepsis, or severe intraventricular hemorrhage. Neurologic examination results were normal in 59%, suspect abnormal in 19%, and definitely abnormal in 22%. Severe CP decreased 43% whereas mild CP increased 13% during the study. The rate of moderate to severe NDI decreased from 21% to 16% when using the BSID III cognitive cutoff of <70 (P = .07) or from 34% to 31% when using the BSID III cognitive cutoff of <85 (P = .67). CONCLUSIONS: Extremely preterm children are at risk for NDI. Over time, the rate of moderate to severe NDI did not differ, but the rates of severe CP decreased, and mild CP increased.

PMID: 29666163

37. Predictive Value of Cranial Ultrasound for Neurodevelopmental Outcomes of Very Preterm Infants with Brain Injury.

Zhang XH, Qiu SJ, Chen WJ, Gao XR, Li Y, Cao J, Zhang JJ.


BACKGROUND: Compared with full-term infants, very preterm infants are more vulnerable to injury and long-term disability and are at high risk of death. The predictive value of ultrasound and imaging on the neurodevelopment is one of the hot topics. This study aimed to investigate the relationship between cranial ultrasound (cUS) variables and neurodevelopmental outcomes of very preterm infants. METHODS: Totally 129 very preterm infants (gestational age ≤28 weeks) in neonatal intensive care unit of Hunan Children's Hospital between January 2012 and November 2014 were included in this retrospective study. Serial cUS (weekly before discharge and monthly after discharge) was performed on the infants until 6 months or older. Magnetic resonance imaging (MRI) was performed on the infants at approximately the term-equivalent age. The mental developmental index (MDI) and psychomotor developmental index (PDI) were followed up until the infants were 24 months or older. The relationship between brain injury and MDI/PDI scores was analyzed. RESULTS: The consistency rate between cUS and MRI was 88%. At the first cUS, germinal matrix hemorrhage (GMH) Grades 3 and 4, hospitalization duration, and weight are significantly correlated with MDI/PDI and prognosis (MDI: odds ratio [OR] = 8.415, 0.982, and 0.042, P = 0.016, 0.000, and 0.004; PDI: OR = 7.149, 0.978, and 0.012, P = 0.025, 0.000, and 0.000, respectively). At the last cUS, gestational age, extensive cystic periventricular leukomalacia (c-PVL), and moderate and severe hydrocephaly are significantly correlated with MDI (OR = 0.292, 60.220, and 170.375, P = 0.004, 0.003, and 0.000, respectively). Extensive c-PVL and moderate and severe hydrocephaly are significantly correlated with PDI (OR = 76.861 and 116.746, P = 0.003 and 0.000, respectively). CONCLUSIONS: Very premature infants with GMH Grades 3 and 4, short hospitalization duration, and low weight have low survival rates and poorly developed brain nerves. Cerebral palsy can result from severe cerebral hemorrhage, moderate and severe hydrocephaly, and extensive c-PVL. The sustained, inhomogeneous echogenicity of white matter may suggest subtle brain injury.

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