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Interventions and Management

1. Functional, neuroplastic and biomechanical changes induced by early Hand-Arm Bimanual Intensive Therapy Including Lower Extremities (e-HABIT-ILE) in pre-school children with unilateral cerebral palsy: study protocol of a randomized control trial.

Araneda R, Sizonenko SV, Newman CJ, Dinomais M, Le Gal G, Nowak E, Guzzetta A, Riquelme I, Brochard S, Bleyenheuft Y; Early HABIT-ILE group.

BMC Neurol. 2020 Apr 14;20(1):133. doi: 10.1186/s12883-020-01705-4.

BACKGROUND: Cerebral palsy (CP) causes motor, cognitive and sensory impairment at different extents. Many recent rehabilitation developments (therapies) have focused solely on the upper extremities (UE), although the lower extremities (LE) are commonly affected. Hand-arm Bimanual Intensive Therapy Including Lower Extremities (HABIT-ILE) applies the concepts of motor skill learning and intensive training to both the UE and LE. It involves constant stimulation of the UE and LE, for several hours each day over a 2-week period. The effects of HABIT-ILE have never been evaluated in a large sample of young children. Furthermore, understanding of functional, neuroplastic and biomechanical changes in infants with CP is lacking. The aim of this study is to carry out a multi-center randomized controlled trial (RCT) to evaluate the effects of HABIT-ILE in pre-school children with unilateral CP on functional, neuroplastic and biomechanical parameters. **METHODS:** This multi-center, 3-country study will include 50 pre-school children with CP aged 1-4 years. The RCT will compare the effect of 50 h (two weeks) of HABIT-ILE versus usual motor activity, including regular rehabilitation. HABIT-ILE will be delivered in a day-camp setting, with structured activities and functional tasks that will be continuously progressed in terms of difficulty. Assessments will be performed at 3 intervals: baseline (T0), two weeks later and 3 months later. Primary outcomes will be the Assisting Hand Assessment; secondary outcomes include the Melbourne Assessment-2, executive function assessments, questionnaires ACTVLIM-CP, Pediatric Evaluation of Disability Inventory, Young Children's Participation and Environment Measure, Measure of the Process of Care, Canadian Occupational Performance Measure, as well as neuroimaging and kinematics measures. **DISCUSSION:** We expect that HABIT-ILE will induce functional, neuroplastic and biomechanical changes as a result of the intense, activity-based rehabilitation process and these changes will impact the whole developmental curve of each child, improving functional ability, activity and participation in the short-, mid- and long-term. Name of the registry: Changes Induced by Early HABIT-ILE in Pre-school Children With Uni- and Bilateral Cerebral Palsy (EarlyHABIT-ILE). **TRIAL REGISTRATION:** Trial registration number: NCT04020354-Registration date on the International Clinical Trials Registry Platform (ICTRP): November 20th, 2018; Registration date on NIH Clinical Trials Registry: July 16th, 2019.

PMID: [32290815](https://pubmed.ncbi.nlm.nih.gov/32290815/)

2. Prolonged Postoperative Intubation After Spinal Fusion in Cerebral Palsy: Are There Modifiable Risk Factors and Associated Consequences?

LaValva SM, Baldwin K, Swarup I, Flynn JM, Pahys JM, Yaszay B, Abel MF, Bachmann K, Shah SA, Sponseller PD, Cahill PJ; Harms Study Group#.

J Pediatr Orthop. 2020 Apr 14. doi: 10.1097/BPO.0000000000001566. [Epub ahead of print]

BACKGROUND: Instrumented spinal fusion is performed to correct severe spinal deformity that commonly complicates cerebral palsy (CP). Prolonged intubation (PI) is a common perioperative complication, though little is known about the risk factors and consequences of this phenomenon. **QUESTIONS/PURPOSES:** The purpose of this study was to determine (1) the preoperative and intraoperative risk factors associated with PI after spine surgery for CP; (2) the perioperative and postoperative complications associated with PI; and (3) any long-term impacts of PI with respect to health-related quality of life. **PATIENTS AND METHODS:** A retrospective case-control analysis of prospectively collected, multicenter data was performed on patients with Gross Motor Function Classification System (GMFCS) 4 or 5 CP who underwent instrumented spinal fusion. Patients extubated on postoperative day (POD) 0 were in the early extubation (EE) cohort and those extubated on POD 3 or later were in the PI cohort. Comparisons were made between PI and EE groups with respect to several preoperative and intraoperative variables to identify risk factors for PI. Multivariate logistic regression was performed to identify independent predictors of this outcome. The postoperative hospital course, rate of complications, and health-related quality of life at 2 years were also compared. **RESULTS:** This study included 217 patients (52% male individuals; mean age, 14.0±2.8 y) who underwent spinal fusion for CP. In this cohort, 52 patients (24%) had EE and 58 patients (27%) had PI. There were several independent predictors of PI including history of pneumonia [odds ratio (OR), 6.2; 95% confidence interval (CI), 1.6-24.3; P=0.01], estimated blood loss of >3000 mL (OR, 16.5; 95% CI, 2.0-134; P=0.01), weight of <37 kg (OR, 6.4; 95% CI, 1.5-27.1), and Child Health Index of Life with Disabilities (CPCCHILD) Communication and Social Interaction score of <15 (OR, 10.8; 95% CI, 1.1-107.3; P=0.04). In addition, PI was associated with a higher rate of perioperative and postoperative respiratory (P<0.001), cardiovascular (P=0.014), gastrointestinal (P<0.001), and surgical site (0.027) complications, in addition to prolonged hospitalization (P<0.001) and intensive care unit stay (P<0.001). **CONCLUSIONS:** Surgeons should seek to optimize nutritional status and pulmonary function, and minimize blood loss in patients with CP to decrease the risk of PI after spinal fusion. Efforts should be made to extubate patients on POD 0 to decrease the risk of complications associated with PI.

PMID: [32301849](#)

3. Selective dorsal rhizotomy for spasticity of genetic etiology.

Lohkamp LN, Coulter I, Ibrahim GM.

Childs Nerv Syst. 2020 Apr 16. doi: 10.1007/s00381-020-04601-x. [Epub ahead of print]

Objective Selective dorsal rhizotomy (SDR) is most commonly applied in the context of the treatment of the spastic diplegic variant of cerebral palsy (CP). Its role in the treatment of spasticity associated with other conditions is not well-established. We sought to review outcomes following SDR for the treatment of functionally limiting spasticity in the setting of a genetic etiology. **Methods** A systematic literature review was performed using the databases Ovid Medline, Embase, Cochrane Library, and PubMed based on the PRISMA guidelines. Articles were included if they described the application of SDR for spasticity of genetic etiology. Reported outcomes pertaining to spasticity and gross motor function following SDR were summarized. **Results** Five articles reporting on 16 patients (10 males, 6 females) met the inclusion criteria, of which four reported on SDR for hereditary spastic paraplegia (HSP) and four on syndromic patients or other inherited diseases, with an overall follow-up ranging from 11 to 252 months. These individuals were found to have several genetic mutations including ALS2, SPG4, and SPG3A. The mean age at the time of surgery was 14.9 years (median 10 years, range 3-37 years). **Conclusions** Although all patients experienced a reduction in spasticity, the long-term gross motor functional outcomes objectively assessed at last follow-up were heterogeneous. There may be a role for SDR in the context of static genetic disorders causing spasticity. Further evidence is required prior to the widespread adoption of SDR for such disorders as, based on the collective observations of this review, spasticity is consistently reduced but the long-term effect on gross motor function remains unclear.

PMID: [32300873](#)

4. Evaluation of the functional outcome of a percutaneous technique in correction of excessive anteversion in cerebral palsy.

El Barbary HM, Basha N, Nawwar AIM, Waly E, Mohamed MT, Badawy MYA, Zein AB, Hegazy M, El Barbary M, Barakat AS.

J Pediatr Orthop B. 2020 Apr 13. doi: 10.1097/BPB.0000000000000731. [Epub ahead of print]

In cerebral palsy, patients' excessive femoral anteversion is one of the most common skeletal abnormalities. The general agreement is concurrent correction of both soft tissue and bony deformities during the same operative setting by combining

open femoral derotation osteotomy (FDO) with soft tissue releases. Fifty-one children (75 lower limbs) with cerebral palsy with a mean age of 10.7 years (range 6-16 years) fulfilling the inclusion criteria who underwent percutaneous FDO and when needed customized soft tissue releases. Derotation was maintained by a pin-in-cast technique. The mean follow-up was 24 m (range 14-36 m) and gross motor function classification system, functional mobility scale (FMS) and anteversion angle using the Staheli rotational profile were evaluated. Femoral anteversion was accurately measured by hip ultrasonography followed by a preoperative three-dimensional gait analysis. Preoperative and postoperative data were statistically analyzed to reveal the validity of this method. Internal and external hip rotation improved significantly ($P < 0.001$, respectively). Mean cast and Schanz screw application time was 49 days and all patients achieved independent walking for at least 5 m within 7 weeks. FMS, ultrasonography measured hip anteversion and gait kinematics also improved significantly ($P < 0.01$, respectively). Two patients (3.92%) developed a mild knee flexion contracture which resolved completely with physiotherapy at 12 m. The pins-in-fiberglass cast provides sufficient rigid fixation to constitute a reliable and reproducible method permitting early weight bearing. It is versatile enough to allow concomitant soft tissue procedures and correction of other accompanying bony deformities.

PMID: [32301821](#)

5. Communication ability and communication methods in children with cerebral palsy.

Kristoffersson E, Dahlgren Sandberg A, Holck P.

Dev Med Child Neurol. 2020 Apr 13. doi: 10.1111/dmcn.14546. [Epub ahead of print]

AIM: To investigate if communication ability and method were related to each other and to age, sex, gross motor function, or manual ability in children with cerebral palsy. METHOD: This cross-sectional study used data registered in the Swedish Cerebral Palsy Surveillance Program registry, involving 3000 children aged 0 to 18 years. Pearson's χ^2 test and Spearman's correlation were used to test associations between variables. RESULTS: Communication ability and method were related to each other and to age, gross motor function, and manual ability. Aided communication methods were more frequently used among older children. The more functional the communication was, the less use of unaided communication occurred. Different communication methods were used across all Communication Function Classification System (CFCS) levels. Speech was most common in more functional levels, used by 72% of the children. Forty-five per cent were considered effective communicators in all environments. For classification of communication level and method, some recurring registration errors were made by the raters. INTERPRETATION: Some raters may need clarification on interpretations of CFCS instructions. Results indicate that children should be presented to aided augmentative and alternative communication and manual signs earlier and to a greater extent.

PMID: [32281100](#)

6. Physiologic and behavioural signs during a dental appointment in children and teenagers with Cerebral Palsy: a comparative cross-sectional study.

Leal TAC, Silva AM, Nogueira BR, Prado Júnior RR, Ferreira MC, Mendes RF.

Eur Arch Paediatr Dent. 2020 Apr 11. doi: 10.1007/s40368-020-00524-y. [Epub ahead of print]

AIM: To evaluate the heart rate (HR) and behaviour of children and teenagers with Cerebral Palsy (CP) when having a dental appointment. METHODS: A comparative cross-sectional study was carried out with 60 participants with CP, between 2 and 14 years old (study group-SG), and 60 normotypical individuals (CG). The sample was paired according to age, gender and socioeconomic status. Behaviour was evaluated during dental prophylaxis using the Frankl Scale, and HR was measured at five moments: before the appointment, when sitting in the dental chair, during the clinical examination, during prophylaxis and immediately after prophylaxis. Mann-Whitney, Friedman and Chi-square tests were applied at a significance level of 5%. RESULTS: SG presented significantly higher HR ($p < 0.001$) and more participants with uncooperative behaviour ($p < 0.001$) than CG in all observational periods. Furthermore, SG participants with uncooperative behaviour presented higher HR values than those in SG who were cooperative in all observational periods ($p \leq 0.002$). CONCLUSIONS: Individuals with CP have a higher HR before and during the clinical session, and are frequently more uncooperative with the procedure than normotypical individuals.

PMID: [32279245](#)

7. DataSpoon: Validation of an Instrumented Spoon for Assessment of Self-Feeding.

Krasovsky T, Weiss PL, Zuckerman O, Bar A, Keren-Capelovitch T, Friedman J.

Sensors (Basel). 2020 Apr 9;20(7). pii: E2114. doi: 10.3390/s20072114.

Clinically feasible assessment of self-feeding is important for adults and children with motor impairments such as stroke or cerebral palsy. However, no validated assessment tool for self-feeding kinematics exists. This work presents an initial validation of an instrumented spoon (DataSpoon) developed as an evaluation tool for self-feeding kinematics. Ten young, healthy adults (three male; age 27.2 ± 6.6 years) used DataSpoon at three movement speeds (slow, comfortable, fast) and with three different grips: "natural", power and rotated power grip. Movement kinematics were recorded concurrently using DataSpoon and a magnetic motion capture system (trakSTAR). Eating events were automatically identified for both systems and kinematic measures were extracted from yaw, pitch and roll (YPR) data as well as from acceleration and tangential velocity profiles. Two-way, mixed model Intraclass correlation coefficients (ICC) and 95% limits of agreement (LOA) were computed to determine agreement between the systems for each kinematic variable. Most variables demonstrated fair to excellent agreement. Agreement for measures of duration, pitch and roll exceeded 0.8 (excellent agreement) for >80% of speed and grip conditions, whereas lower agreement (ICC < 0.46) was measured for tangential velocity and acceleration. A bias of 0.01-0.07 s (95% LOA [-0.54, 0.53] to [-0.63, 0.48]) was calculated for measures of duration. DataSpoon enables automatic detection of self-feeding using simple, affordable movement sensors. Using movement kinematics, variables associated with self-feeding can be identified and aid clinical reasoning for adults and children with motor impairments.

PMID: [32283624](#)

8. Functional near-infrared-spectroscopy-based measurement of changes in cortical activity in macaques during post-infarct recovery of manual dexterity.

Kato J, Yamada T, Kawaguchi H, Matsuda K, Higo N.

Sci Rep. 2020 Apr 15;10(1):6458. doi: 10.1038/s41598-020-63617-0.

Because compensatory changes in brain activity underlie functional recovery after brain damage, monitoring of these changes will help to improve rehabilitation effectiveness. Functional near-infrared spectroscopy (fNIRS) has the potential to measure brain activity in freely moving subjects. We recently established a macaque model of internal capsule infarcts and an fNIRS system for use in the monkey brain. Here, we used these systems to study motor recovery in two macaques, for which focal infarcts of different sizes were induced in the posterior limb of the internal capsule. Immediately after the injection, flaccid paralysis was observed in the hand contralateral to the injected hemisphere. Thereafter, dexterous hand movements gradually recovered over months. After movement recovery, task-evoked hemodynamic responses increased in the ventral premotor cortex (PMv). The response in the PMv of the infarcted (i.e., ipsilesional) hemisphere increased in the monkey that had received less damage. In contrast, the PMv of the non-infarcted (contralesional) hemisphere was recruited in the monkey with more damage. A pharmacological inactivation experiment with muscimol suggested the involvement of these areas in dexterous hand movements during recovery. These results indicate that fNIRS can be used to evaluate brain activity changes crucial for functional recovery after brain damage.

PMID: [32296087](#)

9. Topographical Working Memory in Children with Cerebral Palsy.

Bartonek Å, Piccardi L, Guariglia C.

J Mot Behav. 2020 Apr 13:1-9. doi: 10.1080/00222895.2020.1748861. [Epub ahead of print]

Forty children with cerebral palsy (CP) and 120 typical developing children (TD) performed a topographic working memory (WalCT) test requiring to move their body in a walked vista-space and a visuo-spatial test (CBT) requiring just reaching movements. WalCT score was significantly higher in GMFCS II/III than in TD. CBT score was significantly lower in GMFCS I than in III/IV but lower than TD in all CP groups. Similar results in WalCT between GMFCS I and TD and GMFCS II and III/IV respectively indicate that mobility is associated with topographic working memory. Differently in CBT, the absence of

bodily movement allows using different cognitive strategies. Children should be provided with opportunities and active participation to enhancing spatial awareness and navigational skills.

PMID: [32281907](#)

10. The role of botulinum toxin in multimodal treatment of spasticity in ambulatory children with spastic Cerebral Palsy: extensive evaluation of a cost-effectiveness trial.

Bussmann JBJ, Pangalila RF, Stam HJ, Schasfoort F.

J Rehabil Med. 2020 Apr 16. doi: 10.2340/16501977-2680. [Epub ahead of print]

BACKGROUND: A cost-effectiveness trial (the Space Bop study) on the added value of botulinum toxin injections (BoNT-A) in the leg muscles, as part of a multimodal intervention for ambulatory children with spastic cerebral palsy in the context of a single distinct cycle of care was performed recently by our group. For a broad set of effect outcomes, we found that BoNT-A had no added value if children received comprehensive rehabilitation. However, this counterintuitive finding was met with scepticism. **OBJECTIVE:** Since several noteworthy facts and experiences were recorded during the course of the trial and the dissemination phase, the aim of this paper was to describe and discuss some crucial aspects of, and barriers to, the Space Bop study, related to context and perspective, design and results, as well as publication and implementation. **METHODS:** This paper discusses 5 issues: (i) the design, interpretation and presentation of previous research; (ii) the role of one's own clinical experience and interpretation; (iii) the aims of (BoNT-A) treatment; (iv) conflict of interest, role of industry, and the role of history; (v) optimal treatment modalities and dose-response relationships. **CONCLUSION:** Despite the unambiguous findings from the Space Bop study, several factors hindered acceptance of the results. Awareness of these factors is important when performing rehabilitation research and disseminating and implementing research findings.

PMID: [32301499](#)

11. Principles of Medical and Surgical Treatment of Cerebral Palsy.

Chin EM, Gwynn HE, Robinson S, Hoon AH Jr.

Neurol Clin. 2020 May;38(2):397-416. doi: 10.1016/j.ncl.2020.01.009.

Cerebral palsy is the most common cause of childhood motor disability, affecting 2 to 3/1000 children worldwide. Clinical abnormalities in tone, posture, and movement are the result of brain dysgenesis or injury early in life, and impairment varies in type, distribution, and in severity. The underlying brain disorder may also lead to other associated neurologic and systemic impairments. Variability in functional impairments, which can change during development, necessitates an individualized treatment plan. Treatment options are primarily symptomatic and directed toward optimizing independence, function, and/or ease of care-while limiting side effects. New promising disease-preventing and modifying treatments are emerging.

PMID: [32279717](#)

12. Impaired neuromuscular transmission of the tibialis anterior in a rodent model of hypertonia.

Fogarty MJ, Sieck GC, Brandenburg JE.

J Neurophysiol. 2020 Apr 15. doi: 10.1152/jn.00095.2020. [Epub ahead of print]

Early onset hypertonia is characteristic of developmental neuromotor disorders, including cerebral palsy (CP). The spa transgenic mouse displays early onset spasticity, abnormal gait and motor impairments that are remarkably similar to symptoms of human CP. Previously, we showed that spa mice have fewer motor neurons innervating the TA. An expanded innervation ratio may result in increased susceptibility to neuromuscular transmission failure (NMTF). We assessed NMTF in an ex vivo TA muscle-nerve preparation from spa and wildtype (WT) mice by comparing forces elicited by nerve versus muscle stimulation. TA muscle innervation ratio was assessed by counting the number of muscle fibers and dividing by the

number of TA motor neurons. Muscle fiber cross sectional areas was also assessed in the TA muscle. We observed that NMTF was immediately present in spa mice, worsened with repetitive stimulation, and was associated with increased innervation ratio. These changes were concomitant with reduced TA muscle fiber cross sectional area in spa mice compared to WT. Early-onset hypertonia is associated with increased innervation ratio and impaired neuromuscular transmission. These disturbances may exacerbate the underlying gait abnormalities present in individuals with hypertonia.

PMID: [32292122](#)

13. QUALITY OF LIFE IN CAREGIVERS OF PEDIATRIC PATIENTS WITH CEREBRAL PALSY AND GASTROSTOMY TUBE FEEDING.

Figueiredo AA, Lomazi EA, Montenegro MA, Bellomo-Brandão MA.

Arq Gastroenterol. 2020 Jan-Mar;57(1):3-7. doi: 10.1590/S0004-2803.202000000-02.

BACKGROUND: Cerebral palsy is the most common cause of physical disability in childhood. Caregivers of patients presenting tetraparesis cerebral palsy (TCP) and gastrostomy tube feeding (GTF) were selected for this study because both conditions represent a great demand for their caregivers. **OBJECTIVE:** To describe the quality of life related to the state of health of caregivers of patients with TCP who were fed by gastrostomy, to assess the results linked to the mental health of these caregivers, to compare our data with data from other studies on children with cerebral palsy without gastrostomy and to evaluate the possible interference of gastrostomy in the quality of life. **METHODS:** A number of 30 major caregivers were interviewed and assessed. Quality of life and mental health tools applied and analyzed only for caregivers were: Medical Outcomes Study (MOS) 36-item Short Form Health Survey (SF-36), WHOQOL-BREF and Beck scales. Other information (age, gender, marital status, number of residents per household and psychological support) was evaluated. The Spearman's rank correlation coefficient was used to analyze. A 5% significance level was adopted. **RESULTS:** Results obtained through questionnaires are as follows: moderate hopelessness in 20% of caregivers (the higher the number of residents per household the higher the level of caregiver's hopelessness); moderate and severe anxiety in 33.33% of the sample studied; moderate and severe depression identified in 46.67% of interviewed caregivers; health-related quality of life of caregivers of patients with TCP were found to be below world averages; no significant figures for suicide potential were noted for the population under this study. **CONCLUSION:** The HRQOL of caregivers of TCP patients who were fed by gastrostomy is below the average of the general population. Our results are very similar to those found in other studies that evaluated caregivers of patients with cerebral palsy with different degrees of neurological impairment and no report of using GTF, suggesting that the presence of gastrostomy did not negatively interfere with the caregiver's HRQOL.

PMID: [32294728](#)

14. Mortality and morbidity of preterm neonates weighing less than 750g: A 2-year retrospective cohort study.

Carriere D, Kantor E, Torchin H, Le Ray C, Jarreau PH, Zana-Taieb E.

Arch Pediatr. 2020 Apr 8. pii: S0929-693X(20)30073-7. doi: 10.1016/j.arcped.2020.02.003. [Epub ahead of print]

BACKGROUND: The rate of premature births in France is 6% and is increasing, as is the rate of extremely premature births. Morbidity and mortality rates in this population remain high despite significant medical progress. We aimed to evaluate the morbidity and mortality rate in preterm neonates weighing <750g and to evaluate their outcome at 2 years' corrected age (CA). **METHODS:** This was a retrospective monocentric study including babies born between May 2011 and April 2013 who were preterm and weighed <750g. We evaluated mortality and morbidity in the neonatal period. At 2 years' CA, we focused on developmental quotient (DQ) with the Brunet-Lézine test, on neurosensory assessment (sleeping/behavior), and growth evaluation. **RESULTS:** Among the 107 infants included, 29 (27%) died in the neonatal period. Mean gestational age was 25.6 weeks' gestation. Female sex and higher birth weight were independent predictors of survival. A total of 61 (78.2%) infants showed extra-uterine growth retardation at 36 weeks' postmenstrual age. At 2 years' CA, 57 children were followed up; 38 were evaluated using the Brunet-Lézine test, 20 (52.6%) had a DQc < 85, and none had a severe developmental delay (DQc < 50). Six (10%) children had cerebral palsy and 22 of 56 (39.2%) showed language delay. Growth retardation persisted in 15 of 52 (28.8%) children. **CONCLUSION:** Our results confirm the acute fragility of extremely low-birth-weight babies with a high rate of morbidity and mortality. At 2 years' CA, this population still shows a considerable rate of mild difficulties, whose long-term evolution needs to be followed.

PMID: [32278588](#)

15. Predicting motor outcome in preterm infants from very early brain diffusion MRI using a deep learning convolutional neural network (CNN) model.

Saha S, Pagnozzi A, Bourgeat P, George JM, Bradford D, Colditz PB, Boyd RN, Rose SE, Fripp J, Pannek K.

Neuroimage. 2020 Apr 9;116807. doi: 10.1016/j.neuroimage.2020.116807. [Epub ahead of print]

BACKGROUND AND AIMS: Preterm birth imposes a high risk for developing neuromotor delay. Earlier prediction of adverse outcome in preterm infants is crucial for referral to earlier intervention. This study aimed to predict abnormal motor outcome at 2 years from early brain diffusion magnetic resonance imaging (MRI) acquired between 29 and 35 weeks postmenstrual age (PMA) using a deep learning convolutional neural network (CNN) model. **METHODS:** Seventy-seven very preterm infants (born <31 weeks gestational age (GA)) in a prospective longitudinal cohort underwent diffusion MR imaging (3T Siemens Trio; 64 directions, b=2000 s/mm²). Motor outcome at 2 years corrected age (CA) was measured by Neuro-Sensory Motor Developmental Assessment (NSMDA). Scores were dichotomised into normal (functional score: 0, normal; n=48) and abnormal scores (functional score: 1-5, mild-profound; n=29). MRIs were pre-processed to reduce artefacts, upsampled to 1.25 mm isotropic resolution and maps of fractional anisotropy (FA) were estimated. Patches extracted from each image were used as inputs to train a CNN, wherein each image patch predicted either normal or abnormal outcome. In a postprocessing step, an image was classified as predicting abnormal outcome if at least 27% (determined by a grid search to maximise the model performance) of its patches predicted abnormal outcome. Otherwise, it was considered as normal. Ten-fold cross-validation was used to estimate performance. Finally, heatmaps of model predictions for patches in abnormal scans were generated to explore the locations associated with abnormal outcome. **RESULTS:** For the identification of infants with abnormal motor outcome based on the FA data from early MRI, we achieved mean sensitivity 70% (standard deviation SD 19%), mean specificity 74% (SD 39%), mean AUC (area under the receiver operating characteristic curve) 72% (SD 14%), mean F1 score of 68% (SD 13%) and mean accuracy 73% (SD 19%) on an unseen test data set. Patch-based prediction heatmaps showed that the patches around the motor cortex and somatosensory regions were most frequently identified by the model with high precision (74%) as a location associated with abnormal outcome. Part of the cerebellum, and occipital and frontal lobes were also highly associated with abnormal NSMDA/motor outcome. **DISCUSSION/CONCLUSION:** This study established the potential of an early brain MRI-based deep learning CNN model to identify preterm infants at risk of a later motor impairment and to identify brain regions predictive of adverse outcome. Results suggest that predictions can be made from FA maps of diffusion MRIs well before term equivalent age (TEA) without any prior knowledge of which MRI features to extract and associated feature extraction steps. This method, therefore, is suitable for any case of brain condition/ abnormality. Future studies should be conducted on a larger cohort to re-validate the robustness and effectiveness of these models.

PMID: [32278897](#)