Effect of multilevel surgery with hamstring lengthening in ambulatory children with cerebral palsy

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Background and Objective(s): Hamstring lengthening can effectively improve the extensibility of knee in the patient with cerebral palsy (CP). However, the impact of this lengthening procedure on the ambulation function was not evaluated previously with more comprehensive evaluation tools. The aim of this study is to determine the outcomes of hamstring lengthening as a part of multilevel surgery in children with CP.

Study Design: Cohort study.

Study Participants & Setting: Pre- and post-operative visits of children with spastic CP who underwent multilevel surgery with hamstring lengthening were evaluated. 194 children with spastic cerebral palsy (123 males and 71 females; Age of surgery=11±3.8y). In short-term evaluations (18±6.2mo; Range: 12–36mo), 314 operated limbs (from 181 children) were included. In long-term evaluations (77±15.0mo; Range: 60–114mo), 60 operated limbs (from 36 children) were included.

Materials/Methods: Physical examination and gait kinematic data related with hamstring pre-operative visits, short-term (12–36mo) and long-term (more than 60mo) post-operative follow-ups were analyzed.

Results: Knee flexor strength was weaker in 23.4%, unchanged in 60.5%, stronger in 16.1% of limbs in the short-term and was weaker in 26.8%, unchanged in 48.8%, stronger in 24.4% of limbs in the long-term. Hamstring spasticity was increased in 19.2%, unchanged in 27.8%, decreased in 53% of limbs in the short-term follow-up and increased in 45.0%, unchanged in 25.0%, decreased in 30.0% of limbs in long-term follow-up. Knee extension passive range-of-motion had 4° short-term improvement (p<0.05) but returned to pre-operative level at long-term (p=0.98). Popliteal angle had 10° short-term improvement (p<0.05) and 7° long-term improvement (p=0.01). Changes of Gross Motor Function Measure (GMFM) Dimension D in each pre-operative Gross Motor Function Classification System (GMFCS) level were analyzed. Kinematics analyses of knee flexion at initial contact improved 10° in short-term (p<0.05) and improved 9° in long-term (p<0.05). Maximum knee extension during stance phase improved 9° in short-term (p<0.05) but returned to pre-operative position in long-term (p=0.657). Pelvic anterior tilt during stance phase increased 4° in short-term (p<0.05) but returned to pre-operative position in long-term (p=0.282). Hip extension during stance phase was unchanged in short-term (p=0.36) but increased 6° in long-term (p=0.001). In general, the Gait Deviation Index (GDI) improved 7.2 points in short-term (p<0.05) and 9.6 points in long-term (p<0.05). Changes of GDI in each pre-operative GMFCS level were analyzed.

Conclusions/Significance: Hamstring lengthening associated with multilevel surgery did not worsen strength and spasticity of hamstring in physical examination, but improved hamstring flexibility in the short-term and led to the improvements of sagittal knee, hip and pelvic kinematics that were still present in long-term follow-up analyses. Our results support what was described in previous studies. Effects on gross motor functions based on the GMFM showed more improvements in GMFCS level III-IV and significantly improved in long-term follow-ups. However, GDI was more improved in independent ambulators especially in GMFCS level II. Further studies will be needed to clarify the direct impact from hamstring lengthening alone. We conclude that hamstring lengthening as a part of multilevel surgery is beneficial to ambulatory function of children with CP.

Long-term outcomes after distal femoral extension osteotomy and patellar tendon advancement in individuals with cerebral palsy

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Background and Objective(s): The long-term outcomes of a distal femoral extension osteotomy and patellar tendon advancement (DFEO+PTA) are unknown. Therefore, our purposes were to 1) determine the long-term effects of a DFEO+PTA in individuals with cerebral palsy (CP) who had a DFEO+PTA (cases) on body structure, function, activity, participation, and pain compared to baseline and to individuals who did not have the surgery (controls), and 2) determine if improvements in gait achieved with a DFEO+PTA at short-term are maintained at long-term.

Study Design: This was an IRB approved cohort study.

Study Participants & Setting: All participants had CP, walked in crouch (knee flexion angle >2 SDs above typically developing at contact and minimum flexion) and had knee flexion contact(s) ≥10° at baseline, were ≥20 years old at long-term, and ≥8 years post-DFEO+PTA (cases). Controls had no or alternative treatments to DFEO+PTA.

Materials/Methods: At long-term, participants completed questionnaires (quality of life, satisfaction with life, functional assessment questionnaire, functional mobility scale, frequency of participation, multiple pain questionnaires). A subset completed a gait analysis, 5-times sit-to-stand (5xSTS), and timed-up-and-go (TUG). Appropriate parametric or non-parametric tests were used (p<0.05).

Results: Twenty-eight cases and 24 controls participated in the study (6 additional cases and 7 controls completed questionnaires only). A short-term gait analysis (<1y post-DFEO+PTA) was available for 13/28 cases. At baseline, cases walked with more severe crouch, worse gait deviation index (GDI), and higher oxygen consumption than controls (p<0.05). Between baseline and long-term, GDI scores worsened for controls but knee flexion angles did not change, whereas GDI and knee flexion angles improved for cases. From short- to long-term, cases lost approximately 6° of knee extension at initial contact (p=0.004) and minimum flexion (p=0.007), and GDI significantly decreased (short-term: 72±12, long-term: 66±12, p<0.001). Among case and control limbs, 56% and 61%, respectively, were in crouch at long-