Long-Term Outcomes of Lateral Column Lengthening for Pes Planovalgus secondary to Cerebral Palsy

Constantino CS, Kruger KM, Krzak JJ, Graf A, Flanagan AT, Altiok H, Smith PA, Harris GF

Orthopedic and Rehabilitation Engineering Center, Marquette University and Medical College of Wisconsin
Motion Analysis Laboratory, Shriners Hospitals for Children, Chicago

Introduction

- Cerebral palsy (CP) is the most common motor disability in childhood, affecting 2.6 - 2.9 per 1000 live births.
- Hindfoot eversion with loss of the medial longitudinal arch, called pes planovalgus (PPV), is a common foot deformity in CP potentially causing pain and gait abnormalities.
- A common surgical intervention for PPV is lateral column lengthening (LCL, Fig. 1)
- The International Classification of Functioning Disability and Health (ICF) (WHO, 2001) is an established framework that can integrate and reflect the interplay between the health condition (in this case, adult CP patients treated with LCL for PPV in childhood) and other contextual factors such as activity and participation.
- This is the first study to report the long-term outcomes of lateral column lengthening surgery for pes planovalgus among adults with cerebral palsy treated in childhood that incorporates the domains of the ICF model by using novel objective measures and patient-reported outcome measures to describe and compare clinical outcomes and gait biomechanics among age-matched healthy controls.

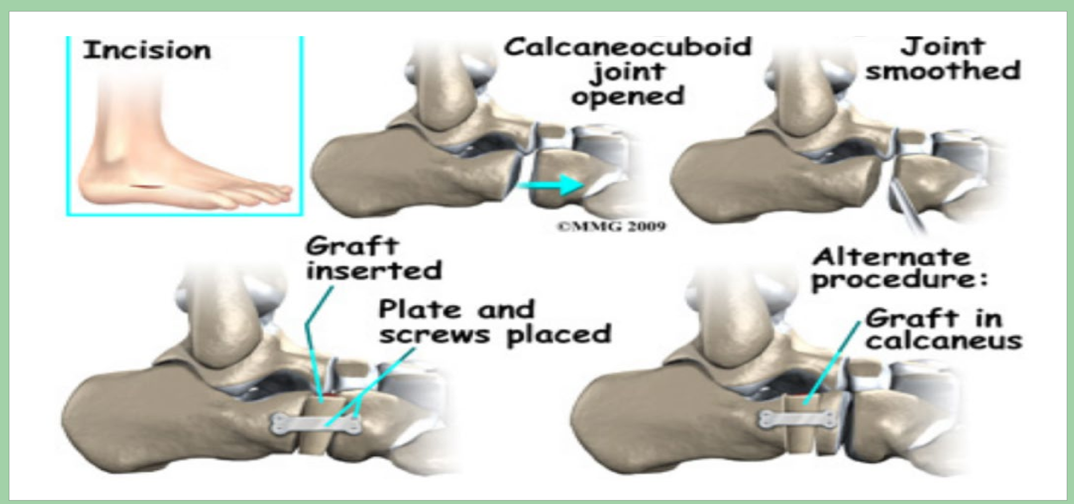

Fig 1. Lateral Column Lengthening

Image source:https://www.facmaspecialists.com/docs/Foot_pdf_foot_flatfoot_acquired.pdf.

Methods

- Thirteen participants with CP treated with LCL for PPV in childhood and 27 controls were included.
- Outcomes were presented in terms of evaluative measures of body structure and function (BSF), and activity, participation, and health-related quality of life .
- BSF: Clinical and radiographic assessments, Quantitative gait analysis, including the Milwaukee Foot Model (MFM), a segmental foot model, provided kinematic data for foot and ankle segments.

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- Patient-reported Outcomes assessments for all patients were done using the American Orthopedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot scale, revised Foot Function Index (FFI-R), Patient-Reported Outcomes Measurement Information System (PROMIS)-57, 36-Item Short Form (SF-36), Assessment of Life Habits (Life-H), and Foot Health Status Questionnaire (FHSQ) for measures of pain, activity, participation, and quality of life.
- Foot type among healthy controls was also determined using clinical examination measures described by Hillstrom et al. because planus and cavus deformities may also exist in healthy, asymptomatic individuals. Making this additional stratification among the control group provides more information when using the MFM to characterize differences in ankle motion and biomechanics among different foot types.

This flowchart presents the results of the study incorporated into the summarized Problem List of the participants following the WHO ICF Model

Medical/Surgical

- Cerebral Palsy
- status post Lateral Column Lengthening
- status post associated surgeries

Table 1. Other associated corrective surgical procedures among the PPV group

Soft tissue surgical procedures	n	Bony surgical procedures	n
Iliopsoas lengthening	4	Proximal varus derotation osteotomy	6
Gracilis lengthening	2	Tibial derotational osteotomy	4
Hamstrings lengthening	8	Acetabulum osteotomy (Dega)	1
Tibialis anterior lengthening	2	Distal femur extension osteotomy	1
Gastroc-soleus lengthening	4	Medial cuneiform osteotomy	1
Posterior tibialis lengthening	2	Subtalar fusion	3
Peroneus brevis lengthening	1	Distal hemiepiphysiodesis	1
Patellar tendon advancement	2	Shelf acetabuloplasty	1
Split anterior tibialis transfer	1		
Split posterior tibialis transfer to peroneus brevis	2	1st metatarsophalangeal joint fusion	2
Semitendinosus release	1	2nd metatarsophalangeal joint fusion	1
Gracilis release	1		
Adductor tenotomy	5		
Hamstring tenotomy	2		
Extensor digitorum tenotomy	1		
Proximal adductor longus and brevis myotomy	1		

n, number of patients among the PPV group who underwent the procedure.

Altered Body Structure and Function

- Pain in 6 out of 13 (46%) participants
- Reduced strength and joint passive range of motion (PROM)
- Calcaneal pitch was less, Meary angle was greater, lateral talo-horizontal angles were not different

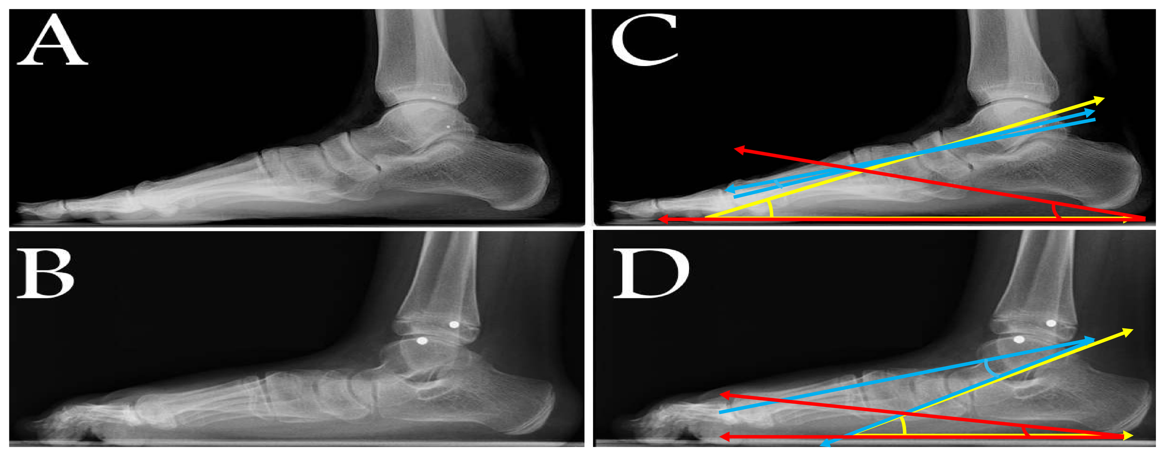

Fig 2. Sample lateral ankle radiographs of a control subject (A), PPV subject (B), showing three angles to measure the degree of flat footedness (blue = Meary angle, red = Calcaneal Pitch, yellow = Talo-horizontal angle); angles superimposed on a control subject's (C) and PPV subject's (D) radiographs

- Segmental Ankle Kinematics: Reduced sagittal tilt at the end of stance phase, abduction of tibia, hindfoot plantar flexion & eversion, reduced plantar flexion, valgus and abduction of the forefoot.
- Kinematics differences for individuals in the Planovalgus controls were greater when compared to the Rectus controls

Limited Activity

- Reduced walking speed, stride/step lengths, and cadence
- Later foot off; decreasing single support time and increasing double support time
- 69% had difficulty with physical function
- 77% had difficulty with personal care
- 77% had difficulty with foot wear

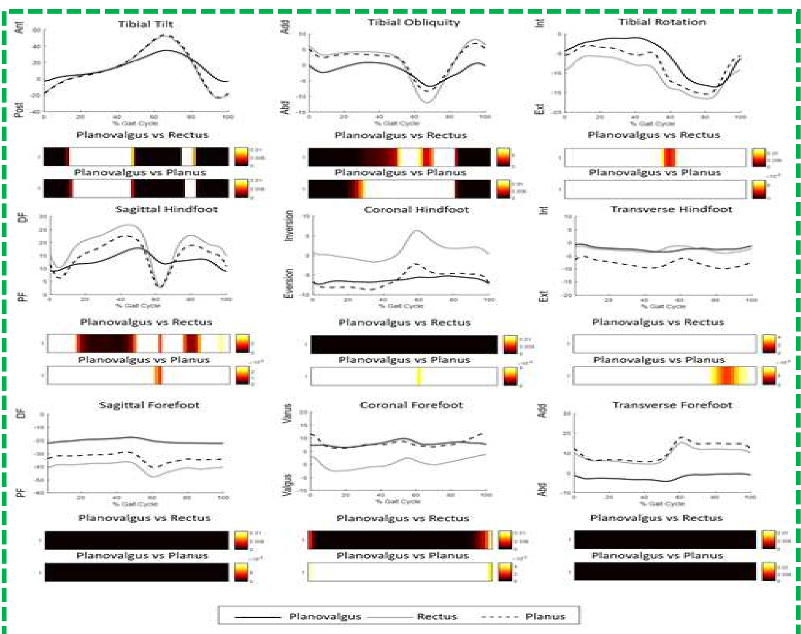

Figure 3. Average multi-segment foot and ankle kinematics for the Planovalgus, Rectus and Planus Groups (controls). Mean comparisons across the gait cycle are provided for Planovalgus vs Rectus and Planovalgus vs Planus Groups. Heat maps with adjusted alphas indicate differences throughout the gait cycle between groups.

Limited Participation

- 46% had role limitations due to physical health
- 62% had difficulty with community life
- 56% had education difficulties
- 73% had employment difficulties
- 85% had recreation difficulties

Personal Factors

- 92% reported having less energy
- 69% had difficulty with fitness
- 62% had difficulty with communication

Environmental Factors

- 54% had difficulty with access to nutrition
- 85% had housing difficulties

Conclusion

Adults with CP treated with LCL surgery for PPV in childhood achieved surgical correction that enables mobility, function, and community participation albeit challenges and measurable differences compared to age-matched controls.

The interplay between impaired body structure and function (strength, passive range of motion, ankle bony architecture), limited activity & participation, and other contextual factors was described to recognize the challenges patients face inside and outside the clinic long after the surgery has been performed.

Addressing contextual factors that influence the disease and impairments can equip patients with better skills they need as they transition into adulthood and enter the workforce.

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Acknowledgements

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