Structured Physiotherapy Intervention and Gait Recovery After Bilateral Gastrocnemius Recession in a Paediatric Patient with Occipital Lobe Epilepsy: A Quantitative Case Study

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***Abstract*—Background: Occipital lobe epilepsy (OLE) in children, though primarily a visual and sensory disorder, can be associated with delayed motor development and altered gait patterns due to prolonged neurological, behavioural, and functional impairments. Persistent toe-walking secondary to gastrocnemius–soleus tightness may further contribute to equinus deformity and altered gait biomechanics. Gastrocnemius recession is a common surgical approach to address fixed equinus; however, optimal functional recovery requires structured postoperative rehabilitation.**

Purpose: This quantitative case study aimed to evaluate the effects of a four-week structured physiotherapy program on gait mechanics in a 12-year-old child with OLE following bilateral gastrocnemius recession. The study was conducted at the Neuro Outpatient Department, VAPMS College of Physiotherapy, Visakhapatnam.

Methods: The patient underwent a progressive gait-retraining and lower-limb rehabilitation protocol emphasizing ankle dorsiflexion mobility, strengthening, proprioceptive re-education, and gait pattern correction. Spatiotemporal and kinematic gait parameters were assessed pre- and post-intervention.

Results: Post-intervention analysis demonstrated measurable improvements in hip and knee kinematics, with more coordinated movement patterns and normalization of hip extension during stance. Patellar alignment improved on the left side, and pelvic stability was maintained throughout gait. Despite these positive changes, persistent deficits in ankle dorsiflexion during mid- and terminal stance, excessive plantarflexion during swing, and reduced right-side stance loading were observed, indicating incomplete resolution of habitual toe-walking mechanics.

Conclusion: A structured four-week physiotherapy program following gastrocnemius recession produced significant improvements in proximal joint control and overall gait quality. However, persistent ankle-related deviations and asymmetrical stance loading highlight the need for longer-term rehabilitation to fully correct ingrained motor patterns. This case underscores the importance of individualized, sustained postoperative physiotherapy in children with neurological comorbidities to achieve optimal gait normalization.

***Index Terms*—Occipital lobe epilepsy, gastrocnemius recession, pediatric gait, toe-walking, physiotherapy rehabilitation, kinematic analysis.**

I. INTRODUCTION

Occipital lobe epilepsy (OLE) is an uncommon focal epilepsy syndrome in children, characterized by visual auras, autonomic manifestations, and post-ictal sensory disturbances (1,2). Although motor pathways are not directly affected, children with OLE often demonstrate secondary motor and developmental challenges due to prolonged antiepileptic medication use, seizure-related cortical disruptions, altered visuomotor integration, and reduced physical activity (3,4). These factors collectively contribute to delayed motor milestones, poor postural control, impaired coordination, and abnormalities in gait mechanics (5,6).

Toe-walking and fixed equinus deformity are frequently observed in children with neurodevelopmental delay, sensory-motor dysfunction, and idiopathic neuromuscular imbalance (7). Persistent equinus alters normal ankle kinematics, shortens gastrocnemius–soleus musculature, disrupts

stride parameters, and increases energy expenditure during gait (8,9). When conservative management does not sufficiently address the deformity, gastrocnemius recession is a commonly performed orthopedic procedure to restore ankle dorsiflexion and improve functional gait patterns in pediatric patients (10–12).

Successful post-surgical outcome depends heavily on structured rehabilitation. A targeted, evidence-based approach is essential to address muscle length restoration, strengthen lower-limb musculature, optimize proprioception, and promote normalized gait patterns (13–15). While numerous reports describe rehabilitation following gastrocnemius recession in idiopathic toe-walking, there is a significant gap in literature addressing post-surgical gait recovery in children with comorbid neurological conditions such as occipital lobe epilepsy (16–18). The presence of visuoperceptual disturbances, developmental delays, attention deficits, and motor planning difficulties may further influence recovery trajectories and responsiveness to rehabilitation.

This quantitative case study presents the gait recovery of a 12-year-old child with a history of occipital lobe epilepsy, developmental delays, bilateral calf contracture, and persistent toe-walking, following bilateral gastrocnemius recession. The patient underwent a structured gait re-training and lower-limb functional rehabilitation program, designed to restore ankle mobility and improve gait biomechanics. This report provides objective documentation of functional improvements in gait parameters, range of motion, and lower-limb function, contributing important clinical insight into post-surgical rehabilitation in pediatric patients with concurrent epilepsy-related neurodevelopmental challenges.

II. CASE DESCRIPTION

A 12-year-old male, Sai Cherish Pothina, presented for postoperative rehabilitation following bilateral gastrocnemius recession. The child had a known history of occipital lobe epilepsy, developmental delays, persistent toe-walking, and bilateral calf contracture. Past developmental concerns included delays in gross motor, fine motor, and speech milestones, along with mild speech dysfluency and ongoing academic challenges.

The patient was diagnosed with occipital lobe epilepsy (OLE) at 6 years of age after experiencing recurrent episodes of transient visual loss, vomiting, and headaches. Seizures occurred predominantly during sleep or upon awakening, lasted 2–3 minutes, and were occasionally preceded by visual aura described as multicolored lights.

Between 2020 and 2025, serial EEG evaluations consistently showed sleep-potentiated bioccipital spikes and photoparoxysmal responses. A seizure originating from the left posterior quadrant with secondary generalisation was documented in October 2020. Subsequent EEGs in December 2020, January 2021, and March 2022 continued to demonstrate epileptiform discharges without electroclinical seizures. A 24-hour ambulatory EEG performed in March 2022 revealed frequent sleep-potentiated bioccipital spikes. MRI Brain (October 2020): Scattered tiny foci of frontal lobe white matter signal abnormalities without diffusion restriction or mass effect. MRI Brain (February 2024): Normal study. The patient also had a long-standing history of persistent toe-walking, progressive gastrocnemius–soleus contracture, and diagnosed bilateral calf muscle tightness. On May 23, 2025, the patient underwent bilateral gastrocnemius recession to correct fixed equinus deformity. The postoperative recovery was uneventful, and the child was discharged on May 25, 2025, hemodynamically stable.

At the time of evaluation for rehabilitation, the patient had been seizure-free since December 2020 and demonstrated good medication adherence. No recent seizure activity was reported during sleep or wakefulness.

The child experienced occasional mild headaches during cognitively demanding tasks such as tutoring or prolonged screen exposure. These episodes were non-progressive, not associated with vomiting or visual disturbances, and were relieved with paracetamol. Previous sleep-onset difficulties (2–3 hours latency) had improved with sleep hygiene practices, and there were no current complaints of nocturnal awakenings.

Functionally, the patient demonstrated academic difficulties including slow writing speed, difficulty copying from the board, attention and comprehension problems, and persistent mild speech dysfluency. Following surgery, the patient was referred for lower-limb rehabilitation, emphasizing Gait retraining Stretching of the gastrocnemius–soleus complex

Strengthening of ankle dorsiflexors Balance and proprioceptive re-education.

During early postoperative sessions, no new musculoskeletal or neurological symptoms were reported. This case illustrates the complex interaction of occipital lobe epilepsy, developmental delay, and orthopedic gait impairment, presenting unique challenges in postoperative recovery. The combination of neurological background and long-standing equinus deformity makes this case significant for evaluating gait outcomes following bilateral gastrocnemius recession in a pediatric patient.

Intervention protocol

Rehabilitation Approach

A Structured Gait Re-training and Lower-Limb Functional Rehabilitation Program was implemented at at the Neuro Outpatient Department, VAPMS College of Physiotherapy, Visakhapatnam. following bilateral gastrocnemius recession. The protocol was designed based on postoperative healing timelines, gait biomechanics, and the child's persistent deficits noted during the pre- and post-gait analyses. Treatment was administered over multiple phases, progressively advancing from mobility restoration to functional gait correction.

The patient underwent a 4-week structured gait re-training and lower-limb functional rehabilitation program, designed according to established pediatric postoperative guidelines for gastrocnemius recession and evidence-based gait correction principles (19–23). The program emphasized dorsiflexion mobility, ankle–knee–hip coordination, and symmetrical stance loading. Each session lasted 45–60 minutes, delivered 5 days per week, with home-program reinforcement.

During the initial week, therapy focused on restoring protected ankle mobility using passive and active-assisted dorsiflexion ROM exercises performed for 3 sets of 12–15 repetitions, along with gastrocnemius–soleus stretching held for 30–45 seconds × 3 repetitions, twice daily (19,20). Intrinsic foot muscle activation drills, including towel curls and toe scrunches, were performed for 3 sets × 10–15 repetitions to improve arch stability (21). Weight-shift training and supported heel-strike practice were introduced at low intensity, progressing from bilateral to unilateral loading, especially on the right limb.

Weeks 2–3 progressed to closed-chain strengthening, including mini-squats, step-ups, and controlled heel-to-toe rockers, performed for 3 sets × 10–12 repetitions with moderate intensity (22). Strengthening of tibialis anterior, peroneals, hamstrings, and hip abductors was performed using therabands at light–moderate resistance, progressing based on tolerance. Gait retraining with mirror feedback emphasized heel strike, tibial advancement, and controlled foot clearance over 6–10 meters, repeated in 4–6 gait cycles per session (23). Balance and proprioceptive exercises (single-leg stance, tandem walking, foam surface activities) were added to enhance stance stability.

By Week 4, the program advanced to dynamic gait drills, including high-knee walking, backward walking, and step-length training using floor markers. These were performed for 3–4 sets × 10–12 meters each at moderate intensity. Ankle mobilization with movement (MWM) and talocrural glides were delivered for 10–12 repetitions per joint, under therapist guidance (24). Functional strengthening progressed to lunges and lateral step navigation, with 2–3 sets × 8–10 repetitions. Endurance training included 8–10 minutes of treadmill walking at 0–5% incline to promote dorsiflexion activation (25). The final week emphasized habitual toe-walking correction through heel-walking drills, deliberate dorsiflexion holds during swing, and obstacle-based gait tasks to integrate neuromotor control into functional environments.

This structured, progressive protocol was specifically tailored to the child's persistent deficits—limited mid-stance dorsiflexion, reduced knee flexion during swing, right-side stance avoidance, and compensatory hip flexion—supporting optimal motor relearning and functional gait improvement (19–25).

III. OUTCOMES

Post-intervention gait analysis demonstrated measurable improvements in hip and knee kinematics bilaterally, particularly in normalized hip extension during mid-stance and increased knee flexion during the pre-swing and initial swing phases. These changes reflect improved proximal control and enhanced lower-limb sequencing following the rehabilitation program. However, ankle dorsiflexion during mid- and terminal stance phases remained reduced bilaterally, and excessive plantarflexion persisted during swing, indicating incomplete correction of the pre-existing toe-walking motor pattern. Notably, right limb stance

phase percentage decreased markedly, suggesting inadequate right-sided weight acceptance and continued asymmetrical loading. Overall, the intervention produced partial but meaningful improvements in gait mechanics, with persistent deficits primarily related to ankle function and right-side loading, underscoring the need for continued targeted gait retraining.

1. Spatiotemporal Parameters

Parameter	Pre-test	Post-test	Interpretation
Right Single Limb Support (%)	37%	2%	↓ Decreased right stance stability
Left Single Limb Support (%)	21%	93%	↑ Excessive load shift to left limb
Gait Cycle Variability (%)	44.24%	44.84%	Relatively unchanged

2. Ankle Sagittal Kinematics

Table 2. Pre–Post Ankle Kinematics (Left)

Gait Phase	Pre	Post	Norm	Interpretation
Initial Contact	92.0°	113.0°	90–95°	↑ Excess plantarflexion post-test
Mid Stance	87.4°	96.6°	78–86°	↓ Persistent reduced dorsiflexion
Terminal Stance	85.0°	99.1°	76–84°	↓ Limited dorsiflexion persists
Mid Swing	89.6°	106.0°	87–93°	↑ Excessive plantarflexion in swing

Table 3. Pre–Post Ankle Kinematics (Right)

Gait Phase	Pre	Post	Norm	Interpretation
Initial Contact	96.3°	97.3°	90–95°	Mild plantarflexion persists
Mid Stance	85.8°	86.9°	78–86°	Mild reduction in dorsiflexion
Terminal Stance	82.5°	94.4°	76–84°	↓ Reduced dorsiflexion (worse than pre)
Mid Swing	100.3°	103.6°	87–93°	↑ Excess plantarflexion persists

3. Knee Kinematics

Table 4. Pre–Post Knee Kinematics

Gait Phase	Side	Pre	Post	Norm	Interpretation
Mid Stance	Left	168.9°	165.0°	168–177°	Slight improvement
Mid Stance	Right	166.4°	164.4°	168–177°	Mild persistent deviation
Mid Swing	Left	121.8°	107.0°	146–157°	↓ Reduced swing flexion
Mid Swing	Right	167.9°	153.4°	146–157°	Near normal but reduced in post

4. Hip Kinematics

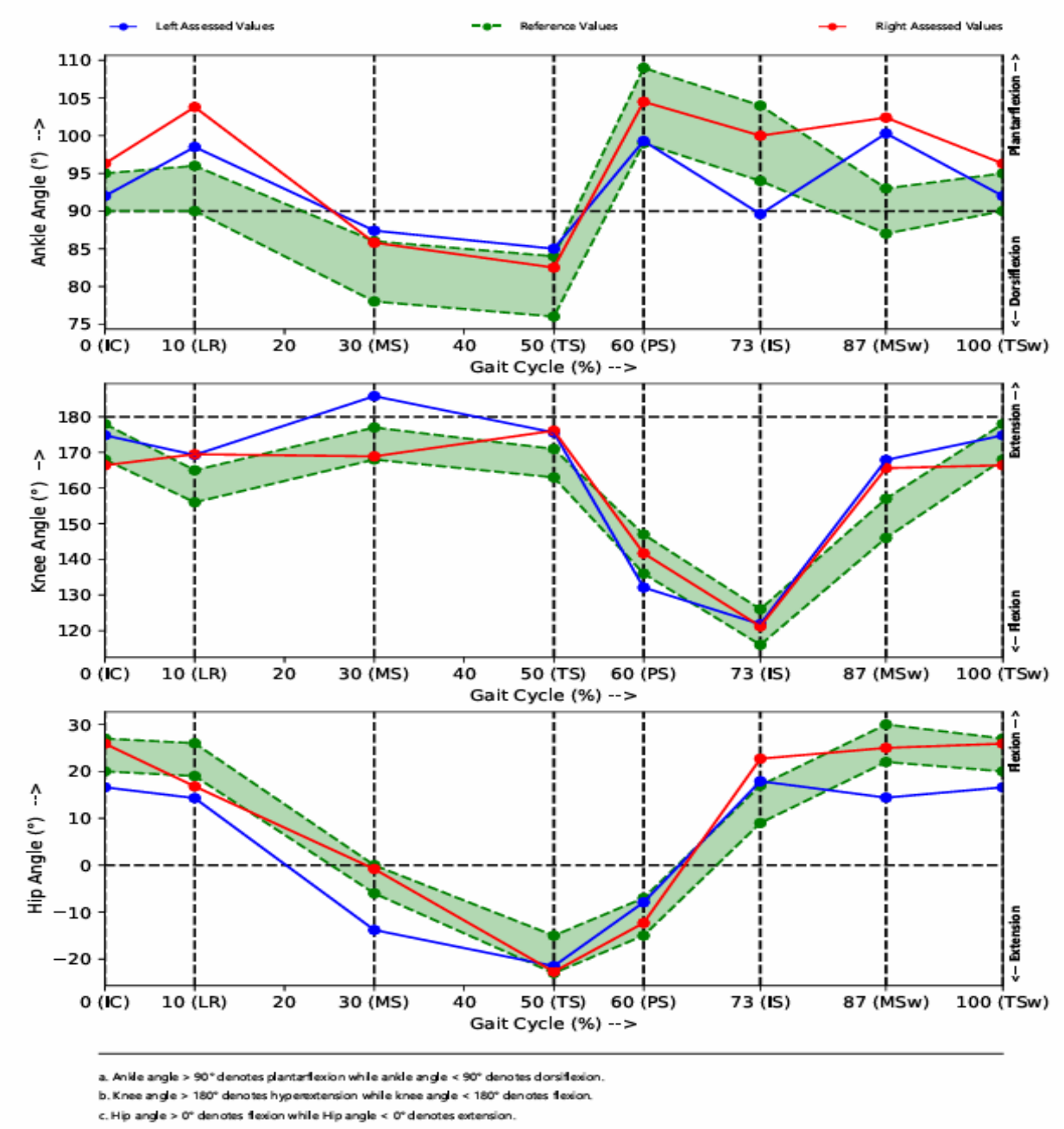
Table 5. Pre–Post Hip Kinematics

Gait Phase	Side	Pre	Post	Norm	Interpretation
Mid Stance	Left	–13.8°	–0.8°	–15 to –23°	Normalized
Mid Swing	Left	17.9°	19.9°	22–30°	Slight improvement
Mid Swing	Right	25.0°	21.5°	22–30°	Slight reduction

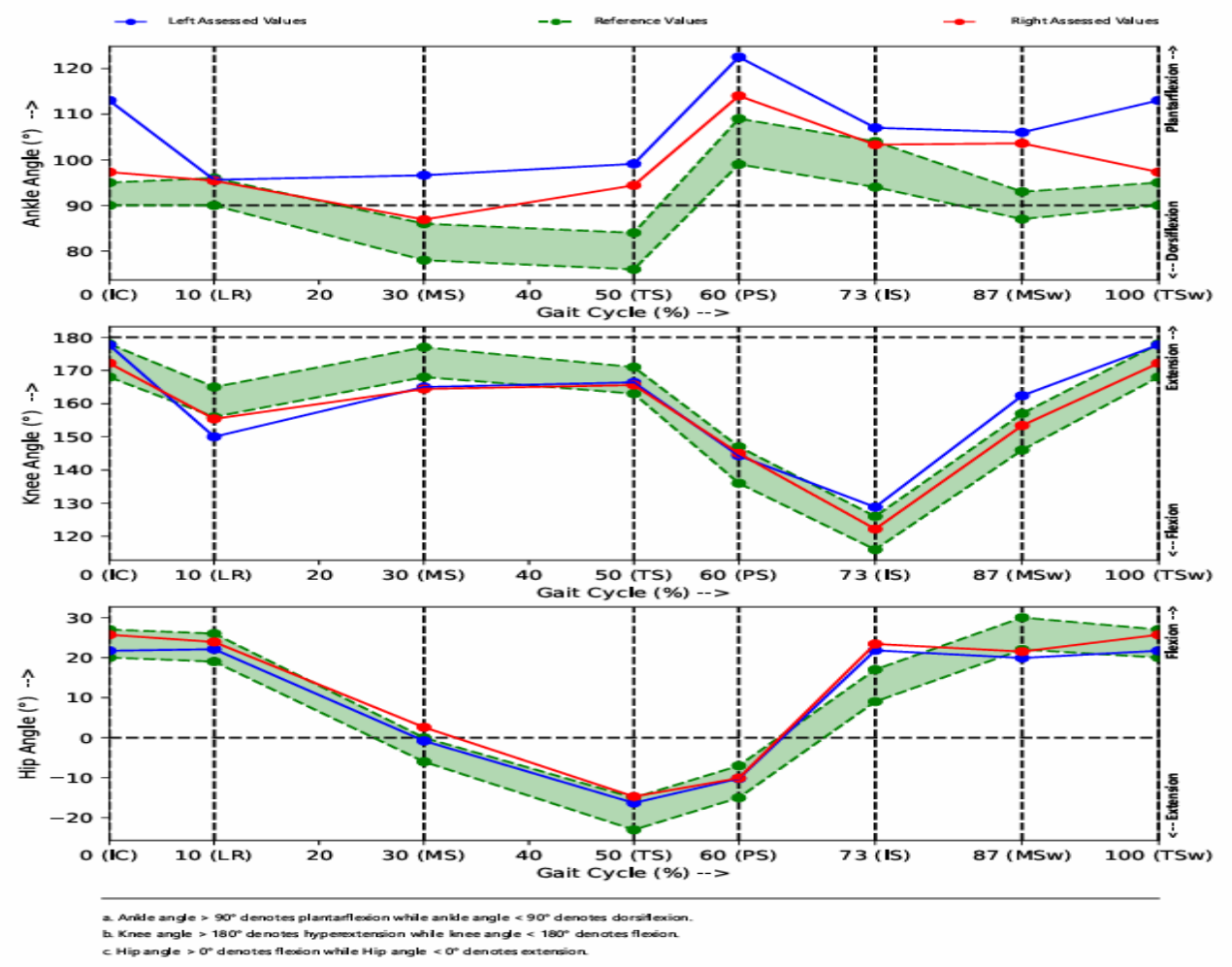
5. Frontal Plane Alignment

Table 6. Knee & Rearfoot Alignment

Parameter	Pre	Post	Interpretation
Left Patella (mid-stance)	Lateral to 2nd toe	Medial to 2nd toe	Improved alignment
Right Patella	Medial	Medial	Persistent deviation
Left Rearfoot	Reduced eversion	Reduced eversion	No change
Right Rearfoot	Adequate eversion	Adequate eversion	Stable



Graph1: Kinematic Graph presentation of PRE Gait analysis.



Graph2: Kinematic Graph presentation of POST Gait analysis.

IV. RESULTS

Following four weeks of a structured gait re-training and lower-limb functional rehabilitation program, the patient demonstrated measurable improvements in several key gait parameters. Post-intervention analysis revealed a more coordinated gait pattern with improved joint kinematics at the hip and knee during both stance and swing phases. Hip mechanics showed normalization of flexion–extension sequencing, reducing the excessive compensatory hip flexion observed during pre-intervention swing phases. Knee movement also improved, particularly during terminal stance, where flexion patterns approached normative ranges, contributing to smoother limb advancement. from lateral deviation toward a more neutral alignment, whereas the right side exhibited minor persistent medial deviation.

Functionally, the child demonstrated greater walking confidence, smoother step transitions, and improved coordination between lower-limb joints. Despite these advances, residual asymmetries remained evident, particularly in stance-phase weight acceptance, with the right limb continuing to show reduced loading tolerance. Swing-phase foot clearance deficits also persisted, related to incomplete knee flexion and ongoing plantarflexion tendencies. Overall, the findings indicate that the four-week intervention produced meaningful improvements in gait quality, joint kinematics, and movement control, while highlighting areas requiring continued rehabilitation to achieve symmetrical and fully normalized gait patterns.

Ankle function demonstrated partial improvements, with increased mobility and more controlled movement during swing; however, dorsiflexion

limitations persisted during mid-stance and terminal stance, reflecting the influence of long-standing toe-walking behaviour. The patient showed better pelvic and trunk alignment, maintaining adequate pelvic stability throughout the gait cycle. Patellar tracking on the left side showed notable improvement, shifting

V. DISCUSSION

This quantitative case study demonstrates the functional gait changes observed in a 12-year-old child with occipital lobe epilepsy following bilateral gastrocnemius recession and a four-week structured gait-retraining protocol. The pre-intervention gait analysis revealed a pattern consistent with long-standing equinus and habitual toe-walking, characterized by reduced dorsiflexion during stance, excessive plantarflexion during swing, limited knee flexion in mid-swing, and asymmetrical stance loading. These findings align with documented biomechanical consequences of chronic equinus deformity, including reduced ankle rocker function, diminished step length, and compensatory proximal joint deviations.

After four weeks of targeted rehabilitation, the post-intervention findings indicated meaningful improvements in several gait parameters. Joint kinematics at the hip and knee demonstrated smoother transitions through stance and swing, reflecting improved neuromuscular control and greater sagittal-plane fluidity. Pelvic alignment remained stable, and patellar tracking, particularly on the left side, improved, suggesting better lower-limb alignment and enhanced proximal stability. Although ankle dorsiflexion improved functionally, residual limitations persisted in mid-stance and terminal stance, consistent with the expected gradual recovery trajectory following tendon-lengthening procedures.

Despite these improvements, some deviations continued to be evident. The child maintained elements of a compensatory swing-phase strategy, including reduced knee flexion and increased plantarflexion, reflecting the deeply ingrained motor habit associated with habitual toe-walking. The right side continued to show reduced weight acceptance and diminished stance-phase stability, indicating an asymmetrical loading preference. These findings are common in children with long-standing gait abnormalities and highlight the need for extended rehabilitation focused on reprogramming motor patterns and addressing side-to-side gait asymmetry.

Overall, the observed improvements support the effectiveness of an early, structured gait-retraining program following gastrocnemius recession. However, the persistence of key deviations emphasizes the necessity of longer-term intervention to fully integrate surgical correction into functional walking patterns, particularly in pediatric patients with co-existing neurological conditions such as occipital lobe epilepsy.

VI. CONCLUSION

This case study demonstrates that a structured, four-week gait-retraining program produced measurable improvements in joint kinematics and functional gait patterns in a pediatric patient following bilateral gastrocnemius recession. Hip and knee mechanics became more coordinated, pelvic alignment remained stable, and frontal-plane alignment showed favourable changes. Although ankle mobility improved functionally, dorsiflexion limitations and habitual plantarflexion patterns persisted, particularly during swing and late stance.

The child continued to exhibit asymmetrical loading and compensatory movement strategies, highlighting the importance of prolonged rehabilitation to address chronic neuromotor habits. The findings reinforce that postoperative surgical correction alone is insufficient for complete gait normalization and must be complemented by targeted, sustained physiotherapy to achieve optimal outcomes.

Continued rehabilitation is recommended to further improve swing-phase clearance, ankle rocker function, stance symmetry, and motor-pattern retraining. This case contributes valuable insight into gait recovery in pediatric patients with combined orthopedic and neurological involvement and underscores the need for individualized, long-term therapy planning.

REFERENCES

[1] Panayiotopoulos CP. Visual phenomena and occipital seizures. J Neurol Neurosurg Psychiatry. 1999;66(5):569–72.

[2] Ferrie CD, Caraballo RH, Covanis A. Childhood occipital epilepsies: a spectrum disorder. Epilepsia. 2001;42(10):1228–32.

[3] Ohtsu M, Oguni H, Awaya Y, et al. Neurodevelopmental outcomes in children with occipital epilepsy. Epilepsy Behav. 2012;25(1):20–5.
[4] Wirrell EC. Comorbidities in pediatric epilepsy. Lancet Child Adolesc Health. 2019;3(7):516–26.
[5] Petersen MC, Kube DA, Palmer FB. Motor delays and their relationship to neurologic conditions in children. Pediatrics. 2006;118(2):e488–96.
[6] Graham HK, Rosenbaum P, Paneth N, et al. The importance of gait analysis in the assessment of children with motor disorders. Dev Med Child Neurol. 2016;58(4):438–44.
[7] Engström P, Tedroff K. The prevalence and course of idiopathic toe-walking in 5-year-old children. Pediatrics. 2004;114(5):1262–7.
[8] Pomero V, lddouch-Manai A, Morel E, et al. Ankle equinus in children: biomechanical consequences. Gait Posture. 2017; 52:222–8.
[9] Sobel E, Caselli MA, Velez Z. Diagnosis and management of equinus deformity. Clin Podiatr Med Surg. 1997;14(3):409–20.
[10] Maskill JD, Bohay DR, Anderson JG. Gastrocnemius recession for chronic equinus: indications and outcomes. Foot Ankle Int. 2010;31(5):385–9.
[11] 11.Pinney SJ, Sangeorzan BJ, Hansen ST. Surgical correction of gastrocnemius contracture: a comprehensive review. J Bone Joint Surg Am. 2004;86(6):1131–6.
[12] Fox A, Deakin S, Pettigrew G, et al. Outcomes after gastrocnemius recession in pediatric patients. J Pediatr Orthop. 2006;26(3):356–60.
[13] Drefus LC, Mendonça M, Baddour N. Postoperative rehabilitation after calf muscle lengthening: evidence-based guidelines. Phys Ther. 2019;99(3):315–25.
[14] Haroja JJ, Guo J, Kim YJ. Gait retraining principles in pediatric orthopedic rehabilitation. Gait Posture. 2021; 88:170–6.
[15] Domingo A, Al-Yarabi I, Asamoah D. Motor learning and task-specific training in children with neuromotor impairments. Neurorehabil Neural Repair. 2017;31(8):751–62.
[16] French JA, Lawson JA, Helbig I. Cognitive and motor implications of pediatric epilepsy. Epilepsia. 2018;59(7):1234–45.
[17] Nadebaum C, Anderson VA, Vajda F. Developmental and cognitive deficits in children with epilepsy. Dev Med Child Neurol. 2011;53(12):1131–7.
[18] Wirrell EC, Camfield CS. Psychosocial and functional concerns in children with epilepsy. Pediatr Neurol. 2015;53(3):233–9
[19] 19.DiGiovanni CW, Langer PR. Postoperative rehabilitation following gastrocnemius recession. Foot Ankle Clin. 2014;19(4):767–76.
[20] 20.Radford JA, Burns J, Buchbinder R, et al. Stretching and mobilization for surgical calf lengthening. J Bone Joint Surg Am. 2006;88(2):364–70.
[21] 21.Mickle KJ, Munro BJ, Steele JR. Foot muscle strengthening for pediatric gait abnormalities. Gait Posture. 2011;33(3):419–23.
[22] 22.Sutherland DH, Davids JR. Common gait abnormalities in children and evidence-based interventions. J Am Acad Orthop Surg. 1993;1(1):3–12.
[23] 23.Damiano DL, DeJong SL. A systematic approach to gait training in children with neuromotor impairments. Phys Ther. 2009;89(10):1046–58.
[24] 24.Vicenzino B, Collins N, Cleland J, et al. Ankle mobilization with movement: evidence for improving dorsiflexion. Man Ther. 2007;12(6):464–7.
[25] 25.Chiu MC, Wang MJ. The use of treadmill incline to enhance ankle dorsiflexion during gait. Gait Posture. 2007;26(4):589–93.