



Empowering Functional Abilities in a 12-Year-Old with Spastic Quadriplegic Cerebral Palsy: A Rehabilitation Case Study

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Introduction:

Kiyaan, a 12-year-old boy diagnosed with spastic quadriplegic cerebral palsy (CP), was referred to outpatient physical therapy following extensive surgical interventions aimed at improving his functional mobility. Born prematurely at 29 weeks' gestation, Kiyaan had a complicated neonatal course, spending six weeks in the neonatal intensive care unit (NICU) where he required respiratory support and nutritional interventions. Despite a cranial ultrasound showing no significant neuroanatomical changes, Kiyaan's developmental milestones were delayed, and he exhibited atypical movement patterns during infancy. He gradually achieved sitting stability with support, but his trunk hypotonicity hindered independent sitting and mobility. Additionally, Kiyaan underwent multiple eye surgeries for retinopathy of prematurity (ROP) to improve his visual perception during ambulation.

Kiyaan's journey with therapy began early in life, receiving home-based early intervention services followed by outpatient therapies at a children's hospital and later school-based services. He underwent surgical interventions, including hamstring lengthenings and Botulinum toxin (Botox) injections, to address spasticity and contractures in his lower extremities. Despite these interventions, Kiyaan's functional mobility remained compromised, leading to extensive surgical procedures at age 12 to improve hip orientation, muscle length, and foot alignment.

Post-surgery, Kiyaan's physical therapy evaluation revealed impairments including pain, increased lower extremity tone, decreased strength, balance deficits, and decreased endurance. He presented with an inefficient gait pattern, decreased independence in mobility and transfers, and required assistive devices for ambulation. The prognosis for Kiyaan's treatment was optimistic due to his motivation to walk, along with the support of his family and therapists.

The comprehensive rehabilitation intervention implemented for Kiyaan focused on addressing his postoperative impairments and functional goals. Initial interventions included stretching, strength training, therapeutic handling, aquatic therapy, and gait training. As Kiyaan progressed, interventions were modified to include advanced strengthening exercises, gait training with partial body-weight support, and patient/parent education. One year postoperatively, Kiyaan achieved his personal goal of standing and walking independently with his walker during a school event, marking significant functional improvement and highlighting the effectiveness of the rehabilitation intervention.

Case Description:

Kiyaan is a 12-year-old boy with a diagnosis of spastic quadriplegic CP referred to outpatient physical therapy 1 week after extensive surgical interventions including bilateral varus derotation osteotomies, a right Dega procedure, bilateral adductor and hamstring lengthenings, and bilateral lateral column lengthenings.

Past Medical History

Kiyaan has an extensive medical history. He was born at 29 weeks' gestation and spent 6 weeks in the neonatal intensive care unit (NICU), during which time he was orally intubated for 2 days, then placed on supplemental oxygen via nasal cannula. He had a feeding tube and several other intravenous lines placed during his NICU stay. He underwent cranial ultrasound to determine the extent of his neurologic insult; however, this assessment did not reveal neuroanatomical changes. Kiyaan had an echocardiogram to rule out cardiac involvement without significant findings. He was discharged from the NICU with an apnea monitor due to respiratory concerns. Kiyaan progressed slowly with his gross and fine motor milestones and often used atypical movement patterns to move. At 6 months, he was able to roll from supine to and from prone, but initiated movement with neck and back extension while rolling his body as a complete unit. Kiyaan was not able to activate his trunk flexors to allow dissociated movement of his UEs from his LEs while rolling. He first attained stability in sitting using a "W" sit pattern, with an anterior pelvic tilt, bilateral hip internal rotation and adduction, knee flexion, and ankle dorsiflexion. Kiyaan' truncal hypotonicity made sitting without assistance or external support difficult and inefficient. He was able to ring-sit and side-sit with minimal to moderate physical assistance. By 18 months of age, he was able to maintain ring-sitting with bilateral UE support and close supervision. He attempted to creep; however, owing to poor lower limb dissociation was unable to coordinate the sequence needed to reciprocally creep. He moved around his environment by advancing both arms alternately, then both legs simultaneously using extensor tone to initiate the movement, with poor ability

to sustain LE hip flexion. At 18 months, Kiyaan underwent his first eye surgery due to retinopathy of prematurity (ROP). This was followed by a second eye corrective surgery when he was 2.5 years old. Following his second eye surgery, his visual perception notably improved during ambulation. Gait training was initiated using a gait trainer with a trunk support, hip guides, bilateral ankle prompts, bilateral forearm prompts, and tilted handgrips to accommodate hand placement. By the time Kiyaan was 2.5 years old, he had progressed from a gait trainer to a posterior walker with hip guides. He ambulated with poor trunk rotation, increased adduction bilaterally during swing phase causing forefoot to hit heel of stance phase leg ("scissoring"), decreased terminal knee extension in stance phase due to tight hamstrings (crouched posture), and initial contact at his forefoot/toes due to increased plantar flexor tone and decreased ankle ROM. Owing to his inefficient and effortful gait pattern, Kiyaan used a manual wheelchair for long distances. To address the spasticity of his LE, he had two rounds of Botox injections to his hamstrings bilaterally, gastrocnemius, and adductors when he was 3 and 3.5 years old and again when he was 4 years old. He underwent bilateral hamstring lengthenings at age 6. At that time, he also had an adenoidectomy to resolve persistent snoring and difficulty sleeping. At age 8, he underwent a third round of Botox injections to the medial and lateral heads of the gastrocnemius on both legs to address increased plantarflexor tone. This was done in an effort to delay the need for further surgical intervention and improve ambulation ability. Kiyaan was involved in therapy from a young age. He participated in home-based early intervention services for the first year of life, received physical and occupational therapies at a children's hospital on an outpatient basis, then moved into weekly school-based services at the age of 5. He had both medically based physical therapy and occupational therapy at a frequency of one to three times a week until the age of 9. Treatment was typically once a week; however, it was increased to two to three times a week following Botox injections and hamstring lengthenings. His family was very involved in his care and was consistent in helping Kiyaan carry over a home exercise program, which changed as his functional abilities improved. Owing to Kiyaan's involvement in school activities and his improved functional mobility, medically based physical therapy transitioned to a consultative basis at the age of 9 and was reinitiated following surgery.

Prior Level of Function

Kiyaan underwent extensive surgical intervention at the age of 12 owing to continued growth, weight gain, increased LE spasticity and contractures, increased crouch gait pattern, pain, poor bony alignment, and decreased ability to move around within his home and classroom.

Functional mobility:

Prior to surgery, Kiyaan was able to transition from sit-to-stand and transition into his walker with close supervision. He was able to transition onto and off the floor by pulling up on a stationary object with minimal physical assistance. He required moderate physical assistance to do so using a half-kneel-to-stand pattern.

Gait/steps:

Prior to surgery, Kiyaan independently ambulated with a posterior walker using a crouched gait pattern with increased adduction across midline during the swing phase and bilateral Cascade Turbo braces. He was able to ambulate household distances and move through his classroom with his walker. He used a manual wheelchair for long distances to minimize fatigue. He was able to manage a curb step given moderate physical assistance.

Bracing:

At the age of 12, Kiyaan was wearing AFOs with SMO inserts, commonly known as TURBO braces made by Cascade. Prior to surgery, he presented with an increased crouched gait pattern.

Physical Therapy Examination

Following surgery, Kiyaan had an acute inpatient stay at a children's hospital where he received physical therapy for bed mobility, transfer training, and parent education on precautions following surgery. Once he was discharged from the hospital, he returned to undergo an outpatient physical therapy initial examination to determine his postoperative plan of care. The results of this evaluation were as follows.

Precautions:

No hip flexion greater than 90 degrees, no forceful hip internal or external rotation, no adduction across midline; knee immobilizers to be worn 2 hours on 2 hours off and throughout the night; weight bearing as tolerated (WBAT) in short leg casts.

Pain:

According to the Numeric Pain Scale (0 to 10), Kiyaan reported a 5/10 pain overall, but reports that left foot is most painful.

ROM:

Bilateral hip flexion to 90 degrees, hip abduction to 35 degrees, hip adduction to neutral, popliteal angles: 25 degrees, ankle motion not tested secondary to short leg casts.

Strength:

MMT bilaterally: hip flexion: 2/5; hip abduction: 1/5; hip adduction: 2/5; knee extension: 3/5; prone knee flexion: 2/5; ankle testing not possible secondary to short leg casts.

Tone: MAS: two bilateral adductors and hamstrings.

Sensation:

Bilateral LE sensation was intact to light touch, hot and cold, sharp and dull.

Functional mobility:

Required moderate physical assistance to perform sit-to-stand transfer; floor-to-stand transfer deferred at this time.

Gait/steps:

Ambulates using posterior walker for 10 feet and moderate physical assistance, wearing bilateral knee immobilizers and short leg casts.

Balance: Kiyaan is able to maintain static standing with both knee immobilizers donned for 5 to 10 seconds without bilateral UE support on his walker; able to stand 30 seconds with UE support on his walker.

Equipment:

Kiyaan is currently using a manual wheelchair at school, but family notes that his propulsion was slow and inefficient, causing difficulty keeping up with peers. The therapists discussed the advantage of using a power wheelchair with Kiyaan and his family, and explained that a power wheelchair would provide Kiyaan energy-efficient mobility for long distances in all environments. Kiyaan and his family are considering power mobility now that he is older, owing to decreased endurance and his inefficient gait pattern. Kiyaan repeatedly states that he enjoys school and would like to reserve some energy for academics rather than using it all to get from one class to another. His family is in the process of getting a van modified with a wheelchair lift to accommodate the increased weight and size of a power chair.

Physical Therapy Assessment/Prognosis

Kiyaan is a 12-year-old young man with a diagnosis of spastic quadriplegic CP. He recently underwent extensive LE surgery to improve hip orientation, increase muscle length, and improve foot alignment. He presents with impairments, including pain, increased LE tone, decreased LE strength, decreased balance, and poor endurance. As a result, he presents with inefficient gait patterns, decreased independence with functional mobility and transfers. The outlook for treatment is good owing to his motivation to walk. Kiyaan, along with his family and therapists, determined that his long-term goal is to walk 25 feet across a stage at school, then stand for about 5 to 10 minutes using his walker alongside his classmates at the end-of-year celebration.

Interventions for first 6 months postsurgery (frequency: three 60-minute sessions per week postoperatively)

Stretching:

Bilateral hip adduction and hamstring stretching, ankle dorsiflexion when casts were removed 8 weeks postop, five reps with a 30-second hold for each stretch.

Strength training:

Functional strength training to start including sit-to-stand repetitions from various seat heights and surfaces, progressing from higher to lower seats with lowest placing hips at a 90-degree angle (using benches, balls, bolsters). Leg strengthening with manual resistance and machines, attention to hip abductors, adductors, extensors and hamstrings, and dorsiflexor strengthening; use of strength training machine with resistance high enough to result in fatigue after one to three sets of 6 to 10 reps (following NSCA strengthening guidelines); core strengthening using medium therapy ball in supine, prone, and sitting.

Therapeutic handling:

Functional movement sequences practiced with facilitation to improve coactivation of LE musculature to promote an active base of support while addressing posture and alignment. Such movement sequences include facilitated weight shifting in standing using parallel bars, progressing to walker with facilitation to gluteals and abdominals given visual cues from a mirror; facilitated step-up with input to gluteus medius/maximus and internal/external obliques.

Bracing:

Following cast removal, he was fitted for molded solid AFOs to limit crouch and promote good foot alignment.

Aquatic therapy:

Casts were removed 12 weeks postop, thereby allowing Kiyaan to participate in aquatic therapy. Aquatic activities included standing balance and gait training in shoulder-deep water progressing down to waist-deep water, closed-chain functional strengthening, and kicking with kickboard for hip strengthening.

Gait training:

Began with stride stance and pre gait activities in standing to increase tolerance for weight bearing and preparation for ambulation; progressed to gait training on even surface using personal posterior walker.

Parent/patient education:

Review of precautions, transfer training, and home stretching program for hip adductors, hamstrings, and triceps surae (after casts were removed).

Intervention 6 months postop (physical therapy: two 60-minute sessions per week, no postoperative precautions)

Stretching:

Continue adductor, hamstring, ankle dorsiflexor stretching, three reps with 30-second hold each to maintain gains achieved.

Strengthening:

Progressed resistance with functional closed-chain strengthening as well as focused single-joint strengthening of muscles important to maintaining optimal upright posture such as triceps surae, quadriceps, gluteus medius, and gluteus maximus.

NDT/therapeutic handling:

Incorporated primarily into functional activities to address patient/family and therapist-determined goals. Including core strengthening with pelvic weight shifting, flexion rotation and extension rotation activities on ball, foot preparation prior to standing activities, and facilitated weight shifting and balance training with and without UE support on walker.

Gait training:

Emphasis on increased walking distance using walker while maintaining optimal posture and alignment to minimize crouch; Partial Body-weight Supported Treadmill Training initiated to increase endurance.

Patient/parent education:

Emphasis on ambulation and functional strengthening, family able to decrease frequency of stretching to once a day due to stability of ROM measurements over 8 consecutive weeks.

Discharge/continuum of care

One year postoperatively, Kiyaan reached his personal goal of standing for 5 minutes with his walker and walking across the stage at school to stand alongside of his classmates during the end-of-the-school-year celebration. At this time, he was discharged from a medically based physical therapy program with a home program. The therapists explained that Kiyaan' therapeutic needs would be best met using an episodic plan of care, and recommended a physical therapy reevaluation in 6 months' time to determine whether further intervention was needed. Prior to discharge, Kiyaan' interests were discussed and options for community activities were provided.

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