Statement of Purpose

Cerebral palsy related contracture of the foot and ankle commonly results in a non-reducible, spastic equinus deformity. This contracture leads to gait instability, pain, bracing difficulties, droplet deformity, and ulcerations. This case series presents a protocol for open Achilles tendon lengthening, and posterior ankle arthroplasty which is intended to create a plamigrade foot that has the ability to dorsiflex beyond 90 degrees. This allows for use of functional electrical stimulation to treat the concurrent droop deformity by using a custom-fitted walk-aid device. Patients are able to ambulate independently postoperatively without need for AFO bracing or other accommodative devices.

Literature Review

Cerebral palsy is a common disability which causes activity limitation and interferes with normal development. It affects approximately 3/1,000 children and adults in the United States. Cerebral palsy is a chronic, non- progressive disorder. Over time, these patients frequently develop tightness, weakness, and muscle contractions. Equinus is the most common lower extremity deformity which occurs with cerebral palsy. It affects gait pattern, standing, and balance adversely. Historically, calf lengthening has been the most common surgical procedure to relieve equinus and improve gait. This has been performed through Achilles tendon lengthening, gastrosoleus complex lengthening, and percutaneous Achilles tenotomy, among other methods. Postoperatively, most patients still require bracing with an AFO secondary to their underlying droop deformity. AFO devices can be used to both improve function, and affect body structure by preventing or treating contractures. With the intent of functional electrical stimulation, improvement of gait in patients with cerebral palsy has been advancing. An evaluation of patients with spastic drop foot receiving FES showed a significant improvement in both walking time, and walking capacity. It has also been shown to improve gait quality, symmetry, muscle strength and motor control in children with cerebral palsy. Though there is emerging literature on the use of FES, there is little literature combining surgical posterior calf lengthening procedures with functional electrical stimulation at the level of the common peroneal nerve as it courses over the fibular neck as a treatment for severe equinus with a concurrent drop-foot deformity.

Case Study

Patients were treated by 1 primary provider from September 2013-November 2015 at St. Francis Hospital and Medical Center in Hartford, Connecticut. 5 patients presented to the primary provider’s office during that time frame with cerebral palsy and required use of an ankle-foot device for ambulation. They were deemed appropriate surgical candidates for an Achilles tendon lengthening, and posterior ankle arthroplasty. Preoperative imaging studies were obtained to ensure there was no anterior osseous block on all patients. All patients underwent general anesthesia with a peripheral block. A thigh tourniquet was utilized, and patients were placed prone on the operating table. A linear incision was made along the posterior aspect of the leg to allow access to the full length of the Achilles tendon, up to the gastrocnemius aponeurosis. A z-type lengthening was performed with arn's pointing proximo-lateral and disto-medial. Most patients gained 14-15 centimeters of length of the Achilles tendon following this lengthening. A posterior ankle arthroplasty was also performed in all of these patients to allow for additional posterior lengthening. The Achilles tendon was then re-approximated with absorbable sutures, and layered closure was performed with absorbable subcutaneous sutures and skin staples. This is demonstrated in Figures 2a-2c, and 4a-4b. All patients were placed into a posterior splint and made non-weight-bearing following the procedure. Staples were removed 2-3 weeks postoperatively. They were sent to physical therapy following staple removal for passive range of motion exercises. Patients were also sent to Hanetherapists labs to be fit with a functional electrical stimulation device 2 weeks postoperatively, and the device was set on a range of motion/weightbearing function only. At 4 weeks they were transitioned to full weight bearing with the external walk-aid on weight bearing function.

Analysis and Discussion

This case series details our approach to lengthen the posterior lower extremity in severe equinus related to cerebral palsy. Surgical principles and technique tips are presented. The main goal is to improve foot and ankle alignment and range of motion at the ankle so the walk-aid device can function maximally for the patient. The key to having a successful end point with a walk-aid device is sufficient ankle joint range of motion to allow for adequate stimulation of motion through the FES system to treat the underlying drop-foot deformity. This allows for discontinuation of ankle-foot orthoses, and most assistive devices. We have seen a significant improvement in gait patterns, and decreased equinus related pain and contracture following these procedures.

5 patients were followed for a minimum 1 year follow up period following their lower extremity surgeries at our facility. There were no postoperative wound healing complications or infections in any of these cases. At most recent follow up, all patients were able to ambulate without the use of AFO, and were not having complications with use of the Walk-Aide device. All patients reported that they would repeat the surgery again, and have reported increases in functional activities of daily living as well as exercise programs.

References


Figure 2: Patient A.
1a. Preoperative lateral ankle film.
1b. Postoperative lateral ankle film.
2a. Z-type lengthening.
2b. Post-Z-lengthening with 12cm posterior length gained.
2c. Postoperative equinus evaluation

Figure 3: Patient B.
3a. Preoperative lateral ankle film.
3b. Postoperative lateral ankle film.

Figure 4: Patient C.
4a. Post-Z-lengthening with 12cm posterior length gained.
4b. Postoperative equinus evaluation

Figure 5: Patient D.
5a. Standing, preoperatively
5b. Standing, postoperatively

Results

- Patients were treated by 1 primary provider from September 2013-November 2015 at St. Francis Hospital and Medical Center in Hartford, Connecticut.
- Five patients presented to the primary provider’s office during that time frame with cerebral palsy and required use of an ankle-foot device for ambulation.
- They were deemed appropriate surgical candidates for an Achilles tendon lengthening, and posterior ankle arthroplasty.
- Preoperative imaging studies were obtained to ensure there was no anterior osseous block on all patients.
- All patients underwent general anesthesia with a peripheral block.
- A thigh tourniquet was utilized, and patients were placed prone on the operating table.
- A linear incision was made along the posterior aspect of the leg to allow access to the full length of the Achilles tendon, up to the gastrocnemius aponeurosis.
- A Z-type lengthening was performed with arms pointing proximo-lateral and disto-medial.
- Most patients gained 14-15 centimeters of length of the Achilles tendon following this lengthening.
- A posterior ankle arthroplasty was also performed in all of these patients to allow for additional posterior lengthening.
- The Achilles tendon was then re-approximated with absorbable sutures, and layered closure was performed with absorbable subcutaneous sutures and skin staples.
- This is demonstrated in Figures 2a-2c, and 4a-4b.
- All patients were placed into a posterior splint and made non-weight-bearing following the procedure.
- Staples were removed 2-3 weeks postoperatively.
- They were sent to physical therapy following staple removal for passive range of motion exercises.
- Patients were also sent to Hanetherapists labs to be fit with a functional electrical stimulation device 2 weeks postoperatively, and the device was set on a range of motion/weightbearing function only.
- At 4 weeks they were transitioned to full weight bearing with the external walk-aid on weight bearing function.

Figure 1: Functional Electrical Stimulation Device
1a. Demonstrated on a patient
1b. FES Device

Contact Information

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