Management of sagittal plane deformity in flatfoot reconstructive surgery utilizing the Baumann gastroc-soleus lengthening procedure

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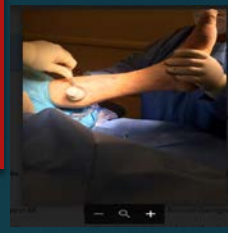


Statement of Purpose

The purpose of this study is to evaluate the outcome and satisfaction of patients who underwent surgical treatment for correction of a sagittal plane deformity in flat foot reconstruction utilizing a Baumann gastroc-soleus release or Achilles tendon lengthening procedures.

Introduction

Flat foot or hyper pronation deformities are some of the most complicated and complex foot and ankle deformities to treat surgically. The primary goal of the surgeon should be to restore the anatomy and alignment of the foot(1). One of the most common causes of pes planus deformity is equinus contracture of the foot and ankle. Equinus contracture of the foot and ankle eliminates the stabilizing and shock absorbing functions of the foot.

Some surgeons rarely address the equinus contracture when addressing flat foot deformity. Most of current literature, however, recognizes the significance of ankle joint equinus as one of the primary deforming forces in those with a symptomatic adult-acquired flatfoot.

Ankle joint equinus is defined as less than 10 degrees of dorsiflexion relative to the leg. Literature also shows that equinus contractures exist in approximately 96 percent of patients with biomechanically induced foot pain and pathologic equinus remains one of the most neglected, underdiagnosed and undertreated pedal conditions. Most of the early literature discussing surgical management of equinus, discussed treatment of spastic contractures in children as well as patients with cerebral palsy(1). The earliest procedures ever performed had high rates of recurrence, calcaneal gait, significant weakness and loss of function.

Anatomical and Biomechanical considerations

The triceps surae complex works to decelerate the forward motion of the tibia during the stance phase of gait as well as enhance plantarflexion and propulsion. The gastrocnemius is the largest, most superficial muscle in the posterior compartment. The origin of the muscle is on the proximal femur attached to the medial and lateral femoral condyles. It extends past the knee, ankle and subtalar joints inserting into the posterior calcaneus.

The soleus muscle is located in the posterior compartment and lies deep to the gastrocnemius. It originates from the proximal tibia and fibula.

The soleus and gastrocnemius have individual pathways with the soleus taking a path laterally to insert on the calcaneus(1). The gastrocnemius moves more in a medial direction before it inserts into the calcaneus medial aspect.

During normal gait function, the center of gravity of the body moves over the foot during the cycle, approaching the heel rise portion of the cycle, the tibia goes through external rotation while there is dorsiflexion of the ankle. Simultaneously, the subtalar joint, influenced by the pull of the posterior tibial tendon, begins to invert into a slight varus position. This leads to repositioning of the medial arch and locking of the midtarsal joint, thus creating a rigid lever for propulsion. This complex motion for propulsion can lead to failure in the face of gastroc equinus.[3] When the triceps surae is too tight, there is a failure in the stabilizing effect of the posterior tibial tendon. This failure of the posterior tibial tendon leads to faulting of the midtarsal joints and the medial column. In the presence of ankle joint equinus, compensation occurs and manifests itself in the form of low back strain, hip and knee pain, calf cramping. One can often achieve relief via surgical correction of the ankle joint equinus.

Limitation of ankle joint dorsiflexion usually manifests itself through abnormal pronation at the subtalar and midtarsal joints(2). Subtalar joint pronation leads to unlocking of the distal structures which causes increased dorsiflexion of the forefoot on the rear foot. When there is uncompensated equinus, there is minimal motion across the subtalar joint and midtarsal joint, and often no heel contact during gait.

The fully compensated equinus deformity in a patient leads to a plethora of deformities including hypermobile flatfoot with maximum eversion through the midtarsal and subtalar joints. A partially compensated foot leads to a pronated subtalar joint, minimal midtarsal joint motion, forefoot eversion and early heel off during the gait cycle(3).

Procedure

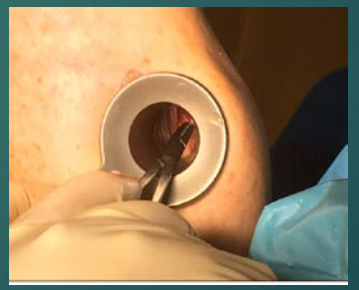
During the years of 2016-2018 a total of 20 patients were selected at our institution to undergo Baumann procedure for gastroc lengthening to help correct sagittal plane deformities during flatfoot reconstructive surgery procedures. Patients were selected based on psychosocial factors, comorbidities and soft tissue compromise. Preoperative radiographs were obtained from the office radiology department. Gastroc recession was performed with the use of a number 15 blade on a long handle along with an anal scope. A medial incision was made about 4 cm long at the junction of the upper and middle third of the lower leg. Blunt dissection between the soleus and gastrocnemius is performed with one's finger. We used an anal scope, which was placed between the gastrocnemius and soleus muscles once they were identified. If the plantaris tendon is visualized, it can be resected. Going as proximally as possible, about 3 parallel tran verse incisions are made. The ankle is then dorsiflexed until neutral positioning is achieved with the knee in full extension. The incision site is then, flushed and closed. A short leg cast is applied with the ankle joint put in 90 degree position.

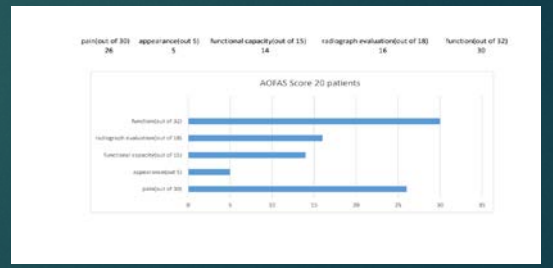
The patient is kept in a posterior splint for 2-3 weeks. Cast for another 3 weeks and CAM boot for another 3 weeks after that. Upon application of the CAM boot, the patients started physical therapy, with ankle range of motion. Patients were graduated to full weight bearing after 8 weeks on average. AOFAS scores were utilized to evaluate patient satisfaction.

Discussion

We treated 20 patients undergoing flatfoot reconstruction who needed sagittal correction due to gastroc equinus with the Baumann procedure. Although there was a limited sample size we have shown that the Baumann procedure provides an adequate alternative if not primary method for gastrocnemius lengthening when performing flatfoot foot reconstruction. Each patient had at least 11 months follow up. We used an AOFAS score questionnaire to determine patient satisfaction (figure 1)We believe that the patient satisfaction during the post-operative period was greater when the equinus contracture was addressed using the Baumann technique. The Baumann procedure offers key advantages to lower extremity sagittal plane correction. The Baumann procedure gives more attention to the thicker and relatively inelastic aponeurosis. If necessary the soleus complex can be lengthened as well. One should consider making multiple incisions in the soleus and gastrocnemius which will spread the tension of the muscle out and prevent the stress being concentrated to one area, preventing subsequent ruptures(1). The procedure has been shown to respect the growth plate of the muscle, allowing for correction of both muscles separately. Literature also shows that the muscle power of the triceps surae was not reduced in contrast with other surgical procedures. Literature review performed by us showed that there occurrence and of over lengthening and recurrence of equinus contracture after tendon Achilles lengthening was greater. There was no recurrence or overcorrection in our study.

In conclusion, because of our study, we recommend use of the Baumann procedure for fixed equinus contractures during flatfoot reconstructive procedures satisfaction.





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