MODIFIED STRAYER GASTROCNEMIUS RECESSION: A Technique Guide for the Supine Positioned Patient

M. Jay Groves, IV, DPM

Gastrosoleal equinus is a common deforming force on the foot and ankle. Pediatric flatfoot, tibialis posterior tendon dysfunction, and diabetic ulceration represent a few of the diverse conditions associated with tightness of the triceps surae. When conservative measures are clinically ineffective, surgical release of the posterior contracture is indicated. Several surgical procedures have been recommended to resolve nonspastic contracture of the gastrocnemius or gastrosoleal complex including both endoscopic and open gastrocnemius recession, as well as, both percutaneous and open Achilles tendon lengthening. The selection of Achilles tendon lengthening and gastrocnemius recession procedures is based upon the clinical evaluation. The focus of this article will be upon the gastrocnemius recession.

When surgically correcting gastrocnemius equinus, other foot stabilizing procedures are frequently indicated (e.g., Evans calcaneal osteotomy, medial calcaneal slide, medial arch stabilization, etc.). With few exceptions, performing and assessing reconstructive procedures is optimal with the patient in the supine position. However, the majority of gastrocnemius recession procedures call for prone positioning of the patient. A gastrocnemius recession carried out in the supine positioned patient would eliminate the challenges and risks of patient repositioning for multiple procedures. It is the purpose of this article to review the clinical rationale and technique guide for performing the modified Strayer gastrocnemius recession – an effective procedure while maintaining the patient in the supine position.

CLINICAL EVALUATION

Since there is no accepted standard for measuring ankle joint range of motion interobserver reliability is inconsistent. Not surprisingly, precise ankle joint measurement remains controversial. There are, however, several recommendations to enhance clinical evaluation of ankle motion and the diagnosis of equinus.

Established values for normal and restricted ankle joint dorsiflexion are broad; consequently, exact measurement is not required. Normal ankle joint dorsiflexion reaches 10 degrees with the knee extended (i.e., dorsiflexion of the foot at the ankle joint is 10 degrees proximal to neutral) and designates an absence of ankle equinus; generally, this is the consensus minimal amount of ankle dorsiflexion required for normal ambulation. Restricted ankle dorsiflexion reaches neutral or less (i.e., in the plantarflexed direction) and designates a presence of ankle equinus.

During the clinical examination ankle equinus can be sub classified into osseous, gastrosoleal, and gastrocnemius types. Osseous equinus is diagnosed using radiographic and/or clinical methods of examination. The differentiation of gastrosoleal from gastrocnemius equinus is carried out using the Silfverskiold test.

Adhering to sound, established clinical examination protocols (e.g., using the Silfverskiold method) improves interobserver reliability. The Silfverskiold test involves measuring ankle dorsiflexion while holding the subtalar joint in neutral or slight inversion. The neutral or inverted foot both mimics a locked midtarsal and subtalar joint during propulsion, and also eliminates abnormal dorsiflexory and compensatory motion at these joints during examination. Once the foot is properly positioned, the amount of ankle dorsiflexion is measured with the knee in extension and flexion. The Silfverskiold method further categorizes equinus as either gastrocnemius or gastrosoleal if this restricted ankle dorsiflexion occurs with the knee in either extension or flexion respectively. The concept is that knee flexion releases tension generated by the gastrocnemius' proximal femoral insertion on ankle dorsiflexion.

The clinical application of this examination method lies in selection of the surgical procedure. Specifically:

1. If ankle equinus is observed only with knee extension (indicating an isolated gastrocnemius equinus) then a gastrocnemius equinus is present. Isolated lengthening of the gastrocnemius (aponeurosis) is all that is required to resolve the contracture.

2. If ankle equinus is observed both with knee extension and flexion then a gastrosoleal or osseous equinus is present. Once the presence an osseous equinus is ruled out, the gastrosoleal equinus may be resolved by surgically lengthening the Achilles tendon.

THE GASTROCNEMIUS RECESSION: PROCEDURE SELECTION

Once the gastrocnemius recession is indicated, the surgeon may choose from several effective procedures. The ideal procedure would accomplish the following goals: 1) Effective elimination of the contracture, 2) Exposes the patient to minimal risks, and 3) Offers a good cosmetic result.

While a procedure may offer exceptional benefits in a specific area the same procedure may demonstrate significant risks in another (Tables 1, 2). It is this author's opinion that the modified Strayer gastrocnemius recession most effectively accomplishes these goals.

When sequencing multiple procedures the posterior release is performed first. This is recommended for the following reasons:

1. Release of ankle contracture decompresses and unlocks other sites of deformity, which improves intra-operative deformity assessment and effectiveness of repair,
2. Dorsiflexion forces required to separate and lengthen the aponeurosis may disrupt other sites of surgical repair if the posterior lengthening is done later in sequencing.

Consequently, at the start of cases involving multiple procedures the initial positioning of the patient is for the gastrocnemius recession.

MODIFIED STRAYER GASTROCNEMIUS RECESSION: PATIENT POSITIONING

Typically, the modified Strayer gastrocnemius recession is performed with the patient under general anesthesia and positioned supine. Once anesthetized ankle equinus is reassessed prior to carrying out the procedure. The surgical limb needs to be safely placed in external rotation. Following a sterile preparation and draping to the anterior tibial tubercle, the heel and Achilles region is rested upon a soft sterile roll to elevate the lower leg above the surgical table; this positioning creates a work space with access to the gastrocnemius aponeurosis.

SKIN INCISION: DETERMINING THE RIGHT LEVEL

A 4-7 centimeter transverse plane skin incision is made in the sagittal plane midsection of the aponeurosis. This midsection level is determined by first holding the foot dorsiflexed and palpating and skin marking the proximal extent of Kagar's triangle – this represents the aponeurosis' distal margin (Figure 1). Next, the gastrocnemius' medial head is palpated and marked at its distal extent — this represents the gastrocnemius aponeurosis' proximal margin. (Figure 2). Finally, the medial margin is palpated and marked (Figure 3). The distance between the aponeurosis' proximal and distal margins is measured, divided in half, and marked. This is the level of skin incision (Figure 4).

The medial portion of this transverse incision level needs to extend medial to the gastrocnemius aponeurosis' medial border. The lateral portion of the incision needs to provide access to the lateral aponeurosis border at the subcutaneous level. Counter-intuitively, the lateral portion of the skin incision does not need to overlie nor extend to the lateral aponeurosis border (Figure 5).

Table 1

RISKS/ COMPLICATIONS	ASSOCIATED GR PROCEDURE
Sural Nerve entrapment	-Endoscopic
Surgical field contamination	-Baker* -Inverted Baker*
Injury/fall risk	-Baker* -Inverted Baker*
Increased anesthesia time	-Baker* -Inverted Baker*
Scar (incision) hypertrophy	-Cephalic to Caudal incision placement -Baker -Inverted Baker

**Risks present when patient is rotated supine for additional procedures.*

Table 2

BENEFITS	ASSOCIATED GR PROCEDURE
Resolution of contracture	-Baker -Inverted Baker -Endoscopic -Strayer (modified)
Repositioning unnecessary	-Endoscopic -Strayer (modified)
Reduced anesthesia time	-Endoscopic -Strayer (modified)
Good cosmetic result	-Endoscopic -Strayer (modified)

Figure 1. The aponeurosis' distal margin begins at Kagar's triangle proximal margin.

Figure 2. The aponeurosis' proximal margin begins at the gastrocnemius' medial head distal margin.

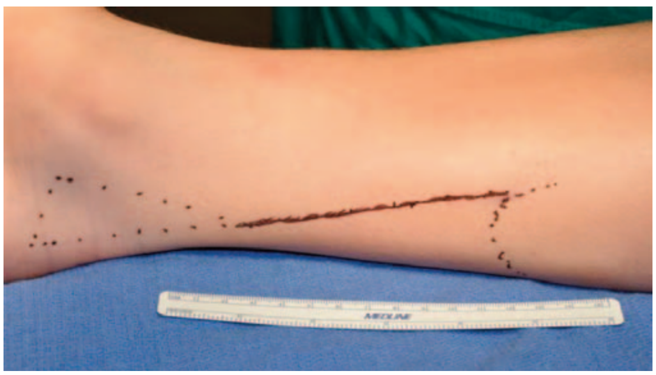

Figure 3. The medial margin of the aponeurosis is palpated and marked.

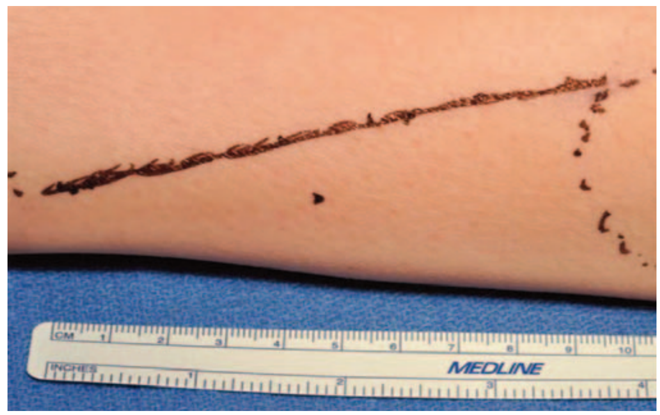

Figure 4.The distance between proximal and distal margins is measured, halved, and marked. This is the level of skin incision and subsequent gastrocnemius recession.

SUBCUTANEOUS DISSECTION

Anatomic dissection proceeds through the superficial fascia in the transverse plane from medial to lateral. Vigilance is maintained throughout this dissection level to avoid lacerating the sural nerve and small saphenous vein. It is the author's experience that these delicate neurovascular structures are encountered in 30-40% of modified Strayer GR procedures. When encountered, vessel loops are used to gently retract, protect, and visually alert the surgeon to their location.

The deep fascial plane level is identified by placing the ankle through its range of motion and visualizing movement of the underlying aponeurosis. A dissection interval is created at this level, and the subcutaneous tissues (including the neuro-vascular bundle) are carefully retracted. A 1-2 cm wide malleable retractor inserted from the lateral aspect is effective in protecting these tissues and creating space for incision of the deep fascia (Figure 6).

DEEP FASCIA INCISION AND GASTROCNEMIUS RECESSION

Dorsiflexing the ankle is important while incising both the deep fascia and paratenon, as well as, during subsequent sectioning of the aponeurosis. With the ankle at 0 degrees of dorsiflexion the deep fascia and paratenon are sharply incised both in line with the length of the original skin incision (Figure 7). The paratenon is elevated from the aponeurosis and the medial margin of the gastrocnemius aponeurosis (GA) is identified. The less visible lateral margin of the deep fascia and paratenon overlying the GA need not be incised. The incised edges of the paratenon are elevated from the GA. A dissection interval between the paratenon and aponeurosis is created with a Freer elevator which is advanced laterally thereby creating a dissection tunnel to the lateral border of the GA (Figure 8). This border is easily palpated, but not easily visualized with the patient in the supine position.

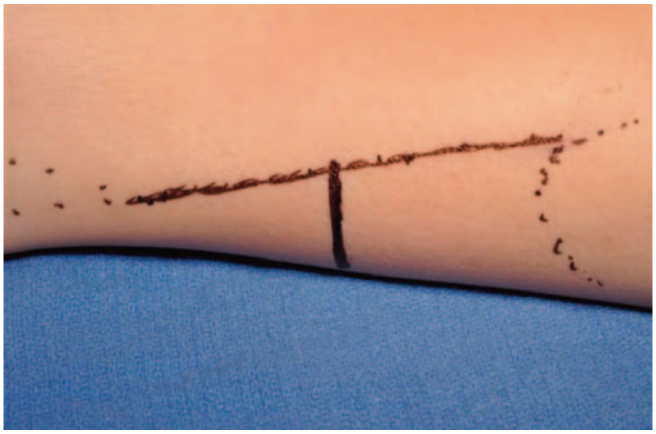

Figure 5.Transverse skin incision placement for the modified Strayer gastrocnemius recession.

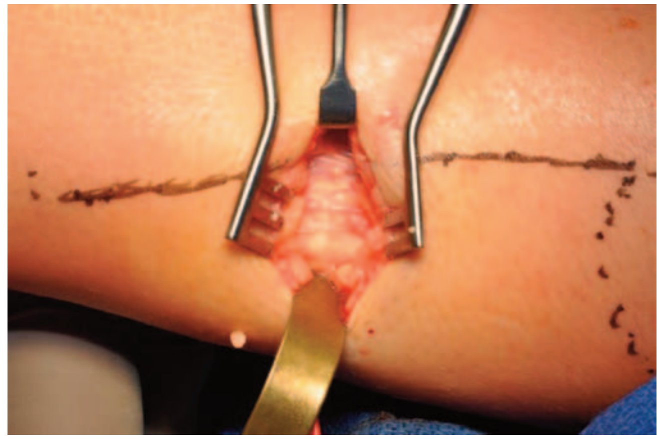

Figure 6.The superficial and deep fascia dissection interval. A malleable retractor is placed laterally between the superficial fascia and deep fascia.

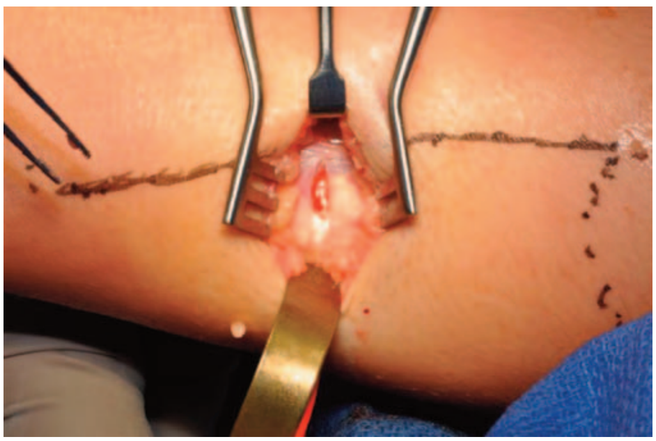

Figure 7. The deep fascia and paratenon incision.

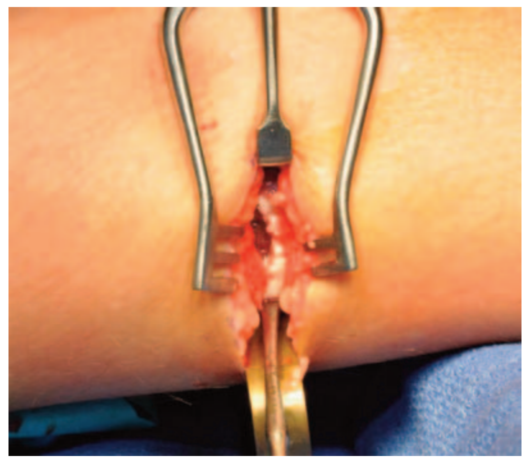

Figure 8. Initiation of the GR from the medial border of the GA. Note the Freer elevator is positioned between the GA and the paratenon; Posterior retraction of the paratenon creates an access plane for sectioning the aponeurosis' less visible lateral fibers.

The gastrocnemius recession is initiated from the medial border of the GA using a controlled depth incision and the tip of a #15 scalpel. As the aponeurosis and plantaris tendon are incised; care is taken to avoid both incision of the underlying muscle tissue and application of excessive dorsiflexion; using good surgical technique in these maneuvers minimizes the respective complications of post-operative hematoma and calcaneal gait.

As previously mentioned the lateral border of the GA is not easily visualized. This edge may be seen by applying medial and anterior tension to the partially sectioned aponeurosis using hand held forceps. When advancing the aponeurosis incision laterally a Freer elevator is used to lift and actively retract the paratenon posterior (Figure 8); this creates a safe zone for transecting the aponeurosis' less visible lateral fibers.

The most lateral fibers may be sectioned blindly provided soft tissues are protected and a controlled depth sectioning technique is used. To confirm complete release of the GA instrument or digital palpation may be used. Once sectioned, final aponeurosis lengthening is achieved while assessing ankle joint dorsiflexion. Up to 10 degrees of dorsiflexion is optimal.

Once lengthening is achieved, 3-0 absorbable single layer closure of the deep fascia and paratenon is recommended. Interrupted suturing of these tissues is effective and efficient. Subcutaneous and skin closure is performed as usual while caring for neurovascular structures. The patient is placed in a Jones dressing and posterior splint.

POSTOPERATIVE COURSE

Frequently, postoperative course is determined by healing at other procedure sites. However, if an isolated gastrocnemius recession is performed the patient is kept nonweight bearing for 1 week, and converted to a walking cast or removable cast boot with a heel lift. The patient is progressed from partial weight bearing to full weight bearing as tolerated.

Physical therapy beginning at 3-4 weeks postoperative is strongly recommended to expedite recovery of lower extremity strength and normalization of gait. The patient may be placed in supportive shoes at 4-6 weeks postoperative with a gradual return to normal activities.

CONCLUSION

The modified Strayer gastrocnemius recession is effective in reducing non-spastic gastrocnemius equinus; offers intra-operative efficiency by eliminating patient repositioning, and creates a safer operative experience for the patient. While detailed meta-analysis is not possible within the scope of this paper, close attention to the risk-benefit analysis suggests that this is a preferred procedure for gastrocnemius lengthening.

BIBLIOGRAPHY

Downey MS: Ankle equinus. In Banks AS, Downey MS, Martin DE, Miller SJ: McGlamry's comprehensive textbook of foot and ankle surgery. Third edition. Philadelphia: Lippincott Williams and Wilkins; 2001.

Silfverskiold N: Reduction of the uncrossed two-joint muscles of the leg to one-joint muscles in spastic conditions. Acta Chir Scand 1924;56:315-30.

Strayer LM Jr.: Recession of the gastrocnemius: an operation to relieve spastic contracture of the calf muscles. J Bone Joint Surg Am 1950;32:671-6.