

Procedure Selection Criteria for Ankle Equinus Based on Associated Medical Conditions, Adjunctive Procedures, Patient Positioning, and Risk Profile

Troy J. Boffeli, DPM, FACFAS, Samantha A. Luer, DPM
Regions Hospital / HealthPartners Institute for Education and Research - Saint Paul, MN



STATEMENT OF PURPOSE

Beyond the Silfverskiold test, ankle equinus procedure selection is frequently based more on surgeon familiarity with a few favorite techniques rather than objective findings. This case study highlights our procedure selection protocol which is based on multiple factors including associated medical conditions, adjunctive procedures, patient positioning, and procedure risk profile.

LITERATURE REVIEW

Ankle equinus is associated with a wide variety of foot and ankle conditions and surgical treatment is commonly performed as an adjunctive procedure. The Silfverskiold test has historically been used to differentiate between gastrocnemius equinus and combined gastrocnemius-soleus equinus (1). A positive Silfverskiold sign is defined as ankle equinus that is present when the knee is extended but that disappears when the knee is flexed which indicates gastrocnemius equinus (1). Combined gastrocnemius-soleus equinus does not improve with flexion of the knee (1). DiGiovanni defined gastrocnemius equinus as <5° dorsiflexion with the knee extended and gastrocnemius-soleus equinus as <10° dorsiflexion with the knee flexed(2). Clear definitions allow consistent diagnosis while surgical procedure selection guidelines are less defined.

The adjunctive nature of equinus surgery has implications regarding patient positioning and postoperative ambulatory status. Initially the surgeon must decide between tendo-Achilles lengthening (TAL) versus gastrocnemius recession (GR) (3). The TAL approach can be performed with an open “Z” lengthening, minimally invasive triple hemi-section approach, or percutaneous complete tenotomy. Within the GR group there are generally 5 choices (Proximal GR/Silfverskiold, intramuscular GR/Baumann, Distal GR/Strayer, Endoscopic GR, and tongue and groove GR/Baker). **Figure 1** illustrates typical patient positioning, incision and exposure for the various procedures. Procedure selection beyond TAL vs. GR would ideally be based on established patient centered guidelines yet these criteria are not well defined. We believe that there is an opportunity to approach procedure selection based on factors specific to the individual patient and planned adjunctive procedures.

CASE STUDY

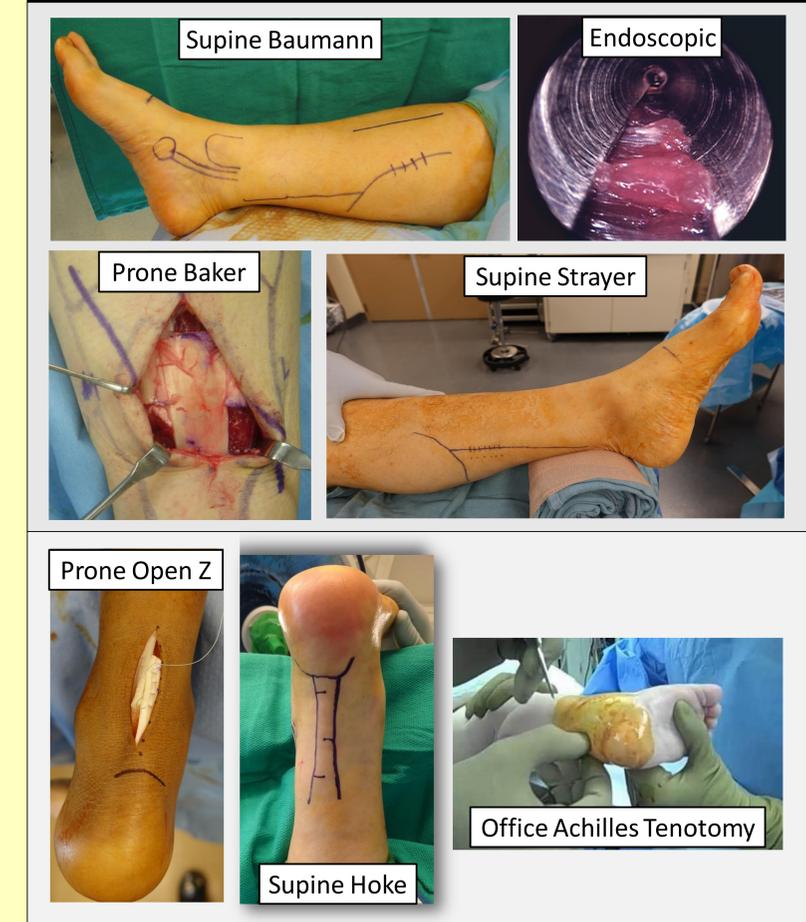
61 yo diabetic male with a past medical history of hypertension, atrial fibrillation on Eliquis, and OSA who presented with right posterior tibial tendon dysfunction, pathologic pronation, and equinus contracture. He had significant pain with walking moderate distances and with attempted daily exercise.

Objective:
-Reduced ankle joint range of motion (0° DF (knee extended/knee flexed) and 15° PF)
-Severe right heel valgus in resting and neutral stance position
-Palpable pedal pulses, no lower extremity edema, good skin quality

Radiographs: pes planus deformity, subtalar and midfoot degenerative joint disease with first metatarsal cuneiform fault

Laboratory Work-up: Vitamin D 71.2

Figure 1. Procedure Selection: Gastrocnemius Recession (top) and TAL (bottom)



Clinical Decision Making Process

- Decision to perform a subtalar joint fusion because the patient was a middle aged, overweight, non-athletic male with PTTD
- Midfoot fusion procedure performed secondary to pes planus deformity without naviculocuneiform fault and midfoot degenerative joint disease.
- Equinus procedure selection was focused on the patient's medical history, adjunctive flatfoot procedures, supine position, anticipation of non-weight bearing for 6 weeks, and desire to avoid over lengthening.

Based on procedure selection criteria in **Table 1**, a Strayer (distal gastrocnemius recession) was performed. See **Figure 2** for case study example intraoperative images and radiographs.

Table 1. Ankle Equinus Procedure Selection Considerations

Criteria	IM Gastroc (Baumann)	Endoscopic Gastroc	Distal Gastroc (Strayer)	Open Tongue & Groove (Baker)	Open Z TAL	Percutaneous TAL (Hoke)
Position	Supine	Supine	Supine	Prone	Either	Supine
Incision & Scar	High on medial calf, less visible scar	Minimally invasive with smallest scar	Medial with risk of skin puckering	Posterior midline calf with most visible scar	Posterior midline distal Achilles with potential healing concerns	3 small incisions with best healing potential in compromised skin
Zone	True isolated gastroc	Gastroc	Gastroc or Gastro-soleal	Gastroc or Gastro-soleal	True Achilles	True Achilles
WB Status	WB helps maintain stretch	WB with below knee boot	WB with below knee boot	WB with below knee boot	NWB unless spastic equinus	NWB unless spastic equinus
PROS	-Hidden scar -Conservative lengthening -Preserves muscle mass	-Small incision -Good visualization for complete release	-Quick procedure -Supine when performing adjunctive procedures	-Suture at desired length to avoid retraction or overlengthening	-Sutures at desired length to avoid retraction or overlengthening	-Best healing potential -Quick office procedure with neuropathy
CONS	-Wide tendon -Muscle bleeding -Least aggressive -need proper incision location	-Time to setup -Added cost -Special training -Nerve risk -Equipment dependent	-Visibility on lateral side is challenging -Need to maintain stretch if NWB to avoid recurrence	-Added time and hassle of prone position -Visible scar -Sural nerve risk	-Potential for over lengthening -Potential skin healing issues	-Blind procedure -Risk of over lengthening
Typical Patient Selection	Positive Silfverskiold in younger and athletic patients with mild equinus	Patient who desires cosmetic scar	Patient undergoing multiple supine procedures (Flatfoot reconstruction)	Isolated equinus procedure or multiple prone procedures	Neuromuscular disease (CVA, CP, TBI), Charcot foot	Charcot, neuromuscular disease, Edema or poor skin quality, expectation of postop AFO use

Multiple procedure selection considerations are presented here highlighting the decision making process within the TAL and GR categories. The authors would like to acknowledge that there is always more than one appropriate procedure for a given patient and that this approach is intended to raise awareness of factors that are worthy of consideration when performing ankle equinus surgery.

Postoperative Protocol: 6 weeks non-weight bearing in a fracture boot followed by 4 weeks of progressive weight bearing in a fracture boot
-Night splint recommended overnight if removing fracture boot to sleep

Follow-up Timeframe: 24 months

Complications: None throughout entire follow-up period

ANALYSIS & DISCUSSION

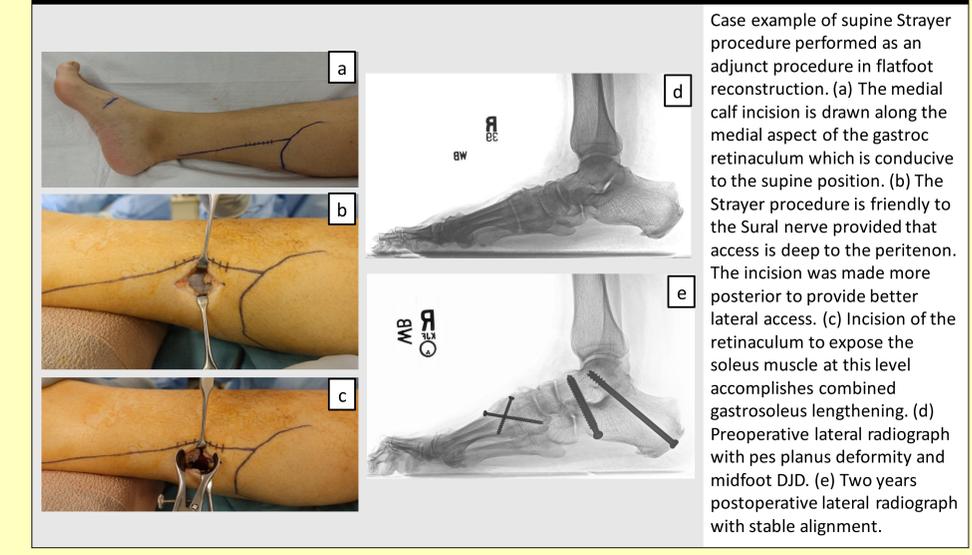
The Strayer procedure is the workhorse of equinus surgery since it is highly conducive to supine surgery, provides adequate lengthening, and is relatively friendly to the sural nerve provided the surgical exposure is deep to the peritenon level (6). It is possible to perform gastrocnemius only Strayer lengthening but only if exposure is above the conjoined tendon just below the gastrocnemius muscle belly (6). Immediate weight bearing in a below knee fracture boot is generally tolerated and often desirable depending on adjunctive procedures. Ideal candidates for Strayer GR include patients who are having multiple procedures that require supine positioning, such as flatfoot reconstruction or total ankle replacement (6, 7). An advantage of distal GR over TAL in conjunction with a total ankle replacement is that the Strayer procedure allows for early weight bearing once the anterior ankle incision is healed (7).

Procedure selection among the various approaches to address ankle equinus can be viewed as either an opportunity or a challenge. While all approaches work, guidelines are lacking to assist the surgeon with ideal procedure selection based on an individual patient's operative needs. The majority of the literature involving equinus procedure selection is level three or four evidence (13). This case study highlights the multitude of factors that contribute to ideal procedure selection including positioning for adjunctive procedures (supine or prone), site of incision which has implications regarding scar visibility, post-operative weight bearing status, risk of injury to the sural nerve or over-lengthening, and degree of lengthening desired. Our approach is to incorporate these factors along with patient specific indications for optimal procedure selection.

REFERENCES

1. Barouk P, Barouk L. Clinical diagnosis of gastrocnemius tightness. Foot Ankle Clin. 2014 Dec;19(9):659-667.
2. DiGiovanni CW, Kuo R, Tejwani N, Price R, Hansen S, Cziernecki J, Sangeorzan BJ. Isolated Gastrocnemius Tightness. J Bone Joint Surg Am. 2002 June;84A(6):962-970.
3. Deheer, PA. Equinus and Lengthening Techniques. Clin Podiatr Med Surg. 2017 Apr;34(2):207-227.
4. Baumann JU, Koch HG. Ventrals aponeurotische verlängerung des musculus gastrocnemius. Oper Orthop Traumatol. 1989;1:254-258.
5. Rong K, Ge W, Li X, Xu X. Mid-term Results of Intramuscular Lengthening of Gastrocnemius and/or Soleus to Correct Equinus Deformity in Flatfoot. Foot Ankle Int. 2015 Oct;36(10):1223-8.
6. Pinney SJ, Sangeorzan BJ, Hansen ST. Surgical Anatomy of the Gastrocnemius Recession (Strayer Procedure). Foot Ankle Int. 2004 Apr;25(4):247-50.
7. Roukis TS, Simonson DC. Management of Osseous and Soft-Tissue Ankle Equinus During Total Ankle Replacement. Clin Podiatr Med Surg. 2015 Oct;32(4):543-550.
8. Harris RC 3rd, Strannigan KL, Piraino J. Comparison of the Complication Incidence in Open Versus Endoscopic Gastrocnemius Recession: A Retrospective Medical Record Review. J Foot Ankle Surg. 2018 March;57:747-752.
9. Hoke M. An operation for the correction of extremely relaxed flat feet. J Bone Joint Surg Am 1939;13:773-83.
10. Lee WC, Ko HS. Achilles tendon lengthening by triple hemisection in adult. Foot Ankle Int 2005;26(12):1017-20.
11. Boffeli TJ, Collier RC. Minimally Invasive Soft Tissue Release of Foot and Ankle Contracture Secondary to Stroke. J Foot Ankle Surg. 2014 May;53(3):369-375.
12. Greenhagen RM, Johnson AR, Bevilacqua NJ. Gastrocnemius Recession or Tendo-Achilles Lengthening for Equinus Deformity in the Diabetic Foot? Clin Podiatr Med Surg. 2012 Jul;29(3):413-24.
13. Cychosz CC, Phisitkul P, Belatti DA, Glazebrook MA, DiGiovanni CW. Gastrocnemius recession for foot and ankle conditions in adults: Evidence-based recommendations. Foot Ankle Surg. 2015 Jun;21(2):77-85.

Figure 2. Case Study Involving Supine Strayer



Case example of supine Strayer procedure performed as an adjunct procedure in flatfoot reconstruction. (a) The medial calf incision is drawn along the medial aspect of the gastroc retinaculum which is conducive to the supine position. (b) The Strayer procedure is friendly to the Sural nerve provided that access is deep to the peritenon. The incision was made more posterior to provide better lateral access. (c) Incision of the retinaculum to expose the soleus muscle at this level accomplishes combined gastrosoleus lengthening. (d) Preoperative lateral radiograph with pes planus deformity and midfoot DJD. (e) Two years postoperative lateral radiograph with stable alignment.