31 Supple Equinus, Equinovarus, and Drop Foot Surgical Strategies

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Abbreviations

EDL	Extensor digitorum longus
EHL	Extensor hallucis longus
GR	Gastrocnemius recession
GSR	Gastrocsoleus recession
PT	Posterior tibial
TA	Tibialis anterior
TAL	Tendo-Achilles lengthening

31.1 Introduction

Lengthening procedures for the leg's superficial posterior compartment musculature have gained in popularity over the past two decades, not only due to evidence indicating highly prevalent equinus contracture in neurologically normal patients with foot and ankle pathology, but also because release of these contractures is safe and associated with excellent clinical results [1, 3–5]. This text serves, first and foremost, as a surgical technique guide; therefore, in the paragraphs below, we will focus primarily on the clinical and technical aspects of these valuable procedures rather than on the scientific literature.

Flexible drop foot and equinovarus deformities, although relatively rare, are quite rewarding to treat. We have had great success utilizing tendon releases and transfers for these patients over the years. Unlike equinus, equinovarus and drop foot require both sagittal and coronal plane tendon balancing; therefore, these multistep and complex procedures can seem intimidating. The chapter will provide technical surgical pearls and complete preoperative clinical work-up for these unique and challenging patients.

31.2 Clinical Cases

31.2.1 Equinus

Our patient is a 50-year-old female who presents with chronic worsening pain to her heel over the last 6 months. She complains of painful calluses under her hallux and fifth metatarsophalangeal joint. She has tried calf-stretching exercises provided by a physical therapist friend of hers and has consistently taken anti-inflammatory medications, yet no pain relief has been noted. The pain

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causes her to limp most days and has forced her to decrease her weight-bearing activities. She is frustrated and looking for relief.

31.2.2 Drop Foot

Our patient is a 62-year-old male who presents with complete loss of left lower extremity common peroneal nerve function secondary to knee trauma 14 months prior. He has chronic foot and ankle instability despite absolute compliance with a well-made ankle foot orthosis (AFO) and extensive physical therapy. He has consistent gait instability, decreased cadence, and nearly absent active dorsiflexion. Regular physical therapy has failed to improve active ankle dorsiflexion. Serial neurological testing has revealed consistent absent function of the peroneals and tibialis anterior muscles. Functional capacity of the posterior tibialis remains intact.

31.3 Patient Presentation

31.3.1 Equinus

History Patients are rarely aware of their gastrocnemius and/or soleus tightness. They will often report any combination of heel pain, Achilles midsubstance or insertional pain, arch pain, forefoot overload pain, plantar callus formation, and even the presence of persistent diabetic ulcers. Oftentimes patients have tried various types of padding or changes to in shoe gear with no relief.

Physical Exam The key to making the diagnosis is to look for it. Always perform a Silfverskiold maneuver during your passive ankle range-of-motion exam, and if less than 10° of dorsiflexion is noted, you have a positive result. We elaborate on our technique and how to interpret the exam results in the Sect. 31.4.3 below.

31.3.2 Equinovarus

History Patients typically present with complaints of pain to the involved heel, metatarsal heads, and lateral column with a noted history of a "turned in" foot and ankle. The "ankle gives out with ambulation" is a common presenting complaint. A history of persistent callosities or even ulcerations of the foot and toes may be noted. Patients often relate being told that they have high arches and that immediate family members share this trait. Many patients may present with a diagnosis of idiopathic distal symmetrical polyneuropathy. Most patients will have undergone a frustratingly ineffective combination of NSAIDs, bracing, and physical therapy prior to surgical consultation (Fig. 31.1).

Physical Exam Findings A pes cavus deformity with associated lateral column overload, a

Fig. 31.1 Preoperative image of a patient with an equinovarus deformity

plantarflexed medial column, a painful fifth metatarsal base, and first and fifth metatarsal head callosities are all often present. Severe cases can see callosities progress to ulcers, especially over the hallux. Overpowered, absent, or weak ankle everters result in predictable hindfoot varus, which, for the purposes of this chapter, but not so in every case, is flexible. Genu recurvatum is sometimes noted and serves to compensate for the equinus mediated functional leg length inequality. Anterior leg compartment muscle weakness with inadequate dorsiflexion during gait will produce falls, stress reactions, and even metatarsal fractures. Neuropathy, whether hereditary or idiopathic, is often present. Manual neurological testing including a Semmes Weinstein monofilament exam, vibratory sensation testing, and deep Achilles tendon reflex should be performed. Claw hallux, claw toe, and hammertoe deformities are common and are due to extensor digitorum longus (EDL) and extensor hallucis longus (EHL) tendon compensatory overactivity during attempted dorsiflexion.

31.3.3 Drop Foot

History Patients often present with persistent "foot slapping" and clumsiness when barefoot or when wearing unsupportive footwear. A history of increasingly frequent ankle sprains may be a complaint. The feeling of walking on the lateral foot is frequently reported with complaints of painful lateral foot callosities that limit activity tolerance. Interestingly, some drop foot patients will present late and show an incredible array of gait compensation strategies and bracing techniques. Some patients may present after an isolated ankle sprain or "stumble" with a chronic tibialis anterior (TA) rupture. If these patients present late, the reconstruction options of this chapter may be required to restore plantigrade posture. Primary tibialis anterior reconstruction procedures are reviewed in Chap. 15.

Physical Exam Findings Poor or absent active ankle dorsiflexion is always observed. EHL and EDL function will be preserved in cases of both acute and chronic TA rupture and results in weak dorsiflexion with lack of inversion power. In neuropathic cases, posterior tibialis overactivity produces hindfoot inversion and inability to evert on stance. As seen with equinovarus cases, EDL and EHL compensatory dorsiflexion overactivity often produces hammertoe, claw hallux, and claw toes deformities. Awkward and fatiguing steppage gait will be observed in the unbraced patient.

31.3.4 Imaging and Diagnostic Studies

X-ray: Equinovarus, Equinus, Drop Foot – Standard weight-bearing ankle and foot radiographs are required to assess alignment and to rule out fractures and degenerative changes. Determining the specific deformity contributions of the ankle and all foot regions must be rigorously considered. In addition, we routinely obtain weight-bearing bilateral hindfoot alignment views to assess tibiotalocalcaneal alignment. This view is easy to perform in the office and does not require any special positioning equipment or film cassette holders like those needed for a traditional Saltzman view (Fig. 31.2).

MRI: Equinovarus and Drop Foot – We typically obtain preoperative hindfoot MRI to confirm adequacy of tendons (i.e., severe degeneration or rupture) to be transferred and rule out degenerative joint disease that might require treatment and therefore alter our surgical plan.

Others: Drop Foot – Nerve conduction and/or electromyographic studies may be warranted to determine the level of nerve function and the presence of unilateral or bilateral neuropathy. Serial examination is utilized to confirm that no chance for nerve recovery remains in affected muscles. Individual muscle testing establishes that adequate power exists in tendon units to be transferred. Botox injections into deformity producing spastic muscles can facilitate bracing, improve ambulation, decrease pain, and prevent ulceration, albeit temporarily.

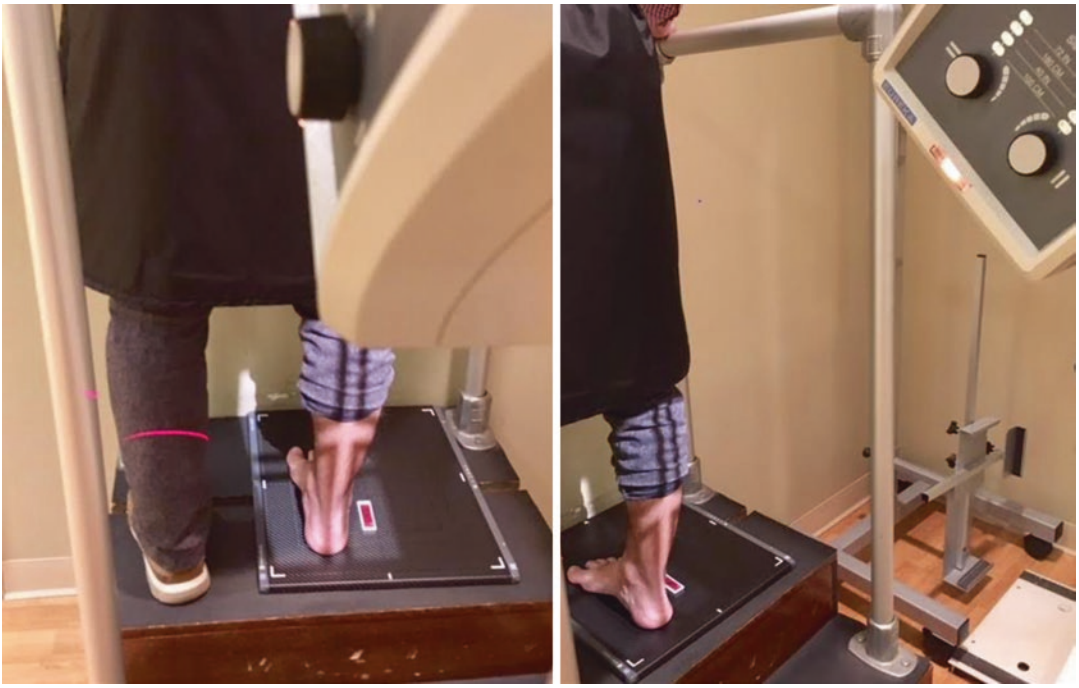

Fig. 31.2 Example of patient positioning for a hindfoot alignment view

31.4 Surgical Treatment

31.4.1 Supple Equinus, Equinovarus, and Drop Foot

Patient Selection: Once a patient has confirmed equinus contracture and then fails an exhaustive course of nonsurgical treatment, the appropriate lengthening procedure is indicated. The majority of our gastrocnemius release cases are done to treat recalcitrant plantar fasciitis, non-insertional Achilles tendinopathy, and forefoot overload syndrome. Gastrocsoleus releases are more commonly used to treat contractures due to rearfoot arthritis, flatfoot deformities, and neurologic mediated equinus, to name a few. Clinical indications for surgical correction of equinovarus and drop foot include a painful, deformed, physically limiting extremity that has failed medication, therapy, bracing, and all other nonsurgical treatment attempts. Establishing realistic postoperative pain and functional expectations is a critical part of operative planning and the patient selection process. Unrealistic expectations, especially within the patient, can almost guarantee a poor outcome and patient dissatisfaction. Eligible patients are not only capable of complying with up to 12 weeks of weight-bearing restrictions and many more months of protective bracing but willing to endure such hardship. Every effort must be exercised to minimize surgical risk; therefore, tobacco use must be discontinued prior to any elective surgery, and preoperative nicotine/cotinine testing is routinely obtained to confirm compliance in at-risk patients.

Preoperative Planning: A complete imaging work-up including plain foot and ankle films, hindfoot alignment images, hip-knee-ankle lower extremity alignment films, and MRI are used to determine the apex of the deformity. Flexible deformities addressed in this chapter are approached using joint-sparing strategies, whereas rigid deformities require the addition of osteotomies and/or arthrodesis covered in Chap. 28 with cavus reconstruction procedures. The degree and level of equinus must both be determined. If additional procedures are planned to address hindfoot varus, plan to have them completed prior to final tendon balancing. Prior to surgery, coordination with primary care physicians, internists, endocrinologists, and neurologists is done to facilitate not only tight sugar control strategies in diabetic patients but to optimize the patient for surgery. In order to minimize diabetes-related surgical complications, a preoperative hemoglobin A1c level less than 8% is necessary. Additionally, screening for complication prone patients includes nutritional labs (albumin, prealbumin, vitamin C, vitamin D) and vascular studies.

31.4.2 Operating Room Setup

Positioning: The vast majority of these cases are completed with the patient in the supine position. Some exceptions to this rule include:

- Hindfoot osteotomies are done in the lateral position at the beginning of the case. Once completed, we deflate the beanbag and transfer the patient to a supine position while avoiding the need for redraping.
- Proximal Achilles lengthening procedures, when combined with distal Achilles procedures, are done in the prone position.

The supine position allows for adequate access necessary to complete both proximal and distal posterior lengthening procedures while also affording excellent access to the multitude of incisions necessary for anterior tendon transfers. The leg can be held by an assistant for posterior group procedures if necessary. The tibial tubercle must be prepped into the surgical field for intraoperative leg rotation and alignment assessment.

31.4.3 Approach Overview

Determining which posterior lengthening procedure is ideally suited to treat each patient requires multiple careful and deliberate clinical assessments of the gastrocnemius, soleus, and ankle joint to quantify each muscle's contribution to the plantarflexion contracture. The Silfverskiold maneuver is our preferred exam technique, and it is important to take care to supinate the subtalar joint during the passive dorsiflexion assessment to avoid false-negative results [9, 10]. Most commonly, isolated gastrocnemius contracture is noted thus indicating open proximal gastrocnemius recession procedure. When both the gastrocnemius and soleus are contracted, any of the following procedures are preferred: an endoscopic gastrocsoleus recession, an open proximal gastrocsoleus recession, or a percutaneous tendo-Achilles lengthening. We recognize that numerous well-described additional posterior lengthening techniques exist; however, as of this writing, if they are not a standard part of our treatment algorithm, they will not be discussed further in this chapter. Complex multi-procedure cases that include a posterior lengthening, as in the case of a Bridle transfer, usually have the posterior lengthening procedure completed first. A documented and practiced operative plan must be completed before entering the operating room with such cases. There are few surgeries that can challenge the number of incisions, number of surgical steps, and number of intraoperative adjustments required by a Bridle transfer case. To minimize the risk of intraoperative struggles and to maximize surgical decision-making efficiency during these complex and relatively rare procedures, we recommend writing down and practicing your operative plan multiple times.

31.5 Posterior Lengthening Procedures

31.5.1 Percutaneous Tendo-Achilles Lengthening (TAL)

The patient is typically supine, and the ankle is tensioned into maximal dorsiflexion by an assistant. Three small stab incisions, starting distally and moving proximally, are utilized. Incisions must be separated by at least 3 cm in order to avoid inadvertent tenotomy. Insert a No. 15 blade through the center of the tendon at each incision level. Turn the blade either laterally or medially once it is completely through the skin and the tendon. The thumb of the opposite hand is used to gently press the tendon onto the blade and a palpable, and sometimes audible, popping is noted as the tendon fibers are sectioned. The incision sequence is typically medial distally, lateral centrally, and medial again proximally. This sequence best avoids sural nerve injury. Once all incisions are complete, gentle progressively increasing passive dorsiflexion is applied until a release is confirmed. A skin stapler is used to close the three stab incisions.

31.5.2 Open Gastrocsoleus Recession (GSR)

A vertical posteromedial 3–4 cm incision is made at the junction of the middle and distal thirds of the leg. At this level, the gastrocnemius tendon has fused with the soleus tendon. Once through skin and subdermal fat, finger palpation is used to divide fat adherent to the crural fascia. Army-Navy retractors are placed to identify the fascia and a vertical fascial incision is made in line with the skin incision. The long arms of the retractors are advanced deep to the fascia and the gastrocsoleus combined tendon is easily visualized. We prefer to confirm we are 3–4 cm distal to the gastrocnemius muscle belly by passively plantarflexing and dorsiflexing the ankle and visualizing the muscle. The sural nerve should be protected by the retractor at this point, but the sural nerve can be deep to the fascia in some cases and must always be anticipated and carefully avoided during tendon sectioning [7]. Starting medially and heading proximal and lateral, and while maintaining the ankle in moderate passive dorsiflexion, divide the tendon under direct visualization while always aware of the sural nerve. Once the medial 50–75% is sectioned, a release will be felt. Be sure to complete the release laterally despite the perceived release. Irrigate the wound with saline and close in layers being sure to close the deep fascia to prevent a potentially painful muscular herniation.

31.5.3 Endoscopic Gastrocsoleus Recession (Endo-GSR)

This procedure is discouraged in patients with a high BMI as the incision needed to adequately identify the proper surgical plane becomes so large that an open procedure can be performed, thus eliminating the main benefit of the endoscopic technique. Also, the instrumentation is sometimes too short to properly execute the release and either a second incision becomes necessary or the endoscopic technique is abandoned in favor of an open approach. The position is supine, and the incision in many ways mirrors that of the open GSR, vertical posteromedial, and at the junction of the middle and distal thirds of the leg. The incision is different in that it is smaller, only 1 cm in length, and it must be slightly medial to the tendo Achilles medial margin. Sharply dissect through the subdermal fat to identify the superficial fascia with the assistance of Ragnell retractors. Vertically incise the fascia and place the endoscopic spatula deep to the fascia but superficial to the tendon. Sweep the spatula proximal, distal, and lateral while manually palpating it under the skin to confirm its superficial location. Slide the endoscope down the spatula and into the same tissue plane, and ensure the sural nerve is not within the path of the endoscope. Visualize the white shining tendon through the scope slot and confirm its identity by passively plantarflexing the ankle and observing tendon motion. Deploy the surgical blade at the lateral tendon margin, and drag it medially while observing tendon division. The foot should be against the scope operators abdomen and maintained in dorsiflexed tension during tendon division. A release is easily felt once complete. We tend not to divide the deep central raphe so as to avoid over lengthening and subsequent weakness postoperatively. Irrigate the wound, and close with skin suture or staples.

31.6 Gastrocnemius Recession, Strayer Procedure

The goal of this procedure is to isolate and release the gastrocnemius. The level of the incision is critical as it must be at the distal margin of the gastrocnemius muscle belly. In most patients, this point is midway between the fibular head and lateral malleolus [12]. Pinney and colleagues recommended starting 2 cm distal to the gastrocnemius muscular prominence and extending 3 cm proximal [7]. We prefer a vertical 3–4 cm incision made posteromedial central to improve safe visualization of the lateral portion of the release.

Subdermal tissue is carefully dissected to avoid sural nerve injury. Once the superficial fascia is identified, it is sharply divided in line with the skin incision. Army-Navy retractors are placed deep to the fascia, and the distal gastrocnemius muscle belly is visually identified. After 44 completed gastrocnemius recessions, Pinney and colleagues observed the sural nerve to lie superficial to the deep fascia only 43% of the time. The nerve was deep to the fascia in the remaining 57% of cases and actually adherent to the tendon surface in 13% [7]. Given this variable anatomy, every surgeon should anticipate the sural nerve deep to the fascia and confirm that it is not adherent to the tendon prior to performing the release. A finger is passed medially and hooked over the medial gastrocnemius. The finger is drawn inferiorly to identify the fusion point of the gastrocnemius tendon to that of the soleus. Once the interval has been established, a malleable retractor can be placed into the interval. The gastrocnemius tendon is then divided from medial to lateral, just distal to the muscle, while the malleable retractor protects the deeper soleus tendon and an angled retractor protects the sural nerve and fascia (Fig. 31.3). The release will extend more proximally as the division heads laterally. Once a release is noted, the wound is irrigated and closed in layers. Care is taken to avoid painful muscular herniation by reapproximation of the superficial fascia prior to skin closure.

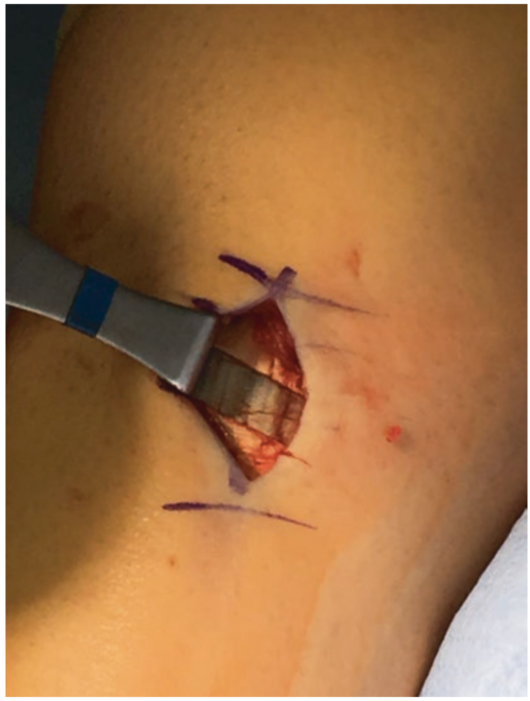

Fig. 31.3 Open strayer procedure, as described above; note the isolated sectioning of the medial gastrocnemius tendon, proximal to the convergence of the gastro-soleus complex

31.6.1 Bridle Procedure, Posterior Tibial Tendon Transfer

In an effort to save valuable tourniquet time, all incisions should be marked (Fig. 31.4a, b), and the exact location of the palpable dorsalis pedis artery should be marked prior to tourniquet inflation.

- *Step 1*: Given that both the gastrocnemius and soleus are typically contracted in these cases, either an open or endoscopic GSR is performed first. Both procedures are described earlier in this chapter.
- *Step 2*: A short 3 cm, longitudinal incision paralleling the posterior tibialis insertion is made. Cheat the incision slightly more distal as you will want to acquire as much tendon harvest length as possible. Expect numerous crossing veins and cauterize until you encounter the tendon sheath. Incise the distal sheath and expose the tendon. I hook the tendon with a Ragnell and retract medially to confirm tendon excursion and to aid in identifying the distal release margins. Meticulous subperiosteal tendon detachment distally will often add up to 10 mm of additional length (Fig. 31.5a). Whip stitch the tendon stump with an 0 caliber suture of your choice.
- *Step 3*: A vertical 4 cm incision paralleling the posterior tibial margin, extending proximally, and starting at the junction of the middle and distal leg thirds is made. Isolation of the posterior tibial tendon is facilitated by gentle alternating pressure on the distal stump. Pull the tendon out through the proximal incision (Fig. 31.5b).
- *Step 4*: Just lateral to the anterior tibial crest and placed just proximal to the medial PT exposure incision, a vertical 6 cm incision is

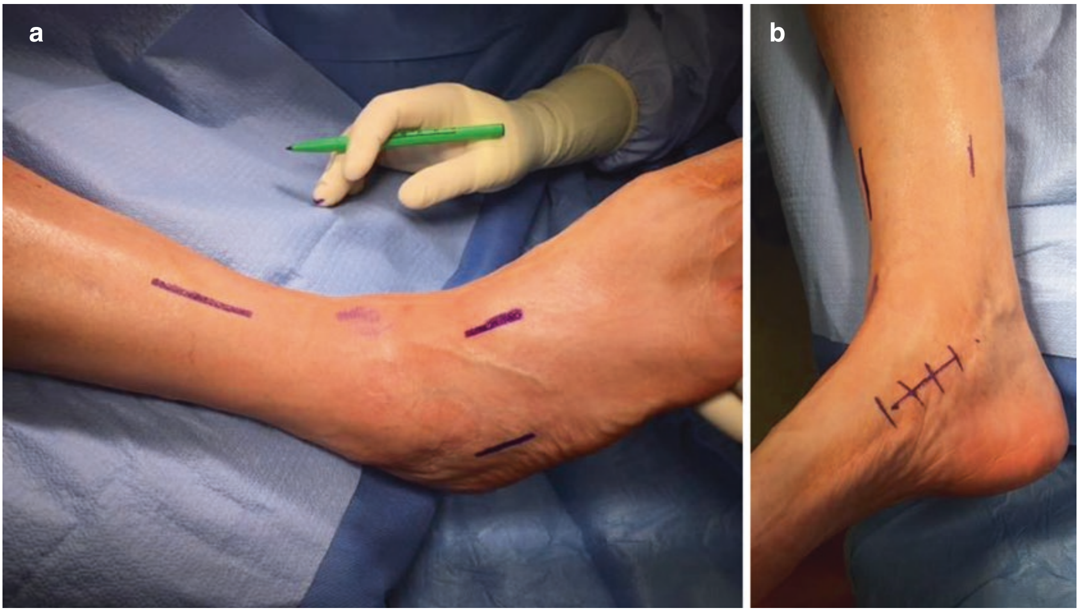

Fig. 31.4 (**a**, **b**) Guide for incisional placement for a posterior tibial tendon transfer

performed. After incising the fascia in line with the incision, expose the interosseous membrane (IO) by sweeping the anterior compartment musculature, along with the neurovascular bundle, laterally. A dry sponge is helpful to clean the IO and dry the musculature thus facilitating better visualization for windowing the IO. Create a window in the IO with a scalpel taking care to only barely incise the membrane along its medial, superior, and lateral margins. A Cobb elevator is typically passed from medial to lateral and tight to the posterior tibia into the IO window. A long curved tendon passer then follows the Cobb as it is retracted medially. Straight instruments are challenging to pass from lateral to medial as they impinge on the fibula, the anterior leg musculature, and, most importantly, the neurovascular bundle. The passer is now in the medial leg incision and positioned to deliver the PT into the IO window. Once this is completed (Fig. 31.5c), PT excursion is again tested, and the IO window enlarged manually if impingement is noted *(If performing an isolated PT transfer, move ahead to Step 9).*

- *Step 5*: A vertical incision 8 cm proximal to the fibular tip and along the posterior fibular margin is made. Isolate the two tendons, and critically evaluate the caliber of the peroneal brevis. If it is robust at this level, it is tenotomized as it is our preferred tendon for the Bridle transfer given its favorable force vector. If the brevis is mostly muscular at this level, perform the traditional peroneal longus tenotomy. The remaining tendons are tenodesed side to side with 0 caliber absorbable suture.
- *Step 6*: A 3 cm incision along the dorsal peroneal brevis insertion margin is made to isolate the tenotomized peroneal tendon. Expect the sural nerve to be close to the incision, and protect it when encountered. Pull the tendon distally out of the incision, and whip stitch its end with an 0 caliber suture.
- *Step 7*: The PT must now be passed through a vertical incision in the tibialis anterior (TA), and properly tensioning this interface is critical. The ankle is held in slight dorsiflexion, and the PT is tensioned distally. The PT and TA should intersect well proximal to the superior extensor retinaculum. At the tendon intersection, incise the central TA, in line with its fibers, and pull the PT through the TA from posterior to anterior. Ensure the ankle remains in slight dorsiflexion and teno-

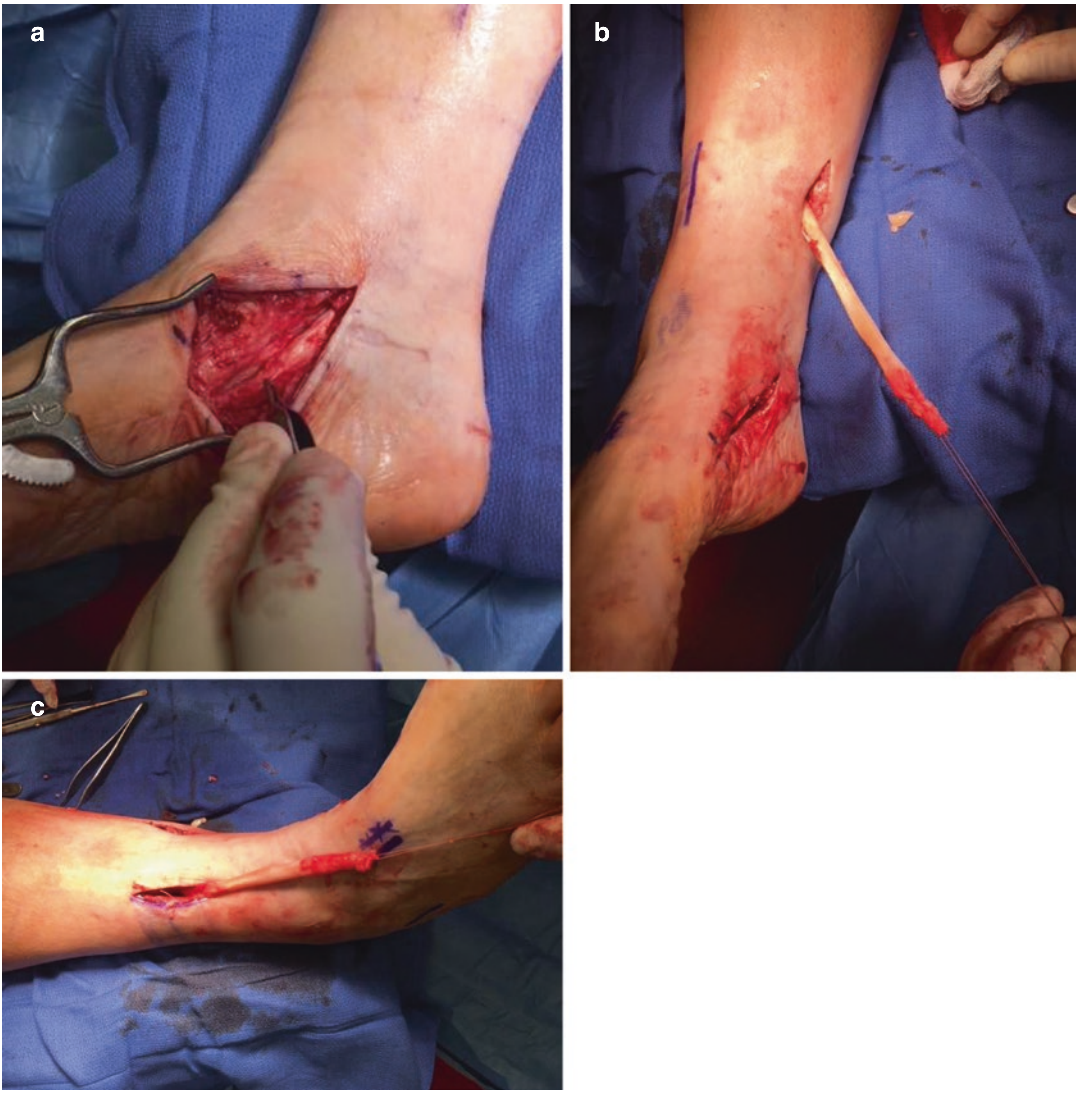

Fig. 31.5 (**a**–**c**) Intraoperative harvest of the posterior tibial tendon with routing through the interosseous membrane

dese the tendons with a high strength nonabsorbable suture 2-0 or larger.

- *Step 8*: Direct the curved tendon passer from the anterior leg IO incision distally to the peroneal insertion incision. Stay superficial to the extensor retinaculum. Grasp the peroneal tendon whip stitch and pull the tendon into the anterior leg incision.
- *Step 9*: I prefer to transfer the PT as far laterally as possible, so, at this point, I will tension the PT distally over the dorsal foot and gauge how much length I have (Fig. 31.5c). In an isolated PT transfer, I can typically reach the lateral cuneiform or cuboid. The Bridle's PT-TA tenodesis will result in some shortening of the PT; therefore, transfer lateral to the middle cuneiform is typically not feasible. A 3 cm vertical incision is made over the appropriate cuneiform taking care to remain lateral to the marked dorsalis pedis artery. Extraperiosteal exposure of the bone is performed, and the starting point for a tenodesis screw guidewire is marked using fluoroscopy. The guidewire is driven through the bone from dorsal to plantar and out the bottom of the foot. Protect the wire's tip immediately with a

Fig. 31.6 Plain film radiograph demonstrating the guide wire placement for the tendon interference anchor in the lateral cuneiform

hemostat or protective cap. Confirm with fluoroscopy that the wire is perfectly centered through the desired cuneiform (Figs. 31.6 and 31.7a-c). Based on the measured caliber of the PT tendon stump, drill the appropriately sized tenodesis screw tunnel over the guidewire. Irrigate bony debris from the transfer site.

- *Step 10*: The curved tendon passer is directed proximally from the cuneiform window toward the anterior leg incision containing the PT while also remaining superficial to the extensor retinaculum. Pull the PT distally to its transfer site. The PT whip stitches are passed through the tenodesis guidewire eyelet and pulled out the plantar foot. Grasp the sutures with a hemostat and tension the transfer by rolling the instrument over its suture. Once at least 5° of dorsiflexion is obtained, place the tenodesis screw. Consider reinforcing the transfer if the cuneiform bone is soft. The plantar sutures can be tied over a well-padded bolster, and/or a small suture anchor can be placed adjacent to the tenodesis site to improve the transfer fixation.
- *Step 11*: Obtaining final Bridle procedure coronal plane foot balance is achieved through completion of the peroneal tendon transfer. A small coronal incision is made through the TA just proximal to the PT-TA tenodesis site. With the foot held in slight eversion, the tendon is tensioned and sutured to the TA with 2-0 or larger nonabsorbable suture. The remaining peroneal stump can then be sutured proximally to the TA for 1–2 cm. As suggested by Richardson et al., a “box stitch” should be placed in the TA both proximal and distal to the PT and peroneal transfers to reduce tension at the transfer sites during early healing. When each is tied, “accordion effect” should be noted confirming de-tensioning [11].
- *Step 12*: If the resting ankle tension is in any degree of plantarflexion at this point in the procedure, it is unrealistic to expect an optimal surgical result long term. Correct the position by re-tensioning the proximal tenodesis if necessary. Once a resting ankle position of 5° of dorsiflexion is achieved, all wounds are irrigated and closed in layers. A bulky Jones splint is applied with a focus on supporting the ankle’s dorsiflexed position (Fig. 31.8).

Procedure Pearls and Pitfalls

Posterior Lengthenings

The importance of a properly performed Silfverskiold exam where concern for equinus contracture is suspected cannot be overemphasized. One must determine which tendons should be released and at what level so as to avoid overlengthening and postoperative weakness. Anticipate variable anatomy of the sural nerve and always identify it. Make every attempt to suture the fascial layers during closure as it will prevent an often frustratingly persistent and painful muscular herniation.

Bridle Procedure and Posterior Tibial Tendon Transfers

Do not operate on a patient with unrealistic expectations of the procedure. As the surgeon, it is your responsibility to educate your patient preoperatively regarding expected functional limitations, bracing requirements, etc. Unless you have already performed dozens of these procedures, I would suggest respecting the procedures' complexity by physically writing down a complete operative plan well ahead of the scheduled case and taking time to read it regularly. This exercise commits the procedures' multiple-step progression to memory and helps to avoid unnecessary intraoperative hesitation and indecision. Such procedural inefficiencies drain valuable tourniquet time and unnecessarily expose the patient to complication risk. If your staff is unfamiliar with the procedure, take time to walk them through the case during the pre-case huddle, or, preferably, well in advance of the case. This will keep them thinking one step ahead and minimize surgical delays. Anticipate suboptimal tendon and bone quality in chronic drop foot patients. Have available multiple suture options and bone anchoring options in the event of poor fixation intraoperatively. In cases of common peroneal nerve injury with anterior muscular compartment weakness, the Bridle's tenodesis effect provides a stable well-balanced foot despite the weak TA. Do not accept any amount of plantarflexion when you observe the final foot position. The time spent re-tensioning will be well worth it in the long run.

Potential Complications

There are a few potential complications to note related to this procedure. Residual equinovarus deformity is always a possibility and is best managed intraoperatively. Load the foot on a flat plate to simulate weight bearing, and carefully monitor the foot position throughout the procedure. Resist the temptation to accept residual deformity if it is noted. If you accept suboptimal intraoperative correction, it will not improve postoperatively. Another possible complication is drop foot from failure of the tendon transfer. Even after successful transfers, patients may continue to exhibit a slappage gait pattern during the first postoperative year. This should be braced and monitored for improvement rather than being seen as a sign of tendon transfer failure. Although dorsiflexion strength is expected to only be about 30–33% of a normal ankle, studies have shown that this strength still is seen as a significant improvement from preoperative levels [2, 13]. Some patients may require a tightening of their tendon transfers due to inadequate intraoperative tensioning or loss of tendon tension postoperatively [11]. It is possible that decreases in both strength and tendon excursion can occur due to postoperative adhesions. An aggressive rehab protocol involving tendon manipulation and activation is important and aims to minimize this complication [2]. A more common complication is leg and foot dysesthesias including hypesthesia in 77% of patients, paresthesias in 61% of patients, and causalgia in 38% of patients. Wound complications occurred in 5.9–13.2% of patients, with an increase seen in overweight patients [2, 11]. Per Cho et al., despite the Bridle procedures complexity, its high percentage of postoperative dysesthesias, and its inability to completely restore full dorsiflexion strength, patient satisfaction rates remained exceptionally high. In their report, 80.6% of patients reported willingness to undergo this procedure again. This was additional support by Johnson et al. in their study who follow patient for two years after the procedure [2, 6, 11] (Figs. 31.7 and 31.8).

Fig. 31.7 Postoperative radiographs following PTT transfer. Images (**a**) and (**b**) show the placement of the tendon in the intermediate cuneiform. Image (**c**) shows guidewire placement in the intermediate cuneiform

Fig. 31.8 Intra- and postoperative imaging of a patient that underwent a Bridle procedure

31.6.2 Post-op Care

Please refer to Chap. 1 for detailed descriptions of each of the different procedures covered in this chapter.

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