
Endoscopic Gastrocnemius Recession

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Keywords

Endoscopic gastrocnemius recession • Ankle dorsiflexion • Indications • General anesthesia • Spinal/local anesthesia • Strayer technique • Lateral portal creation • Cannula • Oral muscle relaxants

Percutaneous techniques are becoming popular for treating many musculoskeletal conditions. Those developed for endoscopic carpal tunnel and plantar fascial release are currently among the most common. The reported benefits of endoscopic surgery include smaller incisions and shorter postoperative recovery time [1–3]. Visualization with an endoscope may also decrease perioperative complications from scarring such as incisional irritation or neuritis, although the overall safety of these interventions has yet to be determined. An endoscopic means of

gastrocnemius recession (EGR) has recently been popularized for correction of ankle equinus contracture as an alternative to formal open gastrocnemius release (OGR) or Achilles tendon lengthening [4–21]. The OGR remains today’s gold standard for aponeurotic lengthening because of its proven record as a safe, rapid, and effective procedure. This open “slide,” however, can involve a large unsightly incision, which is particularly unpopular with young women, and can be associated with sural nerve scarring and neuritis [11, 14, 15, 19, 22]. The EGR, an alternative percutaneous approach, has been sought in an effort to avoid those problems, but it has a significant learning curve, can be associated with poor visualization, and is somewhat instrument dependent [14, 17]. In consideration of its potential advantages and drawbacks, the authors have tried over the last several years to develop a safe and reliable endoscopic technique for gastrocnemius recession.

Gastrocnemius recession has been used successfully for over a century to correct ankle contracture, originally described to treat neurologically impaired individuals [16]. More

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recent data suggesting the presence of isolated gastrocnemius tightness in otherwise healthy patients, however, has popularized more widespread use of OGR in the United States and Europe during the past decade. EGR was first introduced as a treatment alternative in 2002 [13, 21]. Its purported benefits over the standard open means of gastrocnemius release included a smaller incision, a potentially faster recovery, and the versatility of being performed in any patient position. While its recent interest has emerged primarily in response to complications from the open technique, to date, its advantages remain promising but incompletely substantiated [14].

Early results of the endoscopic procedure appear comparable to the open technique regarding improvement of ankle dorsiflexion [5, 10–12, 14, 20]. Using an endoscopic technique, Saxena and Widtfeldt obtained an average 15° immediate improvement in postoperative dorsiflexion, which remained at 12.6° after 1-year follow-up of 18 cases [14]. Pinney et al. reported an 18° dorsiflexion increase sustained 2 months after open Strayer procedure [11]. DiDomenico et al. reported their results on 31 procedures of EGR and noted an improvement of 18° with the knee extended [5]. Trevino et al. did not report the amount of dorsiflexion achieved with their endoscopic results, noting only “significant improvement in ankle dorsiflexion” [20]. All three of these studies dealt with nonspastic equinus. A recent European study reported on 18 procedures on patients with cerebral palsy who exhibited neurological equinus [12]. These authors were also able to achieve total dorsiflexion improvement of almost 20° after using the endoscopic technique. Interestingly, despite available data, the amount of equinus correction actually required for gastrocnemius recession to be successful in impacting long-term outcome in these patients remains unknown. In fact, although many (including these authors) think that such equinus correction remedies varying pathologies of the foot, even the relationship between isolated gastrocnemius release and functional improvement remains obscure. For example, as of today, the mere

definition of pathological equinus has only recently been more closely studied.

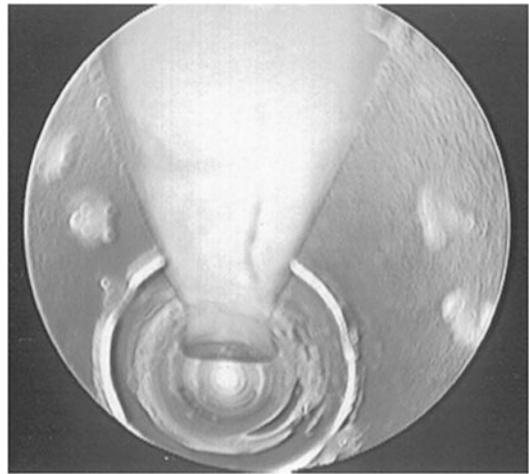
Historically, functional ankle joint dorsiflexion has been defined as 10° with the knee extended and more than 10° with the knee flexed (the Silfverskiold maneuver) [23]. Values below these have been somewhat arbitrarily defined as “equinus contracture.” In 2002, DiGiovanni et al. studied ankle dorsiflexion in non-neurologically impaired populations of individuals who were either asymptomatic controls or patients with symptomatic midfoot and/or forefoot complaints [24]. They concluded that 5° of ankle dorsiflexion with the knee extended and 10° with the knee flexed represented reasonably normal values and suggested that values less than these should be considered evidence of gastrocnemius or Achilles contracture, respectively. They also found a statistically significant association between those individuals who met the criteria for gastrocnemius equinus and an increased incidence of painful midfoot and forefoot pathology. Another study contended that 0° of ankle dorsiflexion with the knee in extension could be “normal” in asymptomatic, adolescent athletes [25]. Based on this data, we consider patients candidates for gastrocnemius recession when their ankle dorsiflexion is less than 5° with the knee extended and they exhibit signs or symptoms of chronic foot overload or inflammation. Common examples would be posterior tibial tendon insufficiency, diabetic forefoot ulceration or Charcot arthropathy, stress fractures, metatarsalgia, Morton’s foot deformity, plantar fasciitis, and insertional Achilles tendonitis, although we think this contracture may potentially play a role in many other biomechanical and functional pathologies of the foot as well. Alternative potential indications for performing an open or endoscopic gastrocnemius recession include patients with symptomatic ankle contracture or those who necessitate midfoot (Lisfranc) reconstruction/arthrodesis, calcaneal osteotomy for hindfoot realignment, or subtalar arthroereisis (Table 1). Whether performed openly or endoscopically, however, the procedure is not meant to take the place of an Achilles lengthening when indicated

Table 1 Indications for endoscopic gastrocnemius recession

1. Gastrocnemius equinus/tightness: (ankle dorsiflexion <5° with the knee in extension)
2. Nonspastic and nonbony deformity and
Asymmetric posttraumatic symptomatic contracture and/or
Calcaneal osteotomy and/or hindfoot realignment and/or
Subtalar arthroereisis and/or
Midfoot arthrodesis and/or
Noninfected forefoot ulcers/derangement

based on the Silfverskiold test. Gastrocnemius recession should also be used cautiously in athletes.

The EGR procedure is typically performed supine under general anesthesia. It can also be performed prone in the event the patient requires such positioning during their foot/ankle surgery. Spinal or local anesthesia may be considered an option for patients who are not good candidates for or do not desire general anesthesia, but we have less experience with this method under such circumstances. Incision placement has been clarified by a recent anatomic study by Tashjian et al. [22]. Ideal sites are determined by locating the inferior extension of the medial gastrocnemius muscle belly as well as identifying the midpole of the fibular shaft. These landmarks provide useful keys to optimal aponeurotic release. Knowledge of the neurovascular anatomy is mandatory, particularly the sural and saphenous structures. The great saphenous vein and the saphenous nerve should be anterior to a medially based incision, which is ideally placed in the midaxial line. This incision is made adjacent to edge of the medial gastrocnemius aponeurosis, typically 9–12 cm proximal to the medial malleolus, and is 1–1.5 cm long (Fig. 1). Once the superficial posterior compartment fascia is opened, a fascial elevator is used to create a pathway between subcutaneous fat and gastrocnemius fascia, in a medial to lateral direction. Care is taken to remain directly posterior to (on top of) the gastrocnemius aponeurosis, a characteristically glistening white structure. An endoscopic cannula with a blunt obturator is then placed through the medial

**Fig. 1** Medial incision placement**Fig. 2** Endoscopic view of gastrocnemius

incision and carefully advanced laterally. The obturator can then be removed for insertion of a 4.0-mm, 30° endoscope through the cannula. The gastrocnemius tendon (Fig. 2) is visualized anteriorly, and the endoscope subsequently advanced toward the lateral aspect of the leg where the subcutaneous tissue appears yellow. The endoscope and cannula are rotated posteriorly and then retrograded back medially approximately 1 cm to locate the sural nerve. Pinney et al. found that the sural nerve can lay directly behind this aponeurosis less than 25 % of the time, but is more often outside of the field of view, and equally common interior and exterior to the superficial posterior compartment fascia at this level. Regardless, care must be taken to ensure that the nerve

does not exist between cannula and the site of aponeurotic release. Based on the findings of Tashjian et al., the sural nerve has been shown to course approximately 1.2 cm or 20 % medial to the lateral gastrocnemius border at the myotendinous junction [19]. Their study did report one sural nerve transection with this EGR approach in the cadaveric setting, and the nerve was seen in only one third of the specimens evaluated endoscopically [19, 22]. Webb et al. also showed the sural nerve to cross the proximal portion of the Achilles tendon from the lateral side [26]. If possible, it is always advantageous to document that the nerve is located posterior to the cannula and thereby protected by it (Fig. 3). Pinney et al. have also shown in their study on the Strayer technique that the nerve can often be adherent to the gastrocnemius aponeurosis [11]. Such situations may require modification or even abandonment of the endoscopic technique in lieu of a more formal, open procedure. Transillumination of the lateral aspect of the leg allows the surgeon to carefully make a cutdown longitudinal incision over the cannula and insert a narrow-tipped suction device, which also helps avoid possible portal neuromas (Fig. 4). The use of suction improves visualization due to the moisture from the subcutaneous fat during transection of the gastrocnemius. Occasionally, serial swabbing with a cotton tip applicator is also helpful to clean the lens of the endoscope and its cannula. The endoscopic can now be placed through the cannula from the lateral portal if performing a two-portal technique.

Once anatomy has been properly and safely defined, the endoscope is temporarily removed and a cannulated knife is introduced as part of the camera (or in the two-portal technique, placed through the medial portal), stabilized over the endoscope (Fig. 5). This assembly is designed to transect the tendon while pushing the blade located forward in its position immediately ahead of the camera and can be done through only the medial portal. Alternatively, a separate independent “hook-blade” can be used, which is useful in cases when the sural nerve or numerous venous structures are located in the vicinity of the proposed transection. This latter technique

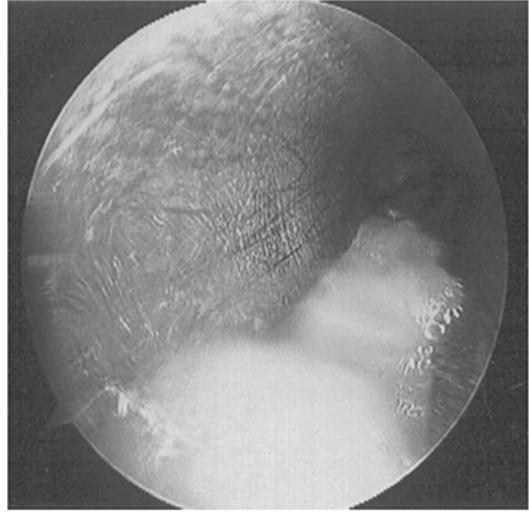


Fig. 3 Endoscopic view of sural nerve with the endoscope and cannula rotated posteriorly 180°



Fig. 4 Creation of lateral portal



Fig. 5 Cannula with endoscopic forward cutting blade



Fig. 6 Endoscopic view of gastrocnemius transection with soleus muscle above

requires two portals and a separate knife blade/handle, which is pulled from the far end toward itself during transection, using the camera to follow the release. We have identified no specific advantage with either technique, and in either case, the foot must remain forcibly dorsiflexed to tension the thick gastrocnemius aponeurosis and permit clean transection. Clamping the medial and lateral margins of the aponeurosis through each portal with a Kocher clamp may also facilitate this process, but requires slightly larger incisions. This adjunct technique can be useful because the gastrocnemius rests more curvilinear rather than straight when viewed in the coronal plane. Thus, the straight, rigid endoscope is sometimes ineffective at releasing the very medial and lateral edges of the tendon as they course more anteriorly away from the endoscope/cannula. As the gastrocnemius is transected with either blade construct, the soleus muscle belly should become visible anteriorly (Fig. 6). Ideally, the fascia of the soleus is not violated. If this occurs, the resultant bleeding can obscure visualization. Although typically only superficial, however, unfortunately this is sometimes unavoidable, and under such circumstances, suction from the lateral portal can be helpful. While this inadvertent violation of the soleus fascia/muscle has not been of any identifiable clinical consequence in our experience, it still

represents a potential risk and undesirable pitfall of this procedure. If the neurovascular structures limit advancement of the cannulated knife, one can transect the aponeurosis from either portal with various endoscopic blades. The hook blade can be used from the lateral portal to complete the transection.

After complete transection of the tendon, ankle dorsiflexion improvement should be noted of at least 10–15°. Anything short of this suggests either the need for an Achilles lengthening or incomplete resection of the gastrocnemius. Recent research by Barouk et al. suggests that most if not almost all of the dorsiflexion correction is obtained by release of the medial as opposed to the lateral gastrocnemius aponeurosis [27]. This is in keeping with our own observations. Once instruments are removed, the medial incision is explored for the plantaris tendon, which is then also transected. The incision is extended as needed, particularly to make sure all medial gastrocnemius fascia is adequately released. In our experience, leaving this tendon behind intact can result in medial sided discomfort as a result of its bowstringing while under dorsiflexion tension. Surgical sites are thereafter irrigated and 5 mL of 0.5 % bupivacaine are introduced into the portals. Incisions are closed with one or two 3-0 nylon sutures, which remain for 2 weeks postoperatively. Oral muscle relaxants, along with dorsiflexion night splinting, can be useful in the postoperative setting to maintain release and minimize muscle cramping. If EGR is performed as an isolated procedure, patients are maintained in a below-knee walking boot for 4–6 weeks, during the latter half of which, it is only required at night and patients are allowed ambulation as tolerated during waking hours. When more extensive foot or ankle procedures are concomitantly performed, they generally dictate postoperative immobilization and weight-bearing status. During the first few months of recovery, self-massage of the transection region and portals is recommended. Physical therapy after surgery is also encouraged and can be helpful to improve gait and decrease fibrosis. The ability to single-leg “heel-raise” can occur as soon 6 weeks post-EGR [14].

The EGR procedure represents an evolving percutaneous technique that has the potential to minimize postoperative scar formation and maximize recovery after gastrocnemius recession. Caution must be exercised in recommending this



Fig. 7 “Tenting” or soleus adherence to subcutaneous tissue

technique, however, because its long-term outcome and relative complication rate as compared with the traditional open technique remain unknown. The most common adverse event noted postoperatively with this approach appears to be transient lateral foot dysesthesia. In our experience, this is most likely due to traction neuritis of the sural nerve, which we have also seen with the open procedure after obtaining an acute increase in ankle dorsiflexion [5, 15]. However, this is typically a benign and self-limiting problem. Based on cadaveric experimentation, sural nerve laceration and/or incomplete gastrocnemius release may prove to be significant risks of this procedure as compared with the open approach, primarily due to impaired visualization. Other potential complications of EGR yet to be fully defined include hematoma, adherence/tenting, push-off weakness, and calcaneus deformity (Fig. 7). The procedure is also highly equipment dependent, requiring significantly greater amounts of instrumentation as compared with the standard release. Unfortunately, this equipment is often not otherwise required for most foot/ankle procedures that might be required at the time of gastrocnemius recession, and thus this need represents an added burden to both surgeon and operating room personnel. With

Table 2 Other authors’ results of endoscopic gastrocnemius recession

Author	Comment	Net improvement in ankle dorsiflexion	Nerve transection	Lateral dysesthesia	Hematoma	Calcaneal gait	Poor cosmesis
Tashjian et al. [19, 22]	Cadaveric	NS	1	NA	NA	NA	NA
Saxena and Widtfeldt [14]	18 cases	12.6°	None	3	NS	NS	1
Trevino et al. [20]	31 cases	NS	None	NS	NS	NS	NS
DiDomenico et al. [5]	31 cases	18°	None	NS	1	3	NS
Poul et al. [12]	18 cases with cerebral palsy	20°	NS	NS	0	NS	NS
Saxena et al. [15]	54 cases	14.8°	None	6/54 (11 %)	1	1	6/54 (11 %)

NS not studied, NA not applicable

experience, the total time required for the EGR approaches that for the OGR.

Experience with the EGR technique is evolving. More studies have been published on any advantages, disadvantages, or comparative results of EGR. While the procedure may hold promise in terms of minimizing incisional issues and maximizing recovery times after isolated gastrocnemius recession, its use should be considered after proper training, and then EGR can be safely advocated for general use (Table 2). With increased experience, however, we think the EGR has become a safe and preferable means of gastrocnemius recession for trained individuals. To date, however, the open technique remains more popular, but overtime EGR, as with many other arthroscopic and other minimal invasive techniques, will likely be considered a more efficient, reliable, and user-friendly means of gastrocnemius recession.

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