Anatomical Aspects of the Gastrocnemius Aponeurosis and its Muscular Bound Portion: A Cadaveric Study—Part II

Neal M. Blitz, DPM, FACFAS,[1] and David J. Eliot, PhD[2]

Gastrocnemius intramuscular aponeurotic recession is performed on the anterior surface of the muscular-bound portion of the gastrocnemius aponeurosis, in the "transection zone" located inferior to the region where the aponeurosis is formed by the separate tendons of the medial and lateral heads of gastrocnemius, and superior to the inferior portions of the muscle's 2 heads. Measurements showed the mean proximal-to-distal length of the transection zone to be 50 mm (range 7 to 100 mm), and the mean width was 88 mm (range 48 to 19 mm). The part of the aponeurosis associated with the medial head contributed 60% of the width of the transection zone (mean 53 mm, range 30 to 80 mm), and the lateral head contributed 40% (mean 35 mm, range 18 to 53 mm). The mean lengths of the parts of the medial and lateral heads that were inferior to the transection zone were 40 mm (range 16 to 68 mm) and 22 mm (range 6 to 35 mm), respectively. In theory, a distal transection will have a large biomechanical effect, releasing more gastrocnemius fibers from their plantarflexory action; whereas a proximal transection will have less effect. An oblique incision or step-cut positioned distally on the medial side may be appropriate if the transection zone is short, if the transection is far distal in the zone, and/or if the medial head extends far distal to the lateral head. Level of Clinical Evidence: 5 (The Journal of Foot & Ankle Surgery 47(6): 533–540, 2008)

Key Words: equinus, gastrocnemius intramuscular aponeurotic recession (GIAR), gastrocnemius recession

Gastrocnemius recession surgery is performed to weaken or eliminate the gastrocnemius muscle's plantarflexory action on the foot. Recent literature demonstrates that surgeons target the aponeurosis on the deep side of the gastrocnemius muscle in order to lengthen the aponeurosis; this procedure is known as the gastrocnemius intramuscular aponeurotic recession (GIAR) (1–3). When performing the GIAR, the transection is a shallow incision through the aponeurosis only, and it leaves the muscle tissue of the gastrocnemius intact. Transection in this location does not interrupt the gastrocnemius entirely, so it allows both intramuscular and aponeurotic lengthening. Theoretically, preservation of the insertion of the gastrocnemius onto the soleus muscle lessens but does not eliminate the biomechanical effect of the gastrocnemius on the foot (Figure 1) (3).

Address correspondence to Neal M. Blitz, DPM, FACFAS, Chief of Foot Surgery, Department of Orthopaedic Surgery, Bronx-Lebanon Hospital Center, 1650 Selwyn Avenue, 3H, Bronx, NY 10457. E-mail: nealblitz@yahoo.com.

[1]Chief of Foot Surgery, Department of Orthopaedic Surgery, Bronx-Lebanon Hospital Center, Bronx, NY.

[2]Touro University California, Department of Basic Science, Vallejo, CA.

Financial Disclosure: None reported.

Conflict of Interest: None reported.

1067-2516/08/4706-0008$34.00/0

doi:10.1053/j.jfas.2008.08.006

The surgical anatomy of the deep portions of the gastrocnemius aponeurosis is best understood in the context of the anatomy of the entire triceps surae muscle complex (Figure 2) (4). The triceps surae is composed of the gastrocnemius muscle, which crosses the knee and is superficial in the posterior compartment of the leg; the deeper, larger soleus muscle, which does not cross the knee joint; and the Achilles tendon, which is the confluence of the distal aponeuroses of the gastrocnemius and soleus. The posterior surface of the soleus is a broad, flat aponeurosis that forms a bed upon which the gastrocnemius muscle lies. The medial and lateral heads of the gastrocnemius arise from distinct origins on the medial and lateral femoral epicondyles. The 2 heads abut and merge below the knee, then separate distally. Both parts of gastrocnemius are anchored to the posterior surface of a single, thin aponeurosis that forms much of the muscle's anterior (deep) surface. Although the anterior surface of the gastrocnemius aponeurosis is in direct contact with the posterior surface of the soleus aponeurosis, there is little or no tendinous connection between the 2 muscles except where they fuse inferiorly. The dimensions of the subcutaneous inferior part of the gastrocnemius aponeurosis have been described previously (1, 2). The superior part of the gastrocnemius aponeurosis is herein referred to as the intramuscular portion, or the muscular-bound portion because its posterior surface directly accepts the insertions of the fascicles of the gastrocnemius muscle.

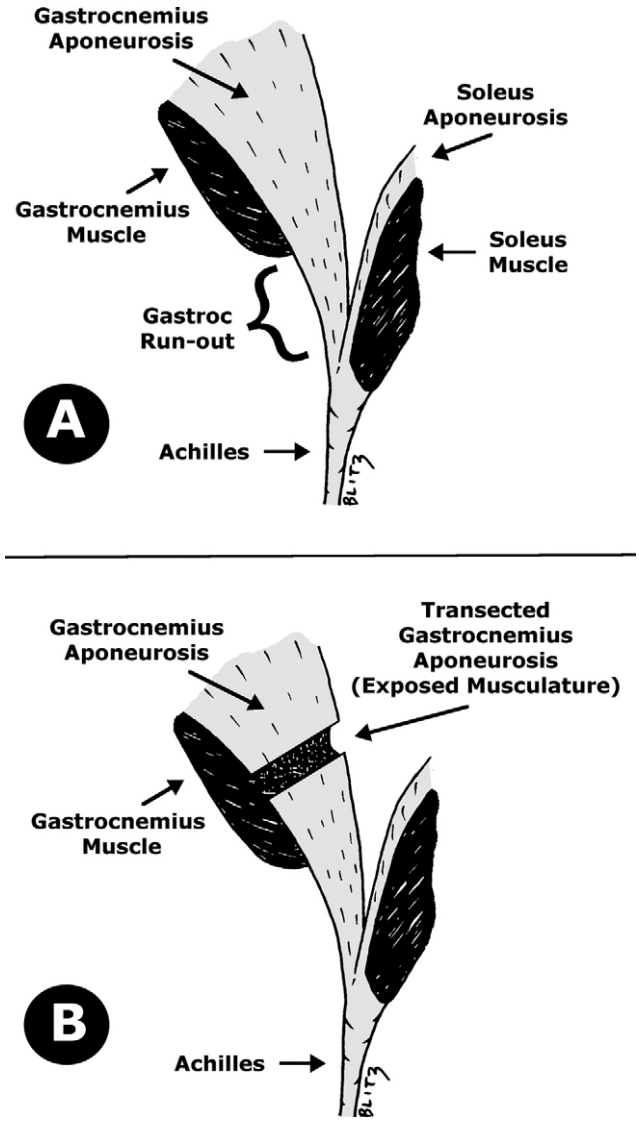

FIGURE 1 Drawings illustrating pertinent anatomy (*A*) and location of transverse sectioning within the muscular-bound portion of the gastrocnemius aponeurosis. (Modified with permission from the author and the publisher, from Blitz NM, Rush SM. The gastrocnemius intramuscular aponeurotic recession: a simplified method of gastrocnemius recession. J Foot Ankle Surg 46[2]:133–138, 2007.)

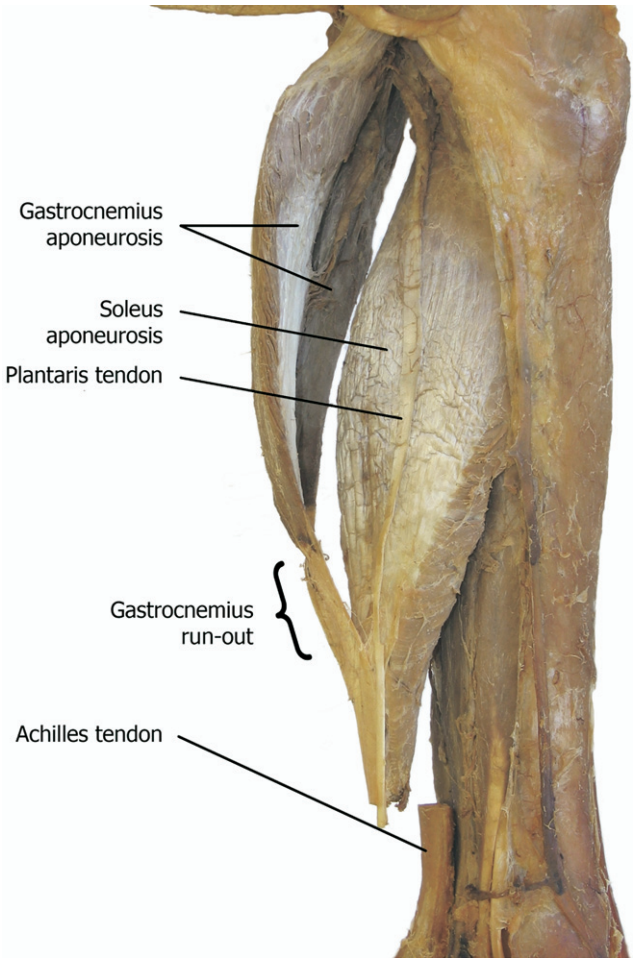

FIGURE 2 Medial view of cadaveric specimen demonstrating the posterior compartment of the leg. Skin, subcutaneous tissue, and superficial fascia are removed. The gastrocnemius muscle fibers are posterior to its aponeurosis, whereas the soleus muscle fibers are anterior to its aponeurosis. The gastrocnemius aponeurosis (without associated overlying muscle) continues for a variable distance (*bracket,* also known as the "gastrocnemius run out") inferior to the distal ends of the medial and lateral heads of gastrocnemius to reach its line of attachment to the soleus. Combined aponeuroses of soleus and gastrocnemius fuse to ultimately form the Achilles' tendon. (Modified with permission from the author and the publisher, from Blitz NM, Eliot DJ. Anatomical aspects of the gastrocnemius aponeurosis and its insertion: a cadaveric study. J Foot Ankle Surg 46[2]:101–108, 2007.)

The GIAR is performed through a medial incision located at the mid-substance of the gastrocnemius muscle (3). After the deep fascia is longitudinally incised, the gastrocnemius and soleus muscles are immediately identifiable. It is our preference to perform the GIAR in the supine position. The interval between the 2 muscle groups is bluntly developed. Deep retractors allow visualization to the lateral aspect of the muscular-bound gastrocnemius aponeurosis. The gastrocnemius aponeurosis is transected from lateral to medial with a curved-belly scalpel. The foot is then dorsiflexed with the knee extended to achieve separation of the transected aponeurosis and an intramuscular lengthening of approximately 1 to 3 cm.

In general, the key to success of the GIAR is dividing the gastrocnemius aponeurosis only, with sparing of the muscle tissue on its posterior surface, at a location where the gastrocnemius muscle bellies are sturdy enough to avoid a full-thickness muscle rupture when the foot is dorsiflexed. The part of the muscular-bound gastrocnemius aponeurosis that is distal enough to convey the force of many muscle fibers, but proximal enough to allow incision with little risk