

Review Article

Reviewing the Gastrocnemius- Soleus Recession Techniques- A Type 1 Surgical Offloading Procedure for Equinus

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Abstract: One among the commonest type 1 surgical offloading procedure is gastrocnemius-soleus recession which is performed to correct equinus in neuropathic foot ulcer as well as other foot and ankle pathologies. There are numerous techniques be it open, percutaneous or endoscopic, being performed in different parts of the world, depending upon availability and surgeons choice. This paper aims to review the open and percutaneous gastrocnemius-soleus recession/lengthening techniques.

Keywords: Gastrocnemius, Recession, Surgery, Equinus, Offloading.

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INTRODUCTION

Achilles tendon, which is the conjoined tendon of gastrocnemius and soleus muscle, is the largest and strongest tendon of the ankle and is one of the main plantar flexor of the ankle [1, 2]. The gastrocnemius and soleus vary in their contribution to the tendo-achilles and it was noted that in 52% of the subject, gastrocnemius contributed 48% and soleus contributed 52% to this strong tendon whereas in 35% of the subject, both contributed 50% each and in 13%, the two third of tendon was formed by gastrocnemius muscle [1].

Gastrocnemius- soleus contracture is stated to be associated with numerous foot and ankle disorders that include metatarsalgia, plantar fasciitis, Achilles tendinosis, neuropathic foot ulcers, etc. [2, 3]. The most common equinus seen is secondary to involvement of soft tissue structures namely gastrocnemius, soleus and tendo-achilles and this results in elevated high forefoot pressure [4, 5].

In today's era, ankle equinus is extremely common in diabetes [5]. It is stated that elevated glucose affects the collagen of the tendon leading to reduced elasticity [6]. It is thought that in 96.5% of foot and ankle pathology, the gastrocnemius tightness is prevalent [7]. A study from Brazil showed disorganized tendon fibers in 89% of diabetes patient with 76% of patient of diabetes having calcification in Achilles tendon [6]. It is also noted that diabetic patients with ankle equinus have

3 times elevated foot pressure then compared with diabetic patient without equinus [8].

Although equinus is defined as the inability to dorsiflex foot/reduction in range of ankle dorsiflexion, there has always been dispute regarding the degrees of dorsiflexion that constitute equinus [9, 10]. Lavery *et al.*, consider equinus of less than 0° of ankle dorsiflexion, Orendueff *et al.*, considers less than 5° degrees as equinus whereas Di-Giovanni *et al.*, considers less than 10° of dorsiflexion as equinus [9-11].

It is often essential for one to differentiate isolated gastrocnemius tightness and often Silfverskiöld test is used to differentiate it though there are other methods also [7-12]. In Silfverskiöld test, one dorsiflexes ankle with knee in extension position and if the equinus resolves in the knee flexed position, it is considered as positive Silfverskiöld test and there is underlying isolated gastrocnemius contracture. A negative Silfverskiöld test indicates tight Achilles requiring tendoachilles lengthening procedures [13].

SURGICAL TECHNIQUES

There are numerous lengthening procedures to addresses equinus and they can be performed at proximal, intermediate or distal level in leg [12-15]. The following are different surgical techniques (Figure 1) performed in 3 different anatomical zones of gastrocnemius-soleus complex [13].

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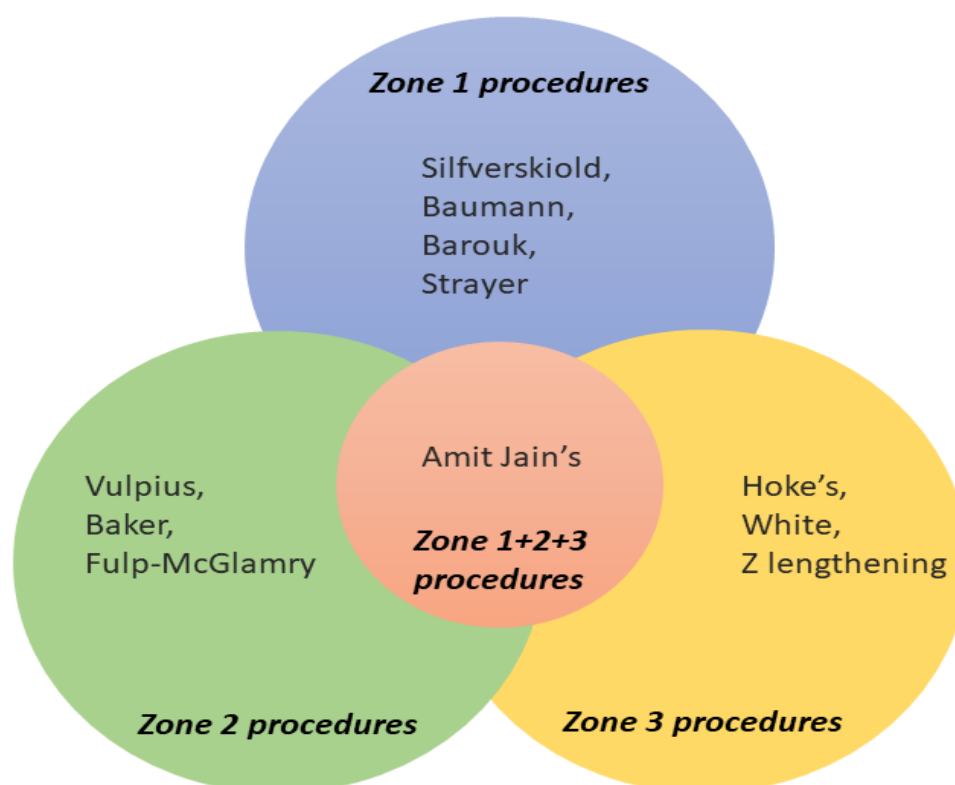


Figure 1: Different types of gastrocnemius- soleus complex recession/lengthening surgeries done for equinus

The Zone 1 lengthening procedures include Barouk's, Baumann, Strayer, and Silfverskiold Procedures [13-15].

1] Silfverskiold Procedure

This operation was described by Silfverskiold in 1924 for spastic equinus contractures in children [15, 16]. In this operation, there is a complete release of proximal gastrocnemius that include both medial and lateral part [15]. This procedure is not commonly performed nowadays [12].

2] Barouk's Procedure

Barouk's procedure is a proximal medial gastrocnemius recession wherein fibrous portion of the medial head of gastrocnemius muscle is released [15-17]. This isolated medial gastrocnemius recession is performed with patient in prone and is considered to be effective in increasing dorsiflexion of the ankle without risk of over lengthening [15-18].

3] Baumann Procedure

Proposed in 1989 for equinus deformity by Baumann and Koch, this is an isolated intramuscular recession of the central gastrocnemius muscle belly [13-15]. It is a selective lengthening procedure with low rate

of over lengthening and often used in equinus of spastic/neuromuscular pathology [13-19].

4] Strayer Procedure

This is one of the most widely used procedure in Zone 1 [13]. Proposed by Luther Strayer in 1950, it involves lengthening by isolated distal gastrocnemius recession [13-15]. One of the common complications of this procedure is risk of sural nerve injury [13].

Zone 2 lengthening procedures include Vulpus, Baker's and Fulp-McGlamry's procedure [13-15].

5] Vulpus Procedure

Vulpus and Stoffel were the first one to describe gastrocnemius recession in 1913 [13-20]. This technique was employed in equinus for neurologically impaired children [13-21]. This procedure involves Chevron shaped cuts in Zone 2 and is non selective [13-19].

6] Baker's Procedure

This non selective gastrocnemius-soleus recession was proposed by Lenox Baker in 1956 and involves an inverted 'U' incision in zone 2 [13-15]. This tongue in groove shaped recession (Figure 2) is modified Vulpus procedure [15-22].

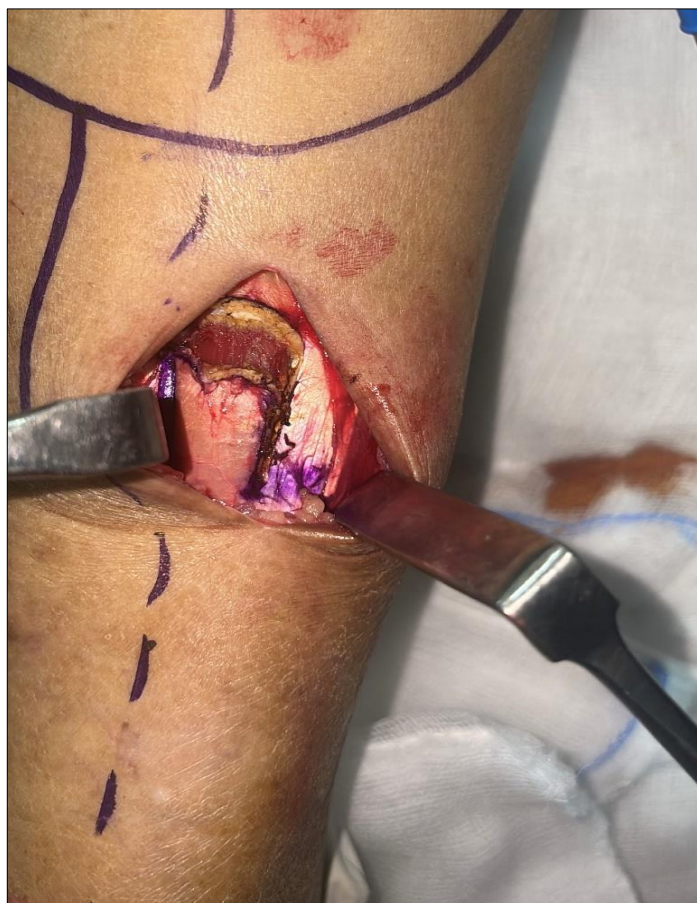


Figure 2: The Baker's Procedure (Tongue in Groove)

7] Fulp- Mc Glamry Procedure

Proposed in 1974 by Fulp and McGlamry, this procedure is a modified Baker procedure that is done in Zone 2 and in this technique a non-inverted “U” incision is used [13].

Zone 3 procedures include Z lengthening, Hoke's and White's procedure's [12, 13]. The procedures done exclusively in this zone carries a greater risk of over lengthening as they are non-selective [13-23].

8] Z lengthening

This open procedure in Zone 3 is done in severe cases of equinus contracture. It is preferred in patient with equinus deformity exceeding 20 degrees and a negative Silfverskiold test [13].

9] Hoke's Procedure

This is one of the commonly performed percutaneous technique for tendo-achilles lengthening and includes triple cut hemisection [12-19]. This

percutaneous technique is often considered in patients with less than 5° of dorsiflexion [8]. The Hoke's technique has risk of over lengthening and imbalance [13].

10] White's Procedure

This technique is an alternative percutaneous tendo-achilles lengthening procedure and involves double hemi section of tendo-achilles [23, 24].

All zone procedure includes the Amit Jain's procedure

11] Amit Jain's Procedure

This new technique proposed by Amit Jain in 2026, is a type of gastrocnemius- soleus complex lengthening that addresses the equinus especially in diabetes patients with foot ulcers [25]. This technique involves 'S' Shaped incision (Lazy 'S') starting in Zone 1 at distal gastrocnemius, traverses in Zone 2 (Figure 3) and ends in proximal part of Zone 3 [25]. This is the only procedure that involves all the 3 Zones.

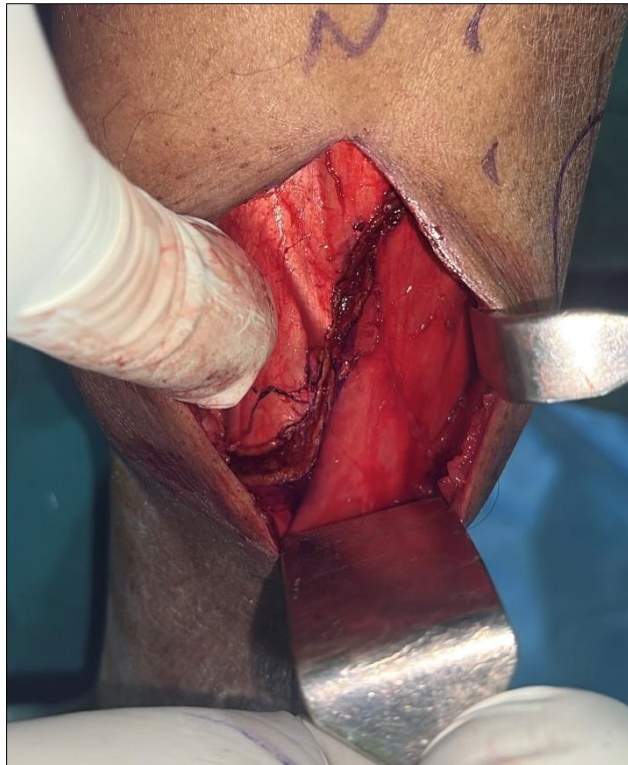


Figure 3: The Amit Jain's Procedure (note the lazy 'S' incision)

CONCLUSION

Gastrocnemius-soleus contracture is extremely common in various foot and ankle pathology. Numerous surgical techniques exist for correcting equinus. The choice of surgery depends on degree of equinus which is determined by Silfverskiöld test. Each of these techniques have their own merits and demerits.

Consent: Not Applicable

Ethical Approval: Not Applicable

Conflict of Interest: None

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