

A new method of gastrocnemius-soleus complex lengthening – A type 1 surgical offloading

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Abstract

Diabetic foot ulcer poses significant challenges in management especially those that are chronic, recurrent or those who failed to respond to conservative/external offloading. In such cases, surgical offloading serves a good option. Gastrocnemius- soleus complex lengthening is one of the surgical offloading that aims to correct equinus. The author describes a new method of gastrocnemius-soleus complex lengthening for healing a chronic trophic forefoot ulcer.

Keywords: Diabetic foot, equinus, gastrocnemius, lengthening, surgical offloading, Amit Jain

Introduction

The worldwide prevalence of diabetes is predicted to be around 552 million by 2030 ^[1]. One of the most debilitating and devastating complication of diabetes is foot ulcers ^[2, 3]. It is estimated that there is 19-34% lifetime risk of developing diabetic foot ulcer ^[4]. One of the primary modalities of managing foot ulcers is offloading ^[5].

The first choice of offloading in current scenario is non-surgical offloading (external) or conservative offloading ^[6]. Numerous methods of non-surgical offloading (Amit Jain's non-surgical offloading classification) exist in different parts of the world ranging from type 1 offloading (simple) to type 3 offloading (complicated) and they include felted foam, cast walkers, Amit Jain's offloading system, total contacts cast, etc ^[7, 8, 9]. When conservative/non-surgical offloading has been inadequate or failed or if ulcer recurs, then one can consider surgical offloading ^[10, 11].

There are numerous types of surgical offloading (Amit Jain's surgical offloading classification) ranging from type 1 surgical offloading to type 3 surgical offloading procedures ^[12, 13]. Some of the common surgical offloading procedures include flexor tenotomies, Keller's arthroplasty, Achilles tendon lengthening, metatarsal osteotomies, etc ^[11, 12, 13].

Gastrocnemius- soleus complex lengthening or recession is one of the popular surgical offloading procedure used in many foot disorders including ulcers ^[11, 14]. This is often done in equinus deformity that results in high forefoot pressures ^[15].

There is often been debate in regards to equinus contractures, with no clear definition ^[16, 17]. Sobel *et al* diagnose ankle equinus when there is less than 0° of dorsiflexion, Orendurff *et al* suggest less than 5° of dorsiflexion whereas Pinney *et al* defines equinus to be less than 10° of dorsiflexion ^[18, 19].

To address this equinus deformity, different types of procedures have been recommended at 3 different zones/level and they include Vulpius, Strayer's, Baumann, Baker's, Hoke's procedure, etc which addresses each zone specifically ranging from proximal to distal corrections ^[20, 21].

We hereby present a new method (Amit Jain's technique) of gastrocnemius-soleus complex lengthening that addresses the equinus in a patient with diabetic foot ulcer.

Case History

A 56-year-old male patient with diabetes mellitus of more than 13 years presented with history of wound for 8 months over right forefoot. He was also hypertensive. There was no history of trauma. Patient showed many doctors, who treated him with dressing and also footwear. He also was given total contact cast previously, but he had discontinued as he found it uncomfortable. The patient thus came to our Institute from his home state to get the ulcer healed. On local examination, a trophic ulcer of 1.5 x 1.2cm was noticed over sole of the right foot at 3rd MTPJ region. The edges were punched out, floor had pale granulation and there was surrounding callus.

There was no pus or probe to bone. He had ankle equinus (Silfverskiöld test showed -2° dorsiflexion on knee extended and 6° on knee flexed). His pulses were palpable, he had peripheral neuropathy (VPT- 50) along with high forefoot pressure on Harris pressure mat studies and Podiascan. His foot X ray did not osteomyelitis.

Patient was suggested deflective offloading with option of felted foam or Amit Jain's offloading system to attempt to heal the ulcer as first recommendation by us but patient wanted faster healing and surgical option as he had only few weeks to stay in our city and he had to travel early to his hometown and resume his work. Patient was thus planned for surgery to address the equinus deformity.

Operative Technique (The New Amit Jain's Procedure)

This procedure involved a 5-6 cm posteromedial longitudinal skin incision in mid-calf region in Zone 2 (Figure 1 and 2). Sharp dissection was done through skin and subcutaneous tissue to reach deep fascia. Injury to saphenous vein and sural nerve were avoided. The deep fascia was incised longitudinally (more than length of skin incision), the gastrocnemius aponeurosis identified and separated from tissues. Proximal part of incision was retracted to identify gastrocnemius muscle- aponeurosis junction in Zone 1 and later the lower part of the incision was retracted to identify the upper portion of tendo-achilles tendon in Zone 3.

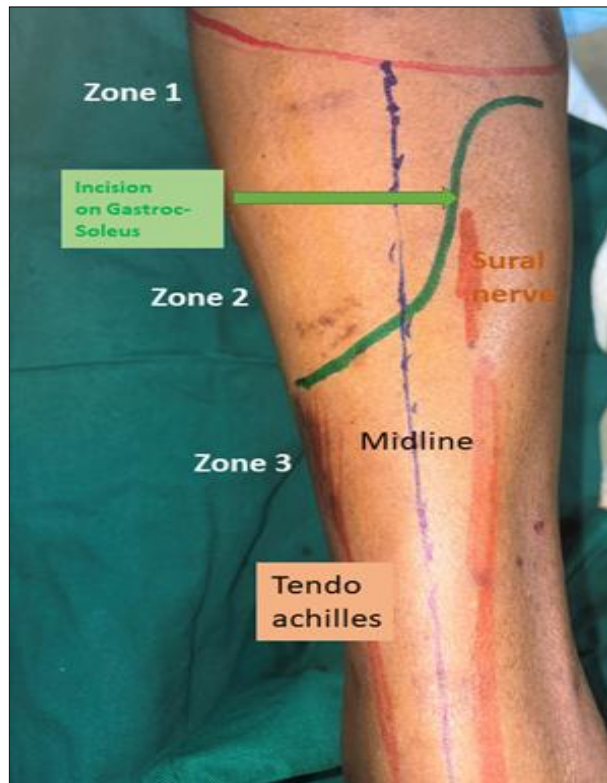


Fig 1: The 3 zones and the marking of the Incision (Green – “S” shape incision on Gastroc-soleus complex) before surgery.



Fig 2: The posterior- medial incision

A “S” shape incision (modified lazy S) was placed (sterile surgical pen marker used) with its upper part starting from the lateral part of gastrocnemius musculotendinous junction in Zone 1, the mid-part traversing in Zone 2 and the lower part of the “S” traversing through the medial part (around 1/3rd)

of the upper portion of tendoachilles tendon in Zone 3 (Figure 3). The aponeurosis complex was incised with no 15 surgical blade (electrocautery also used) taking care to avoid injury to any vessel or underlying muscle. Median raphe and plantaris tendon were encountered which were also divided (Figure 4).



Fig 3: The marking on gastroc-soleus complex which is to be incised



Fig 4: The plantaris tendon

Once the aponeurosis complex was sectioned, the foot was dorsiflexed and a lengthening of around 2 cm was achieved

(Figure 5). The wound was irrigated with povidone iodine and saline.



Fig 5: The length achieved

The fascia and subcutaneous tissue were approximated with absorbable suture (vicryl 3-0). The skin was closed with non-absorbable suture (monofilament suture 3-0) and intermittent mattress technique was used (Figure 6). Dressing was done.

The ulcer over the forefoot was scooped and surrounding callus was debrided. The ulcer was cleaned with povidone-iodine and dressing as done. A Silfverskiold test was re-performed which showed improvement in dorsiflexion (11°) and a below knee POP slab was applied.



Fig 6: Closure of the skin

During the postoperative follow-up, sutures were removed in second week. Patient was subjected to calf stretching exercises. The patient was shifted to therapeutic foot wear at 6 weeks and allowed restricted ambulation. The ulcer showed complete healing at 9th week follow-up visit (patient travels from other part of the country) and did not have difficulty in ambulating.

Discussion

The accepted normal ankle dorsiflexion is 10° with knee extended and 20° with knee flexed [21]. The equinus deformity at ankle joint is known to increase risk of foot ulceration in persons with diabetes in view of them having 3 times higher foot pressures compared to those without equinus [22]. Charles *et al* defines dorsiflexion of less than 10° as stage 1 and dorsiflexion of ankle of less than 5° as stage 2 where there is major increase in forefoot pressure [19]. There are various procedures to correct this equinus deformity that are usually performed at 3 different level/zones [20, 23].

At Zone 1 (proximal part of leg), the commonly done procedures include the Strayer's, Baumann and Barouk's (Proximal medial gastrocnemius release) procedure. These procedures are selective, controlled with conservative lengthening without major risk of over lengthening. The procedures here provide less lengthening compared to T.A.L [20, 24]. Strayer's procedure (modified) is one such commonly performed procedure wherein isolated gastrocnemius recession is performed.

In Zone 2/Intermediate level at leg, the commonly performed procedures include Vulpius and Baker's procedure [20, 24]. Procedures in this zone are not selective but provides more lengthening than zone 1 and greater stability compared to zone 3 [20, 23].

In Zone 3 (distal leg), the commonly performed procedures are Z lengthening of tendoachilles and Hoke's Procedure. Procedures performed in this zone has highest degree of lengthening but it is also non-selective with greater instability, risk of over lengthening and rupture [20, 21, 24].

The new method (Amit Jain's procedure) was designed as we wanted to avoid tendo-achilles lengthening (TAL) and its complications but obtain a reasonable and acceptable lengthening in view of patient having -2° of ankle dorsiflexion with knee extended and 6° of dorsiflexion with knee flexed which actually makes the patient a candidate for T.A.L. This new technique partially divides the gastrocnemius-soleus complex in all 3 Zones progressing from lateral aspect of Zone 1 traversing through Zone 2 towards medial aspect of Zone 3 avoiding sural nerve injury.

This new technique provides good amount of lengthening, better stability compared to T.A.L and is currently only known procedure involving all the 3 zones. One can also use reverse "S" shape (proximal-medial to distal-lateral), "Z" shape or reverse "Z" shape incisions (proximal-lateral to distal-medial) involving all 3 zones. The reverse "S" and "Z" shape incision poses risk of sural nerve injury in view of their lower limb of the incision being in the distal lateral aspect of leg.

Conclusion

Equinus deformity is known to cause high pressure on forefoot and correction of it becomes essential in different foot and ankle pathologies. Different procedures exist for

correcting this deformity but many of the distal procedures have Instability and risk of other complications. The new Amit Jain's procedure for gastrocnemius- soleus lengthening is an effective procedure providing stability as well good amount of dorsiflexion without any major complication.

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