

# Closure of Fasciotomy Wound Using Dynamic Dermal Approximation Technique

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## ABSTRACT

**Purpose:** Compartment syndrome is a surgical emergency that is managed by a fasciotomy. However, it is associated with complications, including long hospital stay, wound infection and osteomyelitis need for further surgery for delayed wound closure or skin grafting, scarring, delayed bone healing, pain and nerve injury, permanent muscle weakness, chronic venous insufficiency, cosmetic problems, and an overall increased cost of care. A need for an early closure technique that will decrease all the above complications is described in this study.

**Methods:** This study was carried out in the Plastic Surgery Department of GMC Srinagar between from January 2020 to December 2022. This hospital-based study was done on compartment syndrome patients where fasciotomy was done and the wound closed by dynamic dermal suture approximation technique and results reviewed and outcome assessed.

**Results:** The technique was applied to a total of 12 patients with compartment syndrome. Ten of twelve patients in study were compartment syndrome of upper limb since severe lower limb trauma patients were excluded in view of need for other procedures. The wounds were divided into three classes as post burn, post trauma and post contrast extravasation. Wound closure was achieved in 75 percent of total cases and all of six post contrast extravasation compartment syndrome patients. **Conclusion:** Following a fasciotomy, wound closure is a topic that is often controversial. The preference for one technique over another is influenced by the

availability of resources, institutional familiarity, and clinical scenarios. Dynamic dermal approximation sutures can be applied with minimal risk to most uncomplicated fasciotomies. The benefits are minimal complication, the best cosmetic outcome, and low cost. However, patients with a high risk of complications may need other methods.

**Keywords:** Compartment Syndrome, Fasciotomy, Wound Closure Techniques, Negative-Pressure Wound closure

## INTRODUCTION

Acute compartment syndrome is a surgical emergency and needs immediate surgical intervention to prevent muscle necrosis secondary to ischemia and nerve death.<sup>[1, 2]</sup> Fasciotomy aims to decrease compartment pressure, restore perfusion and prevent irreversible tissue necrosis.<sup>[1, 3]</sup> The complications of fasciotomy include wound infection, need for surgery for wound closure which may include skin grafting, delayed bone healing, pain, nerve injury, permanent muscle weakness, chronic venous insufficiency, cosmetic problems, and prolonged hospital stay.<sup>[2-4]</sup> Early closure leads to a decrease in associated complications<sup>[5]</sup>. Early primary closure may lead to increased muscle pressure and recurrent compartment syndrome.<sup>[2, 4, 6, 7]</sup> Closure of fasciotomy wounds is challenging, and several techniques have

been developed. There is no consensus existing in the literature regarding the best method for closure of fasciotomy wounds, so the technique applied mostly is based mostly on the surgeon's preference, nature of the injury, condition of surrounding tissues, availability of devices and materials, and resources available.<sup>[6, 8]</sup> Wound closure depends on the viscoelastic and biomechanical properties of the skin.<sup>[9]</sup> A successful closure is defined as the closure of a wound without the need for skin grafting or healing by secondary intention.<sup>[10]</sup> The purpose of this study was to present our experience using dermal approximation technique for post-

fasciotomy wound closure in different types of post compartment syndrome wounds.

## **METHODS**

This study included 12 patients who had undergone open fasciotomies (mean age 38.9, range 22-55 years). The male: female ratio was 2:1. In 50 % of the patients (n =6), contrast extravasation was the inciting factor. (Table: I). The preoperative duration of ischemia was an average of 6 hours to 2 days from onset of symptoms to fasciotomy. Fasciotomy was performed based on clinical signs in the patient. Informed consent was taken from all the patients for the use of photographs in future in research work.

**TABLE: I Describing etiology, method of closure and duration of hospital stay**

<b>Etiology</b>	<b>No of cases</b>	<b>Method of closure</b>	<b>Duration of stay</b>	<b>Complications</b>
Post-burn	(2)	Grafting	34 days	complications 2
Post-trauma	(4)	Dermal closure in 3 Grafting 1	12 Days	complications 3
Post-contrast	(6)	Dermal closure in all	6 days	complications nil

## **SURGICAL TECHNIQUE**

A complete fasciotomy to decompress all compartment pressure was done. Meticulous hemostasis performed, sterile wet gauze applied to cover and protect the exposed tendons and muscles. During the procedure on table application of monofilament, the non-absorbable, synthetic suture is done usually 1-0 proline, rubber shots are applied at the start and end of continuous sutures to prevent skin cut through at the ends of the incision (Fig A1)..The edges of the wound are sutured in running continuous subcuticular suture without tightening. Strict limb elevation is advised with the support of splintage and the wound is reassessed every 6 hours, the limb is reassessed and in case of laxity of skin tightening of the suture is early started, the endpoint being pain or skin colour change. The suture is pulled via the proximal end of the wound so that the closure starts from the distal end. The extra amount of suture derived from tightening is held either by adhesive on the skin or knot or clamp. (Fig A2,3) Before releasing the patient distal perfusion of digits was checked by oximeter placed on digits of injured site and pulses of arteries of injured limb were reassessed. In case of any

compromise in distal vascularity or blanching of skin flap tie was loosened. The advantage of monofilament synthetic sutures is that sutures can be easily loosened if needed, braided sutures are avoided for the same reason. In the intervening periods between the tightening of sutures, the limb is kept in elevation, splintage is applied, and proper non-adherent dressings are done to prevent infection usually sterile gauze was placed over the chlorhexidine impregnated paraffin dressing. Final closure was performed when there was no longer enough tension to interfere with the placement of regular sutures.

### **Case 1**

A 35 year old male patient known case of factor 13 deficiency presented swelling and tightness of right forearm post trivial trauma. The diagnosis of right forearm compartment syndrome was made and high risk surgery was performed under the cover of factor 13. On table dermal approximation sutures were applied and wound closed in 12 days. Patient had multiple episodes of bleeding and hematoma formation which was managed by evacuation and most of

times tightening was performed under the cover of factor 13. (Fig A1-4)



FIG A1 case of factor 13 deficiency, fasciotomy done.



FIG A 2 dermal approximation started after edema resolved.



FIG A 3 Complete closure achieved.



FIG A 4 Satisfactory cosmetic outcome achieved.

### Case 2

A 55 year old male patient known case of carcinoma oesophagus presented with post contrast extravasation compartment syndrome right forearm. Release with application of dermal approximation sutures was done and approximation started just 6 hours post-surgery. Complete closure

achieved within four days of procedure (FIG B 1-2).



FIG B 1 Post contrast compartment syndrome, fasciotomy done, dermal Sutures applied.



FIG B 2 Dynamic wound closure achieved within 6 days.

### Case 3

A 35 year old patient recently operated for acute appendicitis with suspected case mucinous carcinoma appendix advised fir CECT abdomen had post contrast compartment syndrome left forearm and hand. The patient underwent immediate fasciotomy however dermal approximation sutures were applied on first post operative day under local anaesthesia. The wound closure was achieved on six days. The patient presented with delayed cosmetic concern of hypertrophic scarring on volar aspect of arm which was managed by local steroid injections (FIG C1-2).



FIG C 1 Dynamic dermal sutures in place with rubber shots.





FIG C2 Closure achieved with dynamic wound closure technique.

## RESULTS

The dermal approximation sutures were applied to a total of 12 patients with compartment syndrome. Ten of twelve patients in study were compartment syndrome of upper limb since severe lower limb trauma patients were excluded in view of need for other procedures. The wounds were divided into three classes as post burn, post trauma and post contrast extravasation. Wound closure was achieved in 75 percent of total cases and all of six post contrast extravasation compartment syndrome patients.

## DISCUSSION

In compartment syndrome (CS), open fasciotomy is required within hours. Due to the swelling of the muscle tissue, a primary wound closure is often not possible or worthwhile.

A review of Dente et.al<sup>11</sup> describes approximately 20 different methods for primary or delayed primary wound closure after fasciotomy. With the vessel-loop shoelace technique, the duration until final wound closure varies between 4 and 17 days.<sup>12,13,14</sup> In a recent study, 77% of all patients required an SSG. In all studies, the method and samples were often not comparable. Using a device, the Wisebands, Barnea et al described a mean duration to wound closure of 13 days in 88% of total of 16 patients. It is important to mention that in half of the patients, the device was applied after a mean of 7 days.

Yang et al<sup>15</sup> reported on 34 patients treated with NPWT vs standard therapy with saline

wound coverage after fasciotomy in patients with traumatic CS. The definitive closure was after a mean of 6.1 days in the NPWT group vs 16.1 days in the standard group, and there was a need for SSG in 27% (NPWT group) vs 36% in the standard group.

In the case of compartment syndrome, the limiting factor is fascia and once fascia is released and the patient is relieved of compartment syndrome the early closure of the skin has no impact on the pressure of the muscle compartment. In the case of tissue expansion, the viscoelastic properties of the skin lead to skin expansion secondarily to stretch. The late closure of the skin or non-closure leads to contraction of the skin as the reverse of tissue expansion where stretch leads to expansion. The pace of wound closure depends on the pathology of compartment syndrome, in the case of post-contrast extravasation quick wound closure is possible while in the case of post-burn compartment syndrome closure may not be possible, while in some scenarios the raw area may be decreased and some raw area may be left to heal by secondary healing, secondary suturing or skin grafting. The advantage of dynamic dermal approximation sutures is that bedside closure may be achieved without the need for a second surgery. The running nature of sutures leads to equidistribution of pressure along the edges of the wound. The constant stretch on wound edges prevents the contraction of skin and may contribute to the decrease in edema of the involved limb. It appears to be simpler and more economical than any technique so far described for the successful delayed primary closure of fasciotomy wounds.

In our study outcome was variable depending on the cause of injury the best was seen in post-contrast extravasation cases where the forearm wound was completely closed in 48 hours. In post-burn, fasciotomy wounds especially flame burn results with limited benefit were found due to a decrease in elasticity of the skin. Both patients needed skin grafting for wound

closure hospital stay was maximum in this group. Ten out of twelve patients had undergone fasciotomy of the forearm and all subjects were adults.

The maximum time of closure was in post-traumatic forearm fasciotomy in Factor 13 deficient patient, the reason for gradual closure being bleeding on slight disturbance of wound. The patient had four episodes of bleeding and hematoma formation during wound closure and all were managed by IV Factor 13 and evacuation of the hematoma. The closure time was 3 weeks. The case was unique as in this case of bleeding disorder having a post-skin grafting donor site raw area could have been life-threatening.

Two patients with post-burn fasciotomy wound dermal approximation sutures helped in a decrease in the raw area of the wound and prevention of skin contraction both patients needed skin grafting for post-fasciotomy raw areas. In the case of post-burn compartment syndrome, there is a decrease in skin elasticity and the approximation is skin edges may not be possible even after the edema of the limb subsides.

The outcome was best in post-contrast extravasation patients who needed fasciotomy. All patients in this group had fasciotomy of upper limb. The closure time was least in this group average time was 4 days, the reason could be that early fasciotomy changed the wound dynamics, and reabsorption, redistribution and improvement of wound dynamics lead to an early reduction in swelling and thus closure. None of the patients with contrast extravasation needed any further procedure except gradual tightening of dermal approximation sutures. The cosmetic outcome was best among all patients and none of the patient reported any complications.

In our set of patients, none of the wounds was left for healing with secondary intention because of the high complication rate, prolonged hospital stay, and excessive scarring. The patients with severe trauma including multiple bone fractures and

patients who required any repair of the vascular study were not included in the study. All patients with deep burns were excluded.

In case of multiple wounds with difficulty in the closure, attention should first be given to wounds with vital structures exposed, e.g., in forearm closure of fasciotomy wound on the volar aspect should be closed in preference to wound on the dorsal aspect. Patients with infected wounds and wounds with doubtful vascularity of underlying muscle especially in cases of delayed fasciotomy the technique was not applied. None of the fasciotomy wound was managed by NPVT in our study group.

### **FOLLOW-UP**

All patients were followed at regular intervals, the patients who were managed by dermal approximation sutures had an excellent outcome as far as function and the cosmetic outcome was considered. The patient with factor 13 deficiency had a closure time of 12 days and multiple episodes of bleeding during the hospital stay was complicated by flexion deformity of the wrist. The complication was managed by delayed application of a turn buckle splint, as complication was feared in early mobilization or physiotherapy. As far as the overall complication rate is concerned this was least in patients in which complete closure of the fasciotomy wound was possible in a short period. In contrast extravasation group all patients had an excellent outcome

### **CONCLUSION**

The traditional method of reconstruction in fasciotomy wound is skin grafting, however with proper planning application of dermal approximation sutures can decrease time of wound closure, hospital stay, and cost to patient. The technique is simple, effective, economical, and readily available

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