


Fasciotomy for Compartment Syndrome

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ABSTRACT

Compartment syndrome is an orthopedic emergency due to its potential complications and mortality. Many studies have discussed the supporting examination and closure of phasiotomy wounds related to compartment syndrome, but there is still no agreed reference standard for additional diagnostic tool and fasciotomy management. Surgeon's experience and preference are important in the management of compartment syndrome.

Keywords: Fasciotomy, orthopedic emergency, compartment syndrome.

ABSTRAK

Sindrom kompartemen merupakan salah satu kegawatdaruratan ortopedi karena potensi komplikasi dan risiko kematiannya. Banyak penelitian yang membahas mengenai pemeriksaan penunjang dan penutupan luka fasiotomi terkait sindrom kompartemen, namun belum ada referensi yang disetujui sebagai baku standar. Pengalaman dan preferensi dokter bedah terkait merupakan unsur terpenting dalam tata laksana sindrom kompartemen. **Alfonsius Stefano. Fasiotomi untuk Sindrom Kompartemen.**

Kata Kunci: Fasiotomi, kegawatdaruratan ortopedi, sindrom kompartemen.

OVERVIEW

Compartment syndrome is an orthopedic emergency due to its potential consequences such as permanent paresthesia, contractures, muscle dysfunction, limb loss, or even death.[1] Increased local osteofascial compartment pressure by swelling, trauma, or a tight cast may lead to ischemia, and prolonged ischemia may cause tissue anoxia that could trigger a cascade of inflammation and oxidative stress, lead to myonecrosis and ischemic neuropathy.[1]

Incidence of compartment syndrome is estimated to be 3:100.000 population/year, affecting more male than female (10:1) during second and third decades of life.[1] Risk factors for compartment syndrome are young-aged and multiple trauma injuries (i.e. tibial diaphyseal fracture), while the protective factors are thought to be sarcopenia and hypertension.[1]

After diagnosis of the compartment syndrome, fasciotomy must be considered to prevent sequelae and to restore the impaired circulation. Late or missed diagnosis are often found in children, patient with altered mental status, over-overexerted patient due to strenuous exercises, and compartment syndrome due to improper surgery positioning.

DIAGNOSIS

Compartment syndrome is a clinical diagnosis confirmed through anamnesis and physical examination. The complete signs and symptoms are 5 to 6 "Ps" (pain, pressure, pulselessness, paralysis, paresthesia, and pallor). Pain on passive stretch test is an important early symptom but may be subjective. Paresthesia is a late sign of

Table. The recommended compartment for pressure measurement

Location	Recommended compartment presure measurement
Upper Limb	
Arm	Anterior compartment
Forearm	Flexor/volar compartment
Hand	Introsseous compartment
Lower limb	
Thigh	Anterior compartment
Lower leg	Anterior compartment
Foot	Introsseous compartment

Figure 1. A. The modified shoelace technique; B. Shoelace technique application; C. Wound closure after skin approximation

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compartment syndrome. Paralysis is also a late sign that indicate an irreversible soft tissue damage.

Reduced capillary refill is an early sign of vascular injury seen in compartment syndrome which led to pallor and pulselessness as the late sign.

Tissue ischemia is the critical factor in compartment syndrome, some authors stated that a differential pressure (ΔP) < 30mmHg is the predictor of ongoing compartment syndrome. It is calculated as diastolic pressure minus intracompartment pressure.[1] Various devices used for measurement are needle manometer, wick catheter, slit catheter, transducer-tip intra compartmental catheter, and near-infrared spectroscopy.[2] The location for measurement was stated in the **Table.** A sudden burst, change of color, or necrosis of the muscles after release from fasciotomy may confirm diagnosis of compartment syndrome.[1]

FASCIOTOMY MANAGEMENT

Surgical fasciotomy provides an immediate action to decrease the compartment pressure to prevent myonecrosis and ischemic neuropathy. However, it is quite challenging because an immediate closure of the wound is contraindicative (resulting recurrent compartment syndrome), while a delayed closure might increase risk of some complications such as infection, scarring, and increased length of hospital stay. There is still no consensus on the best method for fasciotomy wound closure. It is based on surgeon preference and other factors like the wound condition, availability of devices, patient's preference, and financial resources.[1] Several options to manage the wound are delayed primary wound closure and negative pressure wound treatment (NPWT).[1]

1. Delayed Primary Wound Closure

Various methods may be performed to close the wound by gradually approximate the skin edges once the edema has resolved. Cohn, *et al*, introduced the gradual suture approximation technique in 1986. The loop is tied under light tension every 48 hours at bed side; the suture **(Figure 1A-1C)** can be performed when the wound edges are adequately approximated within one centimeter.[3–5]

Callanan and Macey modified the shoelace technique with the use of several subdermal K-wires along both of wound edges **(Figure 1A-1C)**. It was applied in seven patients without complication.[6]

Figure 2. 'Silver bullet' dynamic tension device

Figure 3. Dermaclose device on fasciotomy wound

Other method incorporates the use of dynamic tension device for approximation of the fasciotomy wound. A stainless steel instrument like silver bullet **(Figure 2)** is sutured into the middle of the wound. It gradually tightened daily through rotation.

Medina, *et al*, performed the fasciotomy closure on 8 of 14 patient with upper limb fasciotomy due to compartment syndrome. The wound closed within 10 days (mean of 7.4 days) and started the approximation of the edges at an earlier time compared to skin grafts (2.1 vs 10.3 days).[7]

Manista report a fasciotomy closure due to compartment syndrome of lower leg extremity by gunshot wound. He used Dermaclose device **(Figure 3)** on the seventh day postfasciotomy and the final closure occurred 8 days after the application of the devices with vertical mattress suture.[8]

Singh and Bluman used Canica dynamic wound closure device for lower leg extremity fasciotomy in combat war injury patient. The devices **(Figure 4)** were placed over the lateral wound under silastic elastomers. Sequential tightening could be done in bedside or in the operating room. Ten out of 11 patients undergone delayed primary wound closure with average time to closure of 2.6 days (range 2 to 6 days).[9]

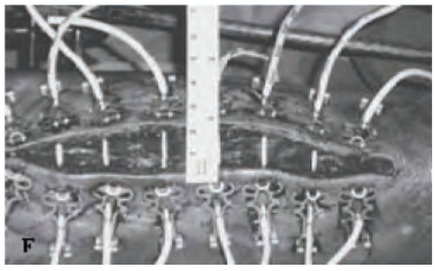

Figure 4. Canica dynamic wound closure application

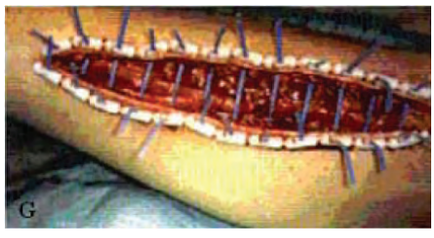

Figure 5. Silicone rubber as external tissue stretching device

External tissue stretching device **(Figure 5)** is made of polyamide or silicone rubber and consists of two holding bars with several straps between them. The stretching is completed in one to two weeks (the tension were increased twice daily). Twenty of 16 patients successfully underwent the wound closure. The mean stretching time was 6.9 days (ranged 4 to 16 days).[10]

2. Negative Pressure Wound Therapy

Negative pressure wound therapy (NPWT) can be applied in various ways depending on the wound condition and surgeon's preference. It can be used as a wet-dry dressing, adjunct to other closure techniques, or as a definite treatment for wound closure. It drain excess fluid from the compartment so the edema are reduced, improve the blood flow, and restrict bacterial growth. But it has other drawbacks such as cost-effectiveness, length of treatment, and related complications like over granulation and vascular erosion that require skin graft.[11–13]

Zenke, *et al*, reported a combination of the shoelace technique with the use of negative

pressure wound therapy. The silastic vessel loops were applied to the wound edges using skin stapler and the dressing applied were connected to the vacuum assisted devices. Only one out of eight wounds (in five patients) undergone lower leg fasciotomy needed skin graft for the wound closure.[14]

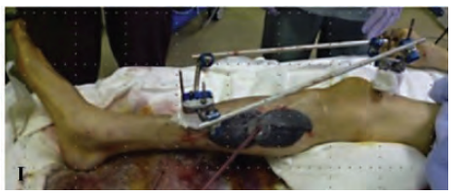

Figure 6 and 7. Combination method of shoelace technique and negative pressure wound therapy

CONCLUSION

There is no consensus regarding the recommended for fasciotomy wound closure. Primary wound closure should be avoided because of the risk of recurrent/persistent compartment syndrome. The use of NPWT may be a choice of treatment but due to cost effectiveness and the availability, it should not become a primary choice. Delayed primary closure with or without dynamic dermatotraction devices should be preferred. Moreover, treating surgeon should be familiar with the choice of treatment they are using.

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