# Delayed Closure Of Fasciotomy Wound In Acute Compartment Syndrome Using A Novel Pasha Device: A Rare Case With Vascular Injury

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**Delayed Closure of Fasciotomy Wound in Acute Compartment Syndrome Using a Novel Pasha Device: A Rare Case with Vascular Injury**

*Key Clinical Message:*

*The Pasha Device offers a novel, effective approach for dermo traction in managing fasciotomy wounds from tibial fractures with vascular injury, promoting timely wound closure and reducing infection risks. Further studies are needed to validate its broader application in complex orthopedic cases.*

*Abstract:*

**Background:** Tibial diaphyseal fractures often complicate and result in Acute compartment syndrome. It is associated with significant morbidity and mortality unless treated promptly. Fasciotomy is one of the mainstays of treatment, and wound closure can be challenging.

**Case Presentation:** This case report showcases our experience with a relatively new and innovative device, the Pasha Device, in dermo traction to facilitate delayed primary closure of a fasciotomy wound due to a closed tibial diaphyseal fracture and vascular injury. A 27-year-old male suffered from a road traffic accident and presented with a closed tibial fracture and compromised distal neurovascular bundle, prompting an urgent fasciotomy. Following the repair of the transacted posterior tibial artery and the application of an external fixator, the Pasha device was employed for wound closure. Based on the Illizarov method, this device facilitated dermo traction through the progressive closure of wound edges over 20 days. Informed consent was obtained from the patient. Complete wound closure was achieved by day 35, demonstrating the effectiveness of dermo traction in promoting delayed primary closure, especially in situations with vascular compromise. A satisfactory wound-healing ratio was achieved within this period, underscoring how this strategy can expedite recovery and reduce the risk of infection.

**Conclusions:** The use of the Pasha Device for dermo traction presents a promising strategy for managing fasciotomy wounds associated with tibial fractures, especially in cases complicated by vascular injury. Further study is crucial to validate its efficacy and safety in a larger cohort. This could potentially offer a cost-effective and efficient method for wound closure in complex orthopedic cases, and your contribution to this research is invaluable.

**Keywords:**

compartment syndrome; closure technique, wound; device, orthopedic fixation; fixation device, orthopedic; equipment, orthopedic

*Introduction:*

Acute compartment syndrome in a tibial diaphyseal fracture has been a prevalent finding after road traffic accidents and requires continuous monitoring of the compartment pressures to avoid complications.[1] Inefficient monitoring and development of the compartment syndrome can have excruciating ramifications such as sensory loss, contractures, muscle death, amputation, and eventually death.[2]

Considering the implications of acute compartment syndrome, a well-timed fasciotomy is necessary to save the limb.[3] However, this fasciotomy leaves substantial skin incisions as open wounds, which can be managed with primary closure using many methods available in the domains of orthopedic and plastic surgery.[4]Additionally, the closed tibial diaphyseal fracture needs fixation due to instability. An external fixator for managing this fracture is considered superior due to internal fixation having a higher probability of deep infection[5].

The serial traction technique is one of the few novel methods to achieve delayed primary fasciotomy wound closure. This technique provides a cost-effective method for the closure of these wounds.[6] The Pasha device helps create the serial traction technique using the Illizarov method and has been effective in delayed primary closure of the fasciotomy wound.[7]

Our study focusses on a patient who had a closed tibial diaphyseal fracture with a fasciotomy wound managed using the dermal traction technique applied by a pasha device in a patient with vascular injury. Previous studies have not applied this study to subjects with vascular compromise.

**Case Report:**

**History and Examination:**

A 27-year-old male landed in the trauma center of a tertiary health care facility in Punjab, Pakistan. The patient was in a road traffic accident and had a closed fracture of the Tibia. The patient had a compromised distal neurovascular bundle. Considering this scenario, the intercompartment pressure of his leg was measured, which was more than 30 mmHg. An urgent fasciotomy was performed, and upon exploration, transection of the posterior tibial artery was observed. The transacted artery was repaired by a general surgeon, followed by an external fixator application for tibia fixation. The fasciotomy wound is shown in figure 1.

A new instrument, the Pasha Device, was used to help close a fasciotomy wound. Grounded in the fundamentals of the Illizarov traction regeneration technique, this device utilizes key components typical of those employed with these tools and methodologies, which are frequently used within orthopedic surgery for both bone and soft tissue traction and regeneration.

The approach started with extensive debridement of the wound to eliminate necrotic tissue and microorganisms, guaranteeing a clean and fresh surgical field. After preparing the wound, two special wires were carefully passed through various subcutaneous planes (layers of tissues lying just above the deep fascia). These wires were positioned to allow for the effective distribution of adhesive tractive stresses.

The suture pulley provided by the Pasha device made from Prolene 0-1 was applied. These sutures were placed to work with the device in performing controlled dermo traction. This machine was like a dermo tractor since it pulled the skin and deeper tissues continuously, thus progressively pulling together the wound ends.

Figures 2, 3, and 4 show that the two threaded bars of the Pasha Device were rigidly fixed along the wound edges. The fixing provided the support necessary for an even distribution of traction forces, thus helping to close the fasciotomy wound successfully. Thus, mechanical traction by the Pasha Device combined with a precise suturing technique resulted in effective wound closure with low tension and good healing conditions.

Over 20 days, the device's wires were tightened, and the edges were brought closer based on the principle of dermo traction, resulting in the complete closure of the wound during this period. This can be seen in figures 5, 6 and 7.

The wound healed entirely over 35 days (figures 8, 9 and 10). The external fixator remains in place and is scheduled for removal around the 75th day. The patient is showing excellent recovery, with significant improvement in mobility. He is now able to bear weight on the affected limb and is expected to return to complete mobility after the removal of the external fixator.

**Methods:**

The patient presented with a closed tibial fracture and compromised distal neurovascular bundle, necessitating urgent fasciotomy. Following repairing the transacted posterior tibial artery and applying an external fixator, the Pasha Device was employed for wound closure. Based on the Illizarov method, this device facilitated dermo traction through progressive closure of wound edges over 20 days.

**Differential Diagnosis:**

Acute compartment syndrome, closed tibial diaphyseal fracture, and vascular injury compromising the distal neurovascular bundle were all possible diagnoses. Each potential diagnosis was carefully considered based on the patient's history, clinical examination findings, and diagnostic imaging results.

**Investigations:**

Diagnostic investigations included measuring intercompartment pressure and imaging studies such as X-rays, CT scans, and vascular imaging. These investigations were crucial for guiding treatment decisions and optimizing patient management.

**Treatment:**

Treatment involved urgent fasciotomy to relieve compartment pressure, ligation of the transacted posterior tibial artery, and application of an external fixator for tibia fixation. The Pasha Device was utilized for wound closure, employing dermo traction principles to gradually bring the wound edges closer over time.

**Follow-Up**

Regular follow-up evaluations were conducted to monitor wound healing progress, assess for complications, and ensure optimal recovery. Clinical examinations and imaging studies were performed to evaluate the patient's response to treatment and guide further management decisions.

**Ethical Considerations** :

Informed consent was taken from the patient, and ethical considerations were discussed.

**Results:**

Results were encouraging when the Pasha Device was used for dermo traction to treat a fasciotomy wound related to a closed tibial diaphyseal fracture, especially in a patient who had vascular impairment.

In our case study, a young male patient involved in a road traffic accident presented with a closed fracture of the Tibia, accompanied by a compromised distal neurovascular bundle necessitating urgent fasciotomy. Upon exploration, a general surgeon observed and promptly repaired the transection of the posterior tibial artery. Subsequently, an external fixator application was performed for tibia fixation.

Following four days of fasciotomy and external fixator application, closure of the fasciotomy wound was planned. The Pasha Device, a novel instrument designed for dermo traction and the Illizarov traction regeneration technique, was utilized for this purpose. The device, incorporating components of the Illizarov method, facilitated dermo traction by inserting two wires in the subcutaneous planes of the wound along with two threaded bars. Pulley sutures using Proline-01 were employed for wound closure, and the two bars were fixated on the wound borders.

Over 20 days, the device's wires were gradually tightened, progressively bringing the wound edges closer through dermo traction. This process led to the wound's closure within the stipulated time frame. By day 35, the wound exhibited complete healing, showcasing the effectiveness of the dermo traction technique facilitated by the Pasha Device.

**Discussion:**

A well-known phenomenon related to vascular compromise is acute compartment syndrome. This alarming phenomenon was observed in our case, similar to previous reports.[8] The presence of a diaphyseal tibial fracture adds to the chances of developing acute compartment syndrome and makes the management strategies a difficult decision.[9]

Different schools of thought have always governed the management of these fractures. Whether open internal fixation or an external fixator is performed is determined according to the patient or the peculiar case. [10] Previous studies have determined that using an external fixator in road traffic accident-associated tibial fractures allows soft tissue injury to heal.[11] In our study setting, this principle is used to achieve delayed primary closure of the fasciotomy wound secondary to acute compartment syndrome.

The fasciotomy wound can be managed with a wide range of choices; however, the most effective method to achieve fasciotomy wound closure is still a debatable topic.[4]

Popular choices for closing fasciotomy wounds include split-thickness skin grafts, vacuum suction dressings, and dermo traction using various types of equipment.[12] The principle of dermo traction is the basis for the pasha device used in this setting.

Additionally, the delayed closure of wounds with tibial fractures is preferred over primary closure, primarily due to increased complications confirmed in studies associated with the primary closure of the fasciotomy wound.[13]

In light of the studies discussed above, an approach to delayed primary wound closure using the dermo traction principle was elected. The novel Pasha device offers this, which uses dermo traction principles with simple Illizarov device components of wires and threaded bare along with proline-1 sutures to achieve the necessary regeneration.[7]

Our study favors using a pasha device for cases where a fasciotomy wound converts a closed tibial diaphyseal fracture into an open fracture. It also provides evidence regarding the efficacy of this method in patients with a compromised distal neurovascular bundle. Due to posterior tibial artery transection, delayed wound closure allows the compromised muscle to form alternate communicating arteries through angiogenesis while the primary vessel (the posterior tibial artery) is damaged.

**Conclusion:**

In conclusion, our study demonstrates the successful application of the Pasha Device for dermo traction in achieving delayed primary closure of a fasciotomy wound associated with a closed tibial diaphyseal fracture, particularly in vascular compromise. By employing the principles of dermo traction over 20 days, facilitated by the innovative design of the Pasha Device, complete closure and subsequent healing of the wound were achieved within 35 days. These results signify the potential of the Pasha Device as a cost-effective and efficient method for managing such complex wounds, offering favorable outcomes and paving the way for enhanced patient recovery and mobility. Further studies on a larger scale are warranted to validate the efficacy and safety of this technique in diverse clinical settings.

**Consent**

Written informed consent was obtained from the patient for publication their data and all the accompanying images.

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**Author contribution statement**

All authors contributed in the study design, writing of the paper, and final approval of the case report.

**Conflict of interest statement**

None.

**Authorship contribution statement:**

1. **Obaid Ur Rehman:** Conceptualization, Formal analysis, Investigation, Resources, and Supervision.
2. **Ameer Hamza Mahmood Ul Hassan:** Data curation, Methodology, and Visualization
3. **Nehala Nooz:** Methodology, Project administration, and Writing - original draft
4. **Muhammad Hasan** : Data curation, Investigation, Methodology, and Writing - original draft
5. **Muhammad Usman Khawaja** : Data curation, Writing - original draft, and Writing - review & editing
6. **Abdur Rehman:** Data curation, Software, Writing - original draft, Writing - review & editing
7. **Javed Iqbal:** Supervision, Software, Writing - review & editing, and funding acquisition.

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**Figure Legends:**

1. Figure 1: Figure 1
2. Figure 2: Figure 2
3. Figure 3: Figure 3
4. Figure 4: Figure 4
5. Figure 5: Figure 5
6. Figure 6: Figure 6
7. Figure 7: Figure 7
8. Figure 8: Figure 8
9. Figure 9: Figure 9
10. Figure 10: Figure 10