

A case report of acute compartment syndrome of the leg from tight traditional bone setter's splint with an underlying close tibia fracture: a need for early recognition and emergency fasciotomy.

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Abstract: Acute compartment syndrome may occur primarily after a fracture of the tibia, when bleeding and haematoma accumulate within a tight osseo-fascial compartments of the leg. But, a tight traditional bone setter's splint applied on the fractured leg would most likely cause compartment syndrome in the leg in which the haematoma couldn't have been significant to result in pressure rise. Often times this is not recognized until it deteriorates to gangrene. This patient presented in our emergency unit with excruciating pain in the leg, swollen cold toes, tense tender calf and prolonged capillary refill, all suggestive of compartment syndrome. We carried out an emergency fasciotomy to save his leg while fracture fixation and wound cover were done as delayed procedures. This case highlights the need for early recognition and emergency treatment of those few patients that present when their limbs are still salvageable.

Keywords: compartment syndrome, traditional bone setter, tight splint, gangrene, fasciotomy

Key messages

- ++ Raised intra-compartmental pressure is a time and level dependent cause of ischaemic tissue damage.
- ++ More commonly, patients with tight bone setters' splints would present to the surgeon at the late stage of gangrene than at the onset of ischaemia.
- ++ When against all odds, a patient in tight splints is transferred to a surgeon, the latter should take urgent actions to save the limb on the background of rapidly closing window of opportunity for limb salvage.
- ++ Early recognition and emergency fasciotomy are important to save the ischaemic limb.
- ++ For this patient, eliminating his pain and saving his limb created a whole lot of difference between the surgeon and the traditional bone setter.

I. Introduction

Acute compartment syndrome of the limb is an uncommon orthopaedic emergency. The incidence ranges from 2% to 12.5% in some series (1, 2, 3). It occurs when there is a build-up of pressure within a tight osseo-fascial compartment above the threshold that permits the normal function of blood vessels, nerves and muscles within the compartment. Compartment syndrome sometimes occurs in the leg after fracture of the tibia from the accumulation of haematoma within the tight space. Most commonly, it occurs when tight splints are applied on the limbs by the bone setters in the course of their treatments of traumas. The value of early recognition cannot be over-emphasized because the tissue damage from ischaemia is worse by the passage of time. A high index of suspicion is not needed to make a diagnosis of compartment syndrome for a clear case like our index patient who presented in the emergency department with complaints of severe pain and traditional bone setter's splints in place. This is because the aetio-pathogenesis of compartment syndrome has been strongly and directly linked with the tight splints applied by these alternative health providers in their practice settings (4, 5). In a related study, some authors reported a high incidence of gangrene from tight splints and infections among patients that were transferred from the traditional bone setters' homes to an orthodox facility (6). Only a few patients present early when their limbs are still salvageable. It is important therefore to identify these group of patients quickly, confirm the presence of compartment syndrome and institute emergency fasciotomy with the intension of saving their limbs and ultimately their lives. Fasciotomies if performed early would eliminate the severe pain and lead to gradual but complete recovery of the limbs. This intervention may create for the patients the glaring differences between the surgeon's and the traditional bone setter's methodologies. On the other hand, if performed later, some inevitable but limited muscle death will lead to late onset Volkmann's ischaemic contracture with the attendant deformity and loss of function. Similarly, if the delay is prolonged and muscle damage is global, there are greater risks of hyperkalaemia, acidosis, myoglobinuria, acute renal failure, sepsis, gangrene and sometime death (3, 7). This case report highlights the

need for the surgeon to take all the necessary actions and quickly too, to save the limbs of those patients who present later but within the rapidly closing window of opportunity for limb salvage.

II. Case Presentation

The patient is a 37 year old male who had a road traffic accident on the 1st of July, 2014 during which he sustained fracture of the left tibia. He was taken to a nearby hospital where a plain radiograph confirmed the fracture. The relatives took him to the traditional bone setter who applied a tight splint on the leg and soon after, his pain worsened. The splint was retained despite the patients' complaint of pain and tightness. By morning, the patient insisted on transfer to our orthopaedic centre, 9 hours after the application of splint, amidst family and friends arguments for and against.

He was in painful distress. The left leg was wrapped in wooden splints spanning the entire length tightly bound with white strips of clothing. The exposed toes were pale, swollen and cold. These indicated ischaemia and so the splints were removed. The leg smeared with earthen and herbal concoction was noted. There were fracture blisters, some already ruptured. The calf was tense and passive dorsiflexion of the toes was very tender though patient could move his toes actively. Capillary refill was six seconds, dorsalispedis pulsation was weak compared to the contralateral side, and toe pulse oximetry showed peripheral oxygen saturation (SpO₂) of 68%, the contralateral side was 98%. A diagnosis of acute compartment syndrome of left leg from bone setter's splint was made with close fracture of the tibia. The plan was to perform emergency fasciotomy in the operating room.

The haemoglobin was 11.2g/dl and urinalysis was normal. Informed consent was obtained and under general anaesthesia, a vertically placed generous incision on the anterolateral aspect of the leg was made and advanced through the deep fascia. As the investing deep fascia was incised the muscles were popping out and the haematoma was evacuated. The muscles were judged viable because of bright red bleeds and colour as well as the contractility. On table, the dorsalispedis pulsation became stronger and the SpO₂ hovered between 95% and 98%. We did not think it was necessary incising other compartments. A loose bulky dressing was applied and the leg was wedged with two pillows and elevated to the patients' heart level. X-ray showed an oblique comminuted fracture of the tibia (Fig.1). The patient was placed on broad spectrum antibiotics and was given anti-tetanus prophylaxis. His urine output was adequate and post fasciotomy serum electrolytes, urea and creatinine measurements were normal.

We planned to fix the fracture as soon as possible with a narrow plate and screws. Three days after fasciotomy, open reduction and plating with a 10-hole narrow Association of Osteosynthesis Dynamic Compression Plate (AO-DCP) was performed under general anaesthesia without a proximal tourniquet. A split skin graft was used to cover the fasciotomy wound in the same theatre session (Fig.2). Recovery was uneventful and the check X-ray showed satisfactory bone alignment and hardware placement (Fig.3). The patient was discharged on the 17th post-operative day. By 12 weeks, he was fit to ambulate (Fig.4). On one of the follow up visits, patient and some family and friends were given an appropriate health talk.

III. Discussion

The tips and tricks for early recognition of compartment syndrome is having a high index of suspicion especially in trauma involving the leg with or without fracture. Pain that is out of proportion to the extent of injury is one of the earliest symptoms. In a situation where a patient's leg is tightly bound with traditional bone setter's splint like in our index case, the clinician should rule out compartment syndrome as a matter of urgency. In this case, pain that worsened and became excruciating soon after application of a splint indicated early ischaemia. Swollen toes, tense calf and cold extremity are also early features of compartment syndrome. However, pulselessness and darkening of the extremity are features of gangrene which is the end but preventable result of unrecognized compartment syndrome. The splint is usually retained because the traditional bone setters do not realize that the tight splints were the cause of the severe pain (8) rather they take it as part of normal response, thus aggravating the tissue ischaemia. The patronage of the traditional bone setters is strongly linked to the influences of family and friends (9). It is therefore not surprising that as soon the radiograph confirmed fracture, patient was taken by some family members to the bone setter. It is also noteworthy that some family members and friends were still arguing for the patient to remain in the bone setter's home even when the patient was having excruciating pain. Patient's insistence eventually paid off but the main reason why the transfer was possible as we found out later was because the patient was responsible for his treatment expenses. The traditional bone setters are not known to refer patients appropriately, at least not at the early stage. Sending out the patients under certain guises becomes necessary when the limb starts darkening or patient may seek a transfer when he is not satisfied with this alternative treatment (8) like in our index case. Quick recognition and early fasciotomy helped to salvage his leg. Further delay could have resulted in more damage and even possibly gangrene, which would be devastating to both patient and family members as the only treatment is amputation (4).

Amputation is an unlikely treatment option in elevated intra-compartment pressure that occurs primarily due to fracture provided this is detected early. Further rise in pressure is commonly caused by the application of tight wooden or bamboo splints on the fractured leg that may already be accumulating haematoma in the tight space, and the traditional bone setters usually do not recognize the danger posed by these devices (8). It is the early diagnosis whether by clinical methods and or by compartment pressure measurement that will make the difference in terms of outcome of compartment syndrome and its' treatment. Normal compartment pressure in the leg varies in individuals and so is the threshold that tips the leg into acute compartment syndrome. This pressure is dependent on the diastolic pressure and so it is not an absolute value. Consequently, the measurement of compartment pressure of the leg is not absolutely necessary to make a diagnosis except the clinical features are equivocal, or patient is unconscious, or has neural problems that make him unable to feel pain. Furthermore, clinical method is the hallmark of diagnosis especially in a resource poor setting. The standard Whiteside manometer has been largely replaced by hand-held instruments like Stryker and Kodiag but as mundane as these instruments are in resource rich settings, they are not available in our centre. And if it will cause delay to arrange for intra-compartment pressure measurement, then it would be a sound surgical decision to err on the side of caution. Summarily, when in doubt, perform fasciotomy because the scar of fasciotomy is better than Volkmann's contracture (10) or losing a limb from gangrene. It is said that no one will blame the surgeon for carrying out fasciotomy but everyone will blame the surgeon for missing the diagnosis of compartment syndrome and inadvertently allowing it to degenerate into gangrene.

Gangrene is the result of prolonged ischaemia. However, limited muscle ischaemia results in late complication of fibrosis and Volkmann's contracture. In very mild cases, the muscles later become hypoplastic and the limb smaller, without loss of function. These complications are more evident if compartment syndrome occurs in childhood fractures. Not surprising, children with or without fractures are more commonly constrained to receive treatments from bone setters (2, 4) and so they are more likely to suffer these long term deformities because of the effect of growth on structural changes. Also the paediatric patients are unable to remove the splints when they develop severe pain and unfortunately, the parents sometimes enforce the retention of the splints as instructed by the bone setter. On the other hand, the older patients like our index case would sometimes initiate and enforce their discharges from the traditional bone setters' homes.

Setting this patient's fractured tibia by orthodox method required the options of plating or interlocking nailing or external fixation. This could have been undertaken primarily at the time of fasciotomy since the muscles were largely viable but it was not possible to make the necessary arrangements for fracture fixation within the emergency time frame. We recognized that fasciotomy necessarily converted a closed fracture to an open fracture and in this patient beyond six hours, which ordinarily makes internal fixation to be contra-indicated. But, we did this under a controlled environment and therefore we decided that an interval open reduction and internal fixation by plating is indicated and in fact the best surgical option in the case. A sterile implant pack that contains varieties of implants, which we would have found useful in treating any fracture configuration primarily at the time of fasciotomy was not readily available in our centre. Therefore, a plating plan necessarily had to be made after fasciotomy for interval ORIF three days later. Split skin grafting was carried out in the same theatre session and this helped to shorten the hospital stay. External fixation was another option but it would have meant longer hospital stay. Comparatively, apart from the slight rise in intra-osseous pressure (11) that would have resulted from intramedullary reaming and nailing on the background of resolving compartment syndrome, we did not have the requisite armamentarium like image intensifier for interlocking nailing. Also, the fracture haematoma which closed interlocking nailing depends on for optimal fracture union was evacuated during the fasciotomy and so this edge was lost. Limitations in the areas of adequate instrumentations and availability of ready to use ranges of implants are part of the bane of orthopaedic practice in our centre, as it is in many other centres in south east Nigeria.

In Nigeria, as in many developing countries, traditional bone setters abound. A lot of people still believe that fractures cannot be treated properly by orthodox doctors and majority of them would consult the traditional bone setters first and later may seek orthodox care when complications occur (8, 12, 13, 14). Some believe that basic training and formulation of training algorithm to improve bone setters' techniques are necessary (15, 16). However, for this to succeed, some authors noted rightly that, there should be a complementary efforts between the conventional orthopaedists and the bone setters (17). Others believe that adequate supervision like in many other processes in Nigeria would be lacking and the fear is that some of the bone setters will stand on the basis of the training and certification to continue their practice with impunity. However, when the orthopaedic team get the opportunity to give a health talk about this menace, it should be seized with the intent of spreading the information to forestall future occurrence among family and friends and ultimately the general public.

IV. Conclusion

Early recognition of compartment syndrome and emergency fasciotomy in the presence of tibia fracture resulted in the salvage of this patient's leg and a planned secondary plating of the seemingly open fracture done in a controlled environment lead to swift recovery without any complication.

Consent

The patient gave unconditional approval for this report and the authority to use part of his image for this publication.

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Fig 1. Plain radiograph showing comminuted fracture of the mid-shaft of tibia



Fig 2. Photograph of the leg showing generous fasciotomy wound to ensure complete decompression



Fig. 3 Plain radiograph showing well aligned bone and well placed hardware.



Fig 4 Photograph at 12 weeks post-operation, showing ambulation exercises and consolidated split skin graft.