Case Report

The Ilizarov technique in severe postburn knee contracture

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Abstract

Background: Postburn knee flexion contracture is associated with contraction of the musculotendinous unit, neurovascular structures, joint capsule and ligaments. Acute correction can lead to serious complications. Gradual correction with the Ilizarov technique is one surgical method to limit these complications.

Aim: To report a case of severe postburn knee contracture successfully managed by the Ilizarov technique.

Case Report: A 12-year-old male presented with features of postburn left knee flexion contracture following poorly managed burn injury sustained 9 months earlier. The flexion deformity was fixed at 160 degrees. There was an initial attempt at contracture release and split thickness skin grafting which was complicated by proximal tibial fracture. After the fracture healed, gradual correction with the Ilizarov frame was commenced. This fully corrected the knee contracture and the associated ulcer was grafted with thick split thickness skin graft. After the Ilizarov frame was removed, he maintained an excellent left knee range of motion at 6 months after.

Conclusion: The Ilizarov technique is an effective and safe procedure to successfully manage severe postburn knee flexion contracture.

Keywords: Ilizarov technique, postburn, knee, contracture

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INTRODUCTION

Knee flexion contracture is a disabling condition,[1-3] and can result from cerebral palsy, arthrogryposis multiplex congenita and other congenital deformities, popliteal pterygium syndrome, juvenile rheumatoid arthritis, haemophilic arthropathy, trauma, prolonged immobilization, and burn.[1-12]

Knee flexion contractures cause reduced mobility, functional impairment, limb length discrepancy and cosmetic defects.[2,4] In knee flexion contractures, the mechanical axis of the limb falls posterior to the knee thereby increasing the demand on the quadriceps muscle to resist progressive crouch. [1,10] Knee flexion contracture therefore cause crouch gait and excessive energy consumption during walking, making daily activities difficult.[1] However, if the increased demand in the quadriceps muscle is associated with quadriceps weakness, it results in a hand to knee gait.[10] If the knee flexion contracture is severe, it can result in the affected person being non-ambulant.[10]

Burn injury is a common cause of trauma especially in low and middle income countries.[13,14] Deep, partial or full thickness burns that are not treated, neglected or managed conservatively can lead to the development of burn scar contracture with significant reduction in joint range of motion if occurring around a major joint like the knee joint.[13-15] Postburn contractures over major joints of the body are characterized by single-celled, highly fragile neoepithelium which may be associated with the shortening of the musculotendinuous units, neurovascular structures, joint capsules and ligaments.[15-17] In long standing contracture, the joint may be subluxed or dislocated with the joint capsules and ligaments becoming tight in the direction of the contracture.[15,16]

Schneider et al had reported that postburn knee joint contractures constituted 22% of major joint contractures in their prospective study.[15,18,19] Postburn knee joint contractures have been classified by various workers. Ogawa and Pribaz classified postburn knee contractures as I - linear contracture of the knee joint (Ia - anterior, posterior, tibial or peroneal surface; Ib - tibial and peroneal surface); II - broadband contracture of the knee (IIa - anterior, posterior, tibial or peroneal surface; IIb - tibial and peroneal surface); III - broadband contracture extending to the neighbouring surfaces; IV - broadband contracture of the entire circumference; and V - others.[11,14] Dougherty et al classified postburn knee contractures into two classes - those affecting it medially or laterally with unburned skin posteriorlly and those with contracture of the entire popliteal area.[11,20] Grishkevich and Vishnevsky classified postburn knee contractures into edge knee flexion contracture in which the popliteal area (flexor surface) remained undamaged, the contracted scars formed a crescent fold along the popliteal fossa edge, the crest of the fold was the scar's edge and the scars of the fold consisted of two sheets - a lateral scar sheet (lateral aspect of the popliteal fossa) and a healthy medial sheet (on the undamaged popliteal fossa); medial popliteal contracture in which there is a crescent scar fold located on the medial aspect of the popliteal fossa with both sheets of the fold scarred and extending to the popliteal fossa edge; and total knee joint contracture with scars tightly surrounding the knee creating severe scar surface deficit without fold.[11] Hudson and Renshaw classified these contractures into mild and severe types on the basis of less or greater than 50% range of motion of the joint.[11,13,20] Postburn knee flexion contractures have also been classified into mild with 100 to 150 degrees range of motion, moderate with 50 to 99 degrees range of motion and severe with less than 50 degrees range of motion.[14,18]

Generally, in the treatment of knee flexion contractures (postburn contractures being inclusive) various surgical and non-surgical methods have been utilized. The non-surgical methods include passive stretching,[14,15] splinting,[4,14] serial casting,[1,2 4,5,7,10,14] corrective bracing,[5] reverse dynamic sling,[1,2] extension de-subluxation hinges,[1,2] and traction.[7,10,14,19] Various surgical methods have been advocated and include hamstring tendon lengthening with posterior knee caspsulotomy,[1,2,5,7,10] distal femoral osteotomy,[1-7,10] femoral shortening,[5,6,10] guided growth with anterior distal femoral hemiepiphysiodesis in the skeletally immature patients,[1,4] incisional contracture release and skin grafting,[11,13,14,19,21,22] Z or V-Y plasty,[6,11,13,20,22] various flaps,[11,13,14,16,17,19] and the Ilizarov method.[1-12,14,19,21-24]

The aim of this paper is to report a case of severe postburn knee contracture managed successfully by the Ilizarov technique.

CASE REPORT

A 12-year-old male presented with postburn wound of the left lower limb with chronic postburn ulcers of the popliteal fossa and fixed flexion contracture of the left knee following a poorly managed burn injury sustained 9 months prior to presentation. Significant examination findings were ulcer over the posterior surface of the distal thigh and proximal half of the leg with the distal thigh and proximal half of the leg adhered together by a contracture. The knee flexion contracture was fixed at 160 degrees of flexion (Figure 1).

There was normal capillary refill in the toes and the sensations over the leg were intact. The right lower limb had a knee range of motion of 0 to 150 degrees. An initial incisional release and split skin grafting was attempted. In the course of the surgery, attempts were made to further extend the knee which resulted in a proximal tibial fracture. The procedure was therefore abandoned and a backslab applied. Wound dressing for the ulcer was continued. The fracture was confirmed to have healed after 8 weeks (Figure 2).

The patient was then planned for gradual correction with application of the Ilizarov frame. Two full rings were applied on the femur and tibia. The rings on the femur and tibia were connected by hinged connecting rods, one placed anteriorly and two placed posteriorly (Figure 3). Daily distraction commenced the following day following the rule of triangles,[25] utilizing a ratio of 1:3 (1mm to 3mm). The wire sites were regularly cleaned with normal saline and covered with povidone iodine dressing. There was no wire site infection. The initial phase of the the distraction is shown in Figure 4. As the distraction progressed, extension plates were applied on the medial and lateral sides. These were maintained until full full extension was obtained after 3 months of distraction (Figure 5). Subsequently, a thick split thickness skin grafting of all the wound surface was carried out (Figure 6). The Ilizarov frame was maintained until the graft took fully (Figure 7). After full graft take, the Ilizarov frame was left in situ (Figure 8) for a total of 6 months from the time of its application. The Ilizarov frame was removed afterwards and range of motion exercises were commenced for the left knee. At follow up 6 months after removal, the left knee range of motion was 0-140 degrees.

Figure 1: Postburn left knee contracture with flexion contracture of 160 degrees

Figure 2a: Medial view

Figure 2b: Lateral view

Figure 2: After initial attempt at knee contracture release and split thickness skin grafting. Sustained fracture of the proximal tibia which united following back slab (cast) immobilization. 2a: Medial view 2b: Lateral view

Figure 3: After application of Ilizarov frame

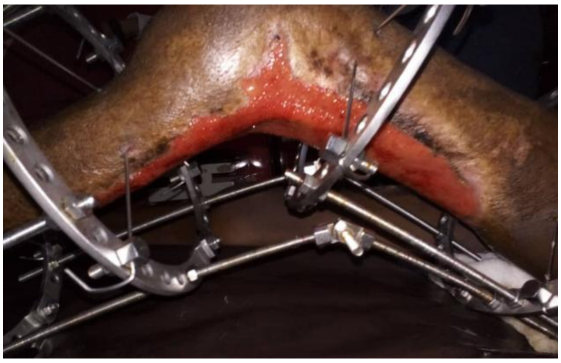

Figure 4: Initial phase of Ilizarov frame distraction

Figure 5: Full correction of the knee contracture with ulcer posteriorly

Figure 6: After thick split thickness skin grafting over all wound surface

Figure 7: After graft take

Figure 8: After full contracture correction with skin graft take and Ilizarov frame still in situ

DISCUSSION

The knee being one of the major joints of the body is involved in the maintenance of an upright posture and a bipedal locomotion.[17] Postburn flexion contracture of the knee will therefore cause reduced mobility, functional impairment and present cosmetic challenges.[2,4,11,14,15]

The index patient was classed as severe postburn knee contracture as the knee flexion deformity was fixed at 160 degrees when the patient presented following the inadequately managed burn injury. Using the Ogawa and Pribaz classification, the index patient falls under the type IV;[11,14] by the Dougherty et al classification the patient falls into the class with contracture of the entire popliteal surface;[11,20] and total knee joint contracture in the Grishkevich and Vishnevsy classification.11 In the Hudson and Renshaw classification, the patient falls under the severe grade [11,13,20] and also under the severe group as reported by Schneider et al. [14,18]

The severity of the postburn knee contracture will determine the treatment modality that will be utilized.[1,3,14] The mild form of postburn knee contracture can be managed by the non-surgical modalities of passive stretching, splinting, serial casting and traction.[1,2,4,5,7,10,14,15,19] The major drawbacks of these non-surgical methods are the limited amount of corrective forces that can be utilized because of the skin's inability to tolerate direct pressure and the risk of knee subluxation.[14] Z and V-Y plasty have also been utilized for mild to moderate varieties.[6,13,20,22]

More severe forms of postburn knee contractures would require surgical procedures which include hamstring tendon lengthening with posterior capsulotomy,[1,2,5,7,10] distal femoral osteotomy,[1-7,10] femoral shortening,[5,6,10] guided growth,[1,4] incisinal release and skin grafting,[11,13,14,19,21,22] Z and V-Y plasty,[6,13,20,22] various flaps,[11,13,14,16,17,19] and the Ilizarov method.[1-12,14,19,21-24]

The contracture in the skin and deeper tissues in postburn knee contracture, makes it difficult to release the contracture fully at the time of open surgery as the neurovascular structures and musculotendinous units stand out as bowstrings, limiting further release.[16] Also the vessels can go into spasm with compromise of the distal limb due to excessive stretch.[16] As a result, acute correction of postburn knee contracture by soft tissue release can lead to undesirable and potentially devasting complications such as peroneal nerve palsy, knee subluxation, hyperextension, skin necrosis, vascular compromise, recurrence,[1,3,4,12,14,16] and fractures as seen in the index patient.

Gradual correction with histiogenesis thus leads to gradual stretching of the musculotendinous units, joint capsule and ligaments as well as the neurovascular structures.[1,3,4,12,14,16] As a result, the complications that may likely follow acute correction such as neurovascular structure risks can be eliminated. [1,3,4,12,14,16] Contracture recurrence is also reduced due to elongation of the soft tissues.[1,3,4,12,14,16]

An adequate incisional or excisional release of postburn knee flexion contracture leaves a large skin defect with exposure of the bowstringed hamstring tendons, major vessels and nerves of the popliteal fossa and this will soft tissue cover.[17] This will necessitate the use of various flaps to cover the defect.[11,13,14,16,17,19]

The index patient had initial attempt at incisional release and split skin grafting. However, this could not correct the deformity as it was of a severe variety.

The Ilizarov device used in the treatment of postburn knee flexion contracture utilizes the principle of tension stress to generate new tissues as the gradual controlled traction on these living tissues create stresses that stimulate regrowth of these soft tissues.[1-12,14,19,21-24] This allows the musculotendinous unit to return to their full length, reduces the risk of vascular compromise and obviates the need for soft tissue releases. The Ilizarov device is versatile, biomechanically stable, adjustable and minimally invasive.[1-12,14,19,21-26] With the Ilizarov device, the index patient had full correction of the postburn knee contracture and the ulcer was covered with thick split thickness skin graft.

The use of the Ilizarov device is not without complications. Complications that can occur with its use include direct damage to neurovascular structures, bleeding with haematoma formation or compartment syndrome, pain, wire loosening, wire breakage, pin tract infection, osteomyelitis, subluxation of the knee, deep vein thrombosis and pulmonary embolism.[1-12,14,19,21-27] With expertise and adequate preoperative planning and postoperative care, the occurrence of these complications can be minimized.

CONCLUSION

The Ilizarov technique is an effective and safe procedure to manage severe postburn knee flexion contracture. With this technique, postburn knee contractures can be managed successfully. It can be combined with skin grafting if there are associated ulcers. However, careful attention to detail is required to reduce the likelihood of complications occurring.

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Conflicts of interest
There are no conflicts of interest

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