Chinese Journal of Traumatology 22 (2019) 364–367

Contents lists available at ScienceDirect

Chinese Journal of Traumatology

journal homepage: http://www.elsevier.com/locate/CJTEE

Case Report

Lengthening of a below knee amputation stump with Ilizarov technique in a patient with a mangled leg

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ARTICLE INFO

Article history:
Received 4 March 2019
Received in revised form
20 May 2019
Accepted 30 June 2019
Available online 1 August 2019

Keywords:
Below knee amputation
Stump lengthening
Ilizarov technique

ABSTRACT

A below knee amputation (BKA) requires sufficient stump length for the fitting of a modern prosthesis. In cases of trauma where the levels of injury are unpredictable, achieving sufficient stump length can be a challenge. We described a case report of using the Ilizarov technique for bone lengthening at the residual BKA stump for a patient who sustained a mangled limb following a road traffic accident. Using this technique, we have successfully lengthened the tibial stump adequately for a functioning prosthesis. As shown in this case, we believe that this technique could attain an excellent outcome for a selected group of patients with short residual BKA stump.

Introduction

A high below knee amputation (BKA) in the setting of trauma can result in a non-functioning stump that is too short for a below knee prosthesis. Conversion to an above knee amputation and the use of composite flap have been described in the literature.[1,2] Ilizarov principles of limb lengthening with the biology of distraction osteogenesis presents another alternative. To our knowledge, this is the first case described in Singapore using the Ilizarov technique for bone lengthening at the residual stump in order to achieve sufficient length for the fitting of a prosthesis. Soft tissue condition is an important factor in the use of this technique.

The patient's consent has been obtained for the purpose of this case report. Domain Specific Review Board approval was not required.

Case report

A 48 year-old Chinese male, with no significant medical history, was brought into the Accident and Emergency (A&E) by the ambulance following a road traffic accident. The patient was a driver of a truck when it collided head-on with another lorry. He was trapped in the driver seat for 30 minutes before extrication. On presentation to A&E, he has a mangled left leg, mangled extremity severity score (MESS) of 8, with a comminuted tibial shaft fracture and Schatzker type 6 tibial plateau fracture, as well as distal third femur shaft fracture (Fig. 1). The tibia was exposed with a near circumferential laceration at the midshaft level, and there was a separate proximal medial laceration of the leg measuring 8 cm × 4 cm (Fig. 2). There was no palpable left dorsalis pedis or posterior tibial pulses.

The patient was brought into operating theatre for emergent surgery. External fixation of the left femur was performed with pins in the proximal and distal femurs. The anterior tibial artery was explored by the vascular surgeons and found to be completely transected, while posteriortibial artery was thrombosed. The non-viable gastric and soleus muscles were excised and BKA was performed by fashioning a posterior flap at the level of the proximal wound (Fig. 3). A relook debridement was performed on post-operative day 3, whereby the wound was found to be healthy with no signs of infection. A negative pressure dressing was applied.

On postoperative day 7, removal of the external fixator pins and plating of the left femur was performed. The below knee amputation wound was inspected and found to be healthy, with a 10 cm × 12 cm skin defect. The wound was continued on negative pressure dressing. On postoperative day 14, the skin defect was covered with split skin graft, performed by the plastic surgeons.

The skin graft was fully taken subsequently and the patient progressed well with physiotherapy, having achieved a left knee ranging from 0° to 100° at 2 months. His left femur fracture healed

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Peer review under responsibility of Chinese Medical Association.

https://doi.org/10.1016/j.cjtee.2019.07.001

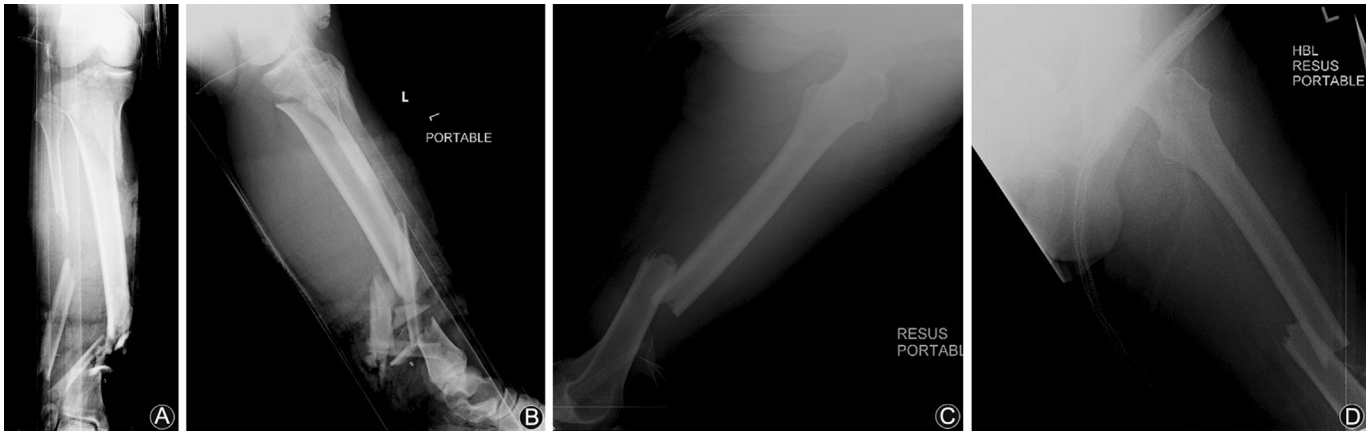

Fig. 1. Radiographs showing left tibial plateau and tibial shaft fractures (A, B), as well as left distal femoral shaft fracture (C, D).

Fig. 2. Clinical picture of left lower limb wounds on presentation to the accident and emergency.

without complications at 3 months. However, patient's stump was deemed too short for the fitting of prosthesis by the prosthetics and orthotics (P&O) team. Surgical options was discussed with him at the time, including an above knee amputation, stump lengthening using a vascularised bone graft, or lengthening using the Ilizarov technique.

The patient eventually chose the latter option of stump lengthening and underwent Illizarov ring fixator application and corticotomy, approximately 5 months after the initial amputation. The procedure was performed by the senior author. Under general anaesthesia, 3 wires were inserted proximally (1 cm distal to the knee joint line) and 3 other wires were inserted distally over the remnant tibial stump (1.5 cm proximal to the end of stump). The wires were connected to two 180 mm Orthofix rings fixator system, and corticotomy was then completed using oscilliating saw and osteotomesunder fluoroscopic guidance (Fig. 4).

At 1 week postoperatively, the process of lengthening was started in the outpatient clinic and interval radiographs were taken on each clinic visit. At 4 weeks, re-corticotomy was performed due to premature consolidation of the posterior aspect of the corticotomy site (Fig. 5). At 8 weeks, adjustment of fixator was performed due to excessive tension over distal pins. The frame was removed at 14 weeks when the stump had attained the intended length of 100 mm. In the same surgery, bone autograft harvested from iliac crest was placed beneath the pseudomembrane, and a locking plate was used to augment the stability of the lengthened stump, while excision of redundant soft tissue was performed.

A total lengthening of 44 mm was performed, achieving a final tibial stump length of 105 mm (Fig. 6). The patient underwent successful fitting of prosthesis by the prosthetics and orthotics team 3 months after removal of frame. He achieved a good range of motion of the left knee of 5°—100° (Fig. 7). He is now ambulating without walking aid, and is planning to return to work as a bus driver after passing his driving assessment test.

Discussion

A BKA stump with insufficient length presents a challenge for prosthesis fitting. In the clinical scenario of patients who had amputation secondary to trauma, the level of amputation is often determined by the site of injury and these patients are often young and active, with no pre-existing illness. Therefore they are expected to regain a high level of function. Conversion to an above knee/through knee amputation for this group of patients is an option. However, there are concerns with higher energy expenditure required,[1] and the poorer compliance with prosthesis.[2] Other

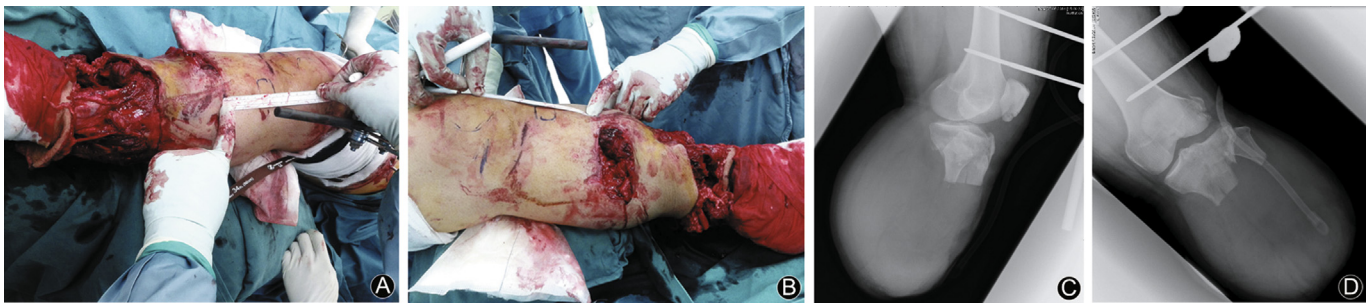

Fig. 3. Intraoperative pictures (A, B) and postoperative radiographs showing a high below knee amputation, along with distal femur external fixator pins (C, D).

Fig. 4. Initial radiographs showing application of Ilizarov frame over tibial stump (A, B).

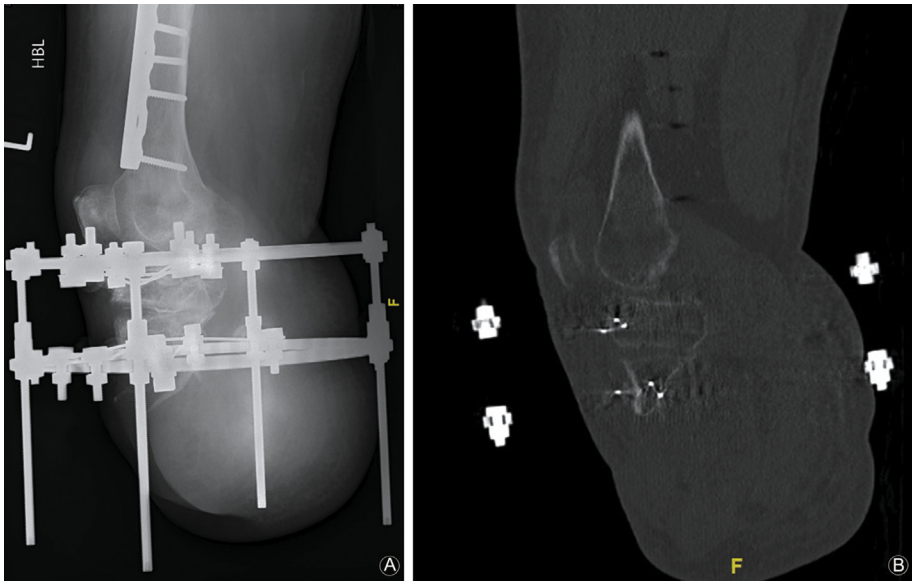

Fig. 5. Radiographs (A) and CT scan (B) showing premature consolidation of the posterior cortex.

possible options that have been described include lengthening of the stump using composite bone flap[3,4] or using the Ilizarov technique.

Stump lengthening using the Ilizarov technique has been published in the literature. Eldridge et al.[5] described in 1990 using the Ilizarov technique to lengthen a BKA stump in a 5-year-old child. In the same year, Latimer et al.[6] showed promising results in his case series, achieving a mean lengthening of 3.5 cm in 3 patients with traumatic BKA. Other authors have since published their cases with similarly good outcomes.[7–9]

In our case, two problems were encountered during the lengthening process. The first was regarding the soft tissue. Most authors concern about the inadequacy of skin and soft tissue resulting in ulceration after stump lengthening, with some advocating the use of tissue expanders, or even myocutaneous flaps.[5] On the contrary, our patient required excision of soft tissue on removal of the frame. This was due to the generous use of posterior compartment muscles when the posterior flap was fashioned during the initial amputation, and, rather than deeming it redundant and excising it initially, a split skin graft was utilized to cover the skin defect. The second problem encountered was the premature consolidation of the posterior aspect of the corticotomy site, which is a known complication with distraction osteogenesis. In our case, this was addressed by performing corticotomy at week 4.

In conclusion, BKA stump lengthening using the Ilizarov method can achieve an excellent outcome for a selected group of patients with short residual BKA stumps. It is imperative that several

Fig. 6. Latest radiographs showing final length of tibial stump after lengthening (A,B).

Fig. 7. Patient standing upright using his prosthesis (A, B). Appearance of his below knee stump (C). Full extension (D) and full flexion (E) of his knee joint.

considerations are taken into account, including a healthy, well-perfused soft tissue envelope, and the capability of the patient to understand the risks and benefits, as well as the treatment duration of Ilizarov frame application. By avoiding a higher level amputation, achieving good patient satisfaction and increased functional ability, stump lengthening should be considered a valuable option for similar cases in the future.

Funding

Nil.

Ethical statement

Informed consent has been obtained from the patient.

Conflicts of interest

Authors declare no conflicts of interest.

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