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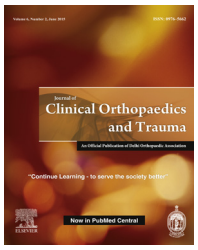

Original Article

Management of complex femoral nonunion with monorail external fixator: A prospective study

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ABSTRACT

Aim: To evaluate 30 patients who underwent distraction osteogenesis with monorail external fixator for complex femoral nonunion.

Method: Complex femoral nonunion includes infective non-union, gap nonunion, and limb-length discrepancy secondary to traumatic bone loss, which needs specialized treatment to ensure the functional integrity of femoral bone. 30 patients, including 28 male and 2 female (aged 22–62 years) patients, underwent surgical debridement followed by bone transport with monorail fixator. The lengthening index, radiographic consolidation index, functional status, bone healing, and various problems, obstacles, and complications encountered during the treatment were assessed.

Results: Patients underwent a mean of 2.2 (range 1–4) surgeries before presentation. The mean bone defect after surgical debridement was 5.83 cm (range 2–16 cm). The mean treatment duration was 204.7 days (range 113–543 days). The mean lengthening index was 13.06 days/cm with range from 12 to 16 days/cm. Mean maturation index was 23.51 days/cm with range from 17 to 45.5 days/cm. In our study, bone result was excellent in 17, good in 9, fair in 3, and poor in 1 patient. In our study functional outcome is excellent in

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9 [30%], good in 14 [46.67%], fair in 5, and poor in 2 patients. In our study, we encountered 34 problems, 17 obstacles, and 8 complications.

Conclusion: We concluded that monorail external fixator is an effective treatment option for complex nonunion femoral shaft fracture and its functional outcome is comparable with any other treatment options. Lack of complications and its effectiveness makes monorail external fixator the treatment of choice for complex nonunion femoral shaft.

1. Introduction

Complex femoral nonunion constituting infective nonunion, gap nonunion, and limb-length discrepancy secondary to bone loss needs specialized planning and assessment. Getting union along with correction of limb-length discrepancy is a challenging job for the orthopedic surgeon. It needed a comprehensive approach for the management of these types of nonunion, with managing of the nonunion and the bone gap simultaneously. Most often, segmental bone defects are managed by transplantation of vascularized or nonvascularized autogenous bone, allograft bone transplantation, or segment transport.[1] However, problems with vascularized bone grafts include donor site morbidity,[2] possibility of necrosis due to anastomotic complications,[3] long remodeling time, and high fracture rate.[4] There are many other ways to treat femoral nonunion. Internal fixation and external fixation along with biophysical enhancement are the classified methods of treatment. Internal fixation along with bone grafting can be done in aseptic nonunion without bone gap. In cases of infective nonunion, in which bone gap is created surgically after thorough debridement, and in cases with traumatic bone gap, bone transport based on principle of distraction osteogenesis is an effective way of getting union and functional limb without limb-length discrepancy.

Bone transport using external fixators alone, as first introduced by Ilizarov, needs long-term management with external fixators.[5] Ilizarov external fixation works on the principle of distraction osteogenesis and is commonly used as effective treatment option for complex femoral nonunion. Ilizarov ring external fixator is the established mode of treatment. But it has many demerits as it is too bulky and cumbersome, has many complications like multiple pin track infections, pin breakage, injury to opposite thigh, knee stiffness, bone osteomyelitis, distraction failure, vascular complications, refracture, etc.[6] Monorail unilateral external fixator based on principle of distraction osteogenesis for bone transport can be used as an effective treatment modality in these complex nonunion femoral shaft fractures. Therefore, we had used monorail fixator in our prospective study of managing 30 patients with femoral nonunion.

2. Material and methods

Our prospective study from 2010 to 2013 included 30 patients (28 male and 2 female) who underwent surgical treatment for complex femoral nonunion. This study was approved by the Medical college ethical board. Informed consent was taken from all the patients before including them in the study. A thorough history regarding mode and mechanism of injury, previous surgeries, and clinical examinations was undertaken. Patient demographics, presenting symptoms and duration, medical history, the presence of tenderness and pain, skin condition, shortening, deformity and function of the knee joint and distal neurovascular status, sinus, and pus discharge were recorded. The diagnostic workup of the patient included hemoglobin, TLC, differential leukocyte count, ESR and CRP, bleeding time, clotting time, blood group, random blood sugar, blood urea, serum sodium, serum potassium, roentgenogram of the affected limbs and chest, and sample for culture from the wound in open fractures (Tables 1 and 2).

All patients had a bone defect of >5 cm (preoperatively or after resection and debridement). Patient was placed on a simple operating table, which was compatible with C-arm image intensifier. The affected limb was painted and draped, and draping was done in such a way to get 90° of flexion intraoperatively to get maximum length of quadriceps muscle while applying the fixator. In cases of infected nonunion, lateral approach for femur was used. After dissection in proper planes, infected bone was exposed. The dead bone was resected and the infected tissues and sinus tract were debrided; soft tissue debridement was done adequately. Cortical bleeding – 'Paprika sign' – was the end point of debridement [Fig. 2] and surgically bone gap was created between healthy bone ends.[7–12] In cases of gap nonunion, bone gap was already present. Sclerosed fracture margin was freshened up till healthy bleeding bone. As bone gap was present, proper maintenance of femur alignment and rotation was necessary. In case of mid-shaft femur bone gap, alignment was made with the temporary application of 4.5 mm high-profile broad DCP and holding it with plate holding forceps or stainless steel wire or with application of proximal and distal screws. The plate was later removed after application of monorail fixator.

Table 1 – Functional outcome according to ASAMI classification after bone transport with monorail fixator [n = 30].

Functional outcome	Patients	Percentage [%].
Excellent	9	30.00
Good	14	46.67
Fair	5	16.66
Poor	2	6.67

Almost 77% patients got a healthy functional outcome and were satisfied with the treatment.