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Original Article

Staged protocol for the treatment of chronic femoral shaft osteomyelitis with Ilizarov's technique followed by the use of intramedullary locked nail

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Abstract

Background: Infected nonunion of the femoral shaft is uncommon, and usually presents with challenging therapeutic and reconstructive problems. There are still controversies over treating infected nonunion of the femoral shaft. The purposes of this retrospective study were to review the treatment outcomes and describe a staged protocol for spontaneous wound healing.
Methods: Six patients with chronic femoral shaft infected-nonunion from October 2002 to September 2010 were included in this retrospective study. Serial plain films and triple films of lower legs were performed to evaluate the alignment of the treated femoral shaft and bony union following our staged protocol of Ilizarov distraction osteogenesis and intramedullary nailing.
Results: An average bone defect of 7 cm was noted after staged osteotomy. Mean follow-up was 87.5 (range, 38−133) months. Union was achieved in all six patients, with an average external fixation time of 6.8 (range, 5−11) months. There was no reinfection. One complication of a 4-cm leg discrepancy was noted, with an initial shortening of 15 cm. The mean knee ranges of motion (ROM) before staged protocols and at final follow-up were 64.2 ± 8.6 (range, 60−75)° and 53.3 ± 9.3 (range, 40−65)°, respectively. The ROM at the knee joint statistically decreased following staged protocols.
Conclusion: In the treatment of chronic femur osteomyelitis, the staged protocol of Ilizarov distraction osteogenesis followed by intramedullary nailing was safe and successful, and allowed for union, realignment, reorientation, and leg-length restoration. With regard to the soft tissue, this technique provides a unique type of reconstructive closure for infected wounds. It is suggested that the staged protocol is reliable in providing successful simultaneous reconstruction for bone and soft tissue defects without flap coverage.

Keywords: femoral shaft; ilizarov fixator; nonunion; osteomyelitis

1. Introduction

Many complications may occur following treatment of femoral shaft open fracture such as nonunion, malunion, delay union, bone defect, bone and joint deformity or stiffness, limb-length discrepancy, and osteomyelitis.[1−3] Severe chronic osteomyelitis may lead to nonunion and massive skeletal defects caused by procedures such as radical debridement and sequestrectomy.[4] Soft-tissue damage around the fractures and subsequent wound management are other important factors affecting the outcome. A distinct advantage of Ilizarov treatment is the active use of the affected limb to improve its physiological function, which consequently minimizes the development of disuse osteoporosis and atrophy of the soft tissue.[5]

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

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However, there is no consensus in the literature regarding the ideal management of osteomyelitis after treating open femoral shaft fractures. In this study, we retrospectively reviewed the treatment of patients with chronic femoral shaft osteomyelitis, and provided a staged protocol with spontaneous wound healing using wet-to-dry dressing followed by simultaneous distraction−compression osteogenesis with Ilizarov's technique to restore soft-tissue defects and the bony gap without further flap coverage for the docking site. The external fixator was shifted early to an intramedullary locked nail when callus formation was visible at the distraction site. The combined technique reduces external fixation time and the consolidation index compared with classic techniques for the treatment of long-bone nonunion associated with chronic osteomyelitis.[6]

2. Methods

Six consecutive cases of infected nonunion of the femur between October 2002 and September 2010 were included. The study population consisted of three men and three women, with a mean age of 37.8 (range, 28−55) years at the time of injury. Four cases of infected femoral nonunion or osteomyelitis had developed after a closed fracture, and two after an open fracture. Informed consent for participation in the study was obtained from patients.

All patients underwent the same protocol at the authors' institution. Inclusion criteria were: absence of pin-tract infection when shifting the external fixator to a locked nail, and the existence of a suitable space in the intramedullary canal to accommodate a locked nail. Additional bone grafting was performed around the docking site in all patients. Full weight-bearing was allowed to enhance callus maturation during the distraction stage. All cases were followed, with complete data for final evaluation.

2.1. Staged protocols

The staged protocols for treating chronic osteomyelitis and soft tissue loss around the femoral shaft included (Fig. 1): (1) radical debridement for infected bone and soft tissue and the additional insertion of an antibiotic-impregnated cement-rod for 10 days in cases of previously existing septic medullary implant; (2) the use of Ilizarov's apparatus for all patients except those needing a delayed application because of a previously existing septic medullary implant; (3) osteotomy in healthy bone; (4) simultaneous distraction−compression osteogenesis and histogenesis; (5) additional docking-site bone grafting; and (6) shifting the external fixator to a locked nail with a closed technique when callus formation was visible at the distraction site. Appropriate intravenous antibiotics based on intraoperative culture results were used throughout treatment for all patients.

2.1.1. Radical debridement

Radical debridement is necessary before performing Ilizarov's procedure. With regard to infected bone, adequate debridement should give the remaining bone a healthy appearance with an opened intramedullary canal and bleeding surface, and is performed on a fracture table under traction. During sequestrectomy, the typical bone cut is made perpendicular to the anatomic femoral axis using a power saw cooled with saline irrigation. Under C-arm fluoroscopy, a K-wire is used as a guide for the bone cut. The remaining bone edges require soft tissue coverage to avoid desiccation, secondary necrosis, and osteomyelitis. When determining the amount of diseased bone to be removed, bone quality, rather than bone volume, was given priority. The remaining bone surfaces had visible bleeding spots and serosanguinous fluid discharge from the opened intramedullary canal or the multiple pin tracts made on the cancellous bone. The surgical wound was left open, and wet dressing was necessary. The presence of granulation tissue around the proximal or distal bone surface ensured adequate debridement. Ilizarov's apparatus was applied immediately following radical debridement.

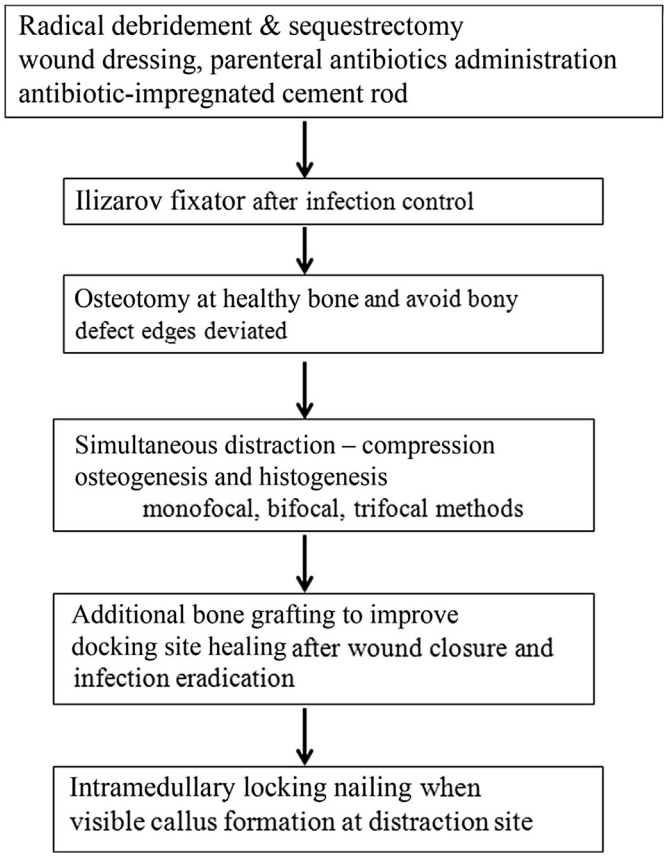

Fig. 1. Flowchart of the staged protocols. In the first stage, the intraoperative wound cultures were performed, and then appropriate parenteral antibiotics were prescribed throughout the protocols. The first stage of radical debridement and sequestrectomy might be arranged several times based on the wound conditions.

2.1.2. Osteotomy

One week later, osteotomy of the healthy bone was performed after applying the external fixator. The fracture table position and two-level osteotomies were suggested. When a short bone segment is left after an osteotomy of the femoral

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