The Knee xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

The Knee

Knee arthrodesis by the Ilizarov method in the treatment of total knee arthroplasty failure

Andrea Antonio Maria Bruno [a,*], Alexander Kirienko [b], Andrea Peccati [c], Paolo Dupplicato [a], Massimo De Donato [a], Enrico Arnaldi [a], Nicola Portinaro [c]

[a] Arthroscopic and Reconstructive Surgery of the Knee Unit, Humanitas Research Hospital, Rozzano, Milan, Italy
[b] External Fixation Unit, Humanitas Research Hospital, Rozzano, Milan, Italy
[c] Orthopaedics Department, University of Milan, Milan, Italy

ARTICLE INFO

Article history:
Received 8 June 2015
Received in revised form 22 September 2016
Accepted 3 November 2016
Available online xxxx

Keywords:
TKA failure
Ilizarov method
Knee arthrodesis

ABSTRACT

Background: Currently, the main indication for knee arthrodesis is septic failure of a total knee arthroplasty (TKA). The purpose of this study was to evaluate the results of knee arthrodesis by circular external fixation performed in the treatment of TKA failure in which revision arthroplasty was not indicated.
Methods: The study involved 19 patients who underwent knee arthrodesis by the Ilizarov method. Clinical and functional assessments were performed, including Knee Society Score (KSS). A postoperative clinical and radiographic evaluation was conducted every three months until the end of the treatment. Postoperative complications and eventual leg shortening were recorded.
Results: KSS results showed a significant improvement with respect to the preoperative condition. Of the 16 patients in the final follow-up, 15 patients (93.7%) achieved complete bone fusion. Major complications occurred in patients treated for septic failure of TKA and most occurred in patients over 75 years of age; the mean final leg shortening was four centimeters.
Conclusion: In our experience, the Ilizarov method is effective for performing a knee arthrodesis in the case of extensive bone loss. At the same time, it is possible to correct the associated leg deformities or limb length difference. In addition, only the Ilizarov method provides a mechanical stimulus for bone formation and improves the quality of the bone and of the microcirculation, which enhances the host response against infection. Despite these attributes, knee arthrodesis by the Ilizarov method must be considered a 'salvage procedure' in cases of severe outcomes from knee surgery in which revision arthroplasty is not indicated.

1. Introduction

Knee arthrodesis is a widely performed surgical procedure which has well-defined indications [46,55,64,79], and the procedure represents the best choice for those patients with extensive bone loss and recurring knee infections (Table 1). The main goal of such a procedure is to gain a stable and pain-free lower limb with a low risk of reinfection and a better functional outcome compared to an above-the-knee amputation. Conway and colleagues reported that the mean Knee Society Score (KSS) following a

* Corresponding author at: Arthroscopic and Reconstructive Surgery of the Knee Unit, Humanitas Research Hospital, Via A. Manzoni, 56, Rozzano, 20089 Milano, Italy.
E-mail address: andrea.bruno@humanitas.it (A.A.M. Bruno).

http://dx.doi.org/10.1016/j.knee.2016.11.002
0968-0160/

Table 1
Indications and contra-indications of knee arthrodesis.

Indications	Contra-indications
Extensor muscle deficit	Contralateral knee amputation
Poor soft tissue coverage	Contralateral knee/hip arthrodesis
Extensive bone loss	Degenerative changes in ipsilateral hip/ankle
Recurring infections/highly virulent microorganisms	Severe degenerative spine osteoarthritis
Charcot knee joint	Life-threatening infection
Poliomyelitis sequelae	

successful knee arthrodesis is approximately 70 points [16], and that an acceptable functional outcome cannot be represented by a KSS of lower than 50 points [13,16,30,69,73]. Besides the functional outcome, Pring and colleagues demonstrated a lower energetic expense in patients with knee arthrodesis compared to those with under-the-knee amputation [57], with a significantly lower overload to the hip joint and the spine.

In the last decades, many surgical techniques have been proposed for performing knee arthrodesis: internal osteosynthesis, intramedullary nailing, and external fixation [6,55,64]. The aim of our work is to review these surgical techniques and present our experience with knee arthrodesis performed at our institution using the Ilizarov method.

2. Methods

Between 2005 and 2012 we treated 19 knees (seven right and 12 left) belonging to 19 patients (17 females and two males). The mean age of the patients at surgery was 75 years (range: 38–85). Fourteen patients (74%) had septic total knee arthroplasty (TKA) loosening, three patients (16%) had revision TKA failure for extensor apparatus deficit and aseptic loosening, and two patients (10%) had a fracture at the previous arthrodesis site. The mean time between last surgery and knee arthrodesis performed by our unit was 14.2 months (range: one to 42.8). All of the patients were seen at our outpatient clinic, and before surgery underwent preoperative clinical controls: plain radiograph films, evaluation by an anesthesiologist, cardiology evaluation, and thorax radiograph (for patients older than 55 years or for smokers). For all patients we used the KSS to assess the clinical and functional preoperative status (we used 0 instead of negative values): the mean values were, respectively, 11.63 (range: 0–27) and 3.95 (range: 0–25). For those patients with septic TKA failure, we used the Cierny–Mader classification introduced by the University of Texas Medical Branch (UTMB) [14]. According to such classification, we had 15 cases (94%) with stage B (14 type 4, and one type 3), and also one case (six percent) with stage C type 4.

We used the Anderson Orthopaedic Research Institute (AORI) classification proposed by Engh [22–25,56] to assess the bone defect of the femur and the tibia at the time of the prosthesis removal during surgery. According to such classification, we had two cases (12%) with moderate bone loss after aseptic TKA failure (AORI degree: 2B), 15 cases (88%) with severe bone loss (AORI degree: 3), 14 cases after septic TKA failure, and one case after aseptic TKA failure.

2.1. Indications for knee arthrodesis

In our clinical practice knee arthrodesis was shown to be the best treatment choice in those patients with local compromise of the bone due to infection (Cierny–Mader stage B or C and types II, III, and IV), extended bone loss for which TKA or TKA revision could not be performed (AORI type 2 or greater), poor soft tissue coverage, extensor apparatus deficit associated with recurrent infection and/or extended bone loss. In patients with less-severe compromise of bone and soft tissues, TKA or TKA revision was taken into consideration. No other surgical techniques other than circular external fixation were used to perform knee arthrodesis.

2.2. Surgical technique

All of the patients were treated under general anesthesia by the same surgeon (A.K.), using the same surgical technique. The technique comprised an anterior approach to the knee through the previous skin incision, removal of prosthetic components, spacers, or cement, accurate bone and soft tissue debridement, preparation of the arthrodesis bone surfaces using an osteotome, apposition of the bone surfaces to achieve maximum bone contact, temporary arthrodesis and stabilization using two percutaneous crossed 2.5 mm wires, and skin suture.

The procedure entailed application of a distal femoral ring, placed perpendicular to the femoral anatomic axis, fixed with three Kirschner wires and one or two five millimeter or six millimeter diameter half-pins, and application of a proximal femoral arch, fixed with three or four half-pins. Connection of the distal femoral ring and the proximal femoral arch was by threaded rods, and application of a proximal tibial ring, placed perpendicular to the tibial anatomic axis, was fixed with two or three crossed Kirschner wires and one or two five millimeter diameter half-pins.

The distal tibial ring was placed perpendicular to the tibial anatomic axis, four to eight centimeters proximal to the ankle joint, fixed with two crossed Kirschner wires and one half-pin. Connection of the tibial rings was by threaded rod, and connection of the

Please cite this article as: Bruno AAM, et al, Knee arthrodesis by the Ilizarov method in the treatment of total knee arthroplasty failure, Knee (2016), http://dx.doi.org/10.1016/j.knee.2016.11.002