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One-Stage Total Knee Arthroplasty With Pre-Existing Fracture Deformity Post-Fracture Total Knee Arthroplasty

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ABSTRACT

The aim of the study was to assess the results of treating knee osteoarthrosis with total knee arthroplasty (TKA) after previous tibia and/or femur fractures resulting in axial limb deformities. Thirty-six knees (34 patients) were operated on. At the most recent follow-up, 4.8 years after surgery, all but one patient demonstrated an improvement in both clinical and functional KSS. This male patient required revision after 2 years. Improved range of motion was generally noted, especially extension, however, two patients with both tibia and femur fractures had worse results. TKA is an effective method of treatment for patients with arthrosis after a previous femur or tibia fractures. When deformity is severe semi-constrained or constrained, implants with extensions may be necessary.

Femur and tibia fractures are common in everyday orthopedic practice. Malunion may lead to multiaxial lower limb deformity and subsequent secondary osteoarthritis of the knee. Total knee arthroplasty (TKA) is a method of choice in the treatment of this type of gonarthrosis [1–3]. Other treatment options like arthrodesis, correction osteotomies or cartilage reconstruction procedures could be used in very selected and specific cases. Long-term survival is ensured by correct implant placement in relation to the axis of the lower limb and adequate soft tissue balancing. However, implant placement is made more difficult by axial deviations of the tibia or femur, and use of revision components or limb correction osteotomies may be necessary. During preoperative planning, the surgeon may face additional difficulties related to previous operations such as nonunion, range of motion limitation, hardware that must be removed, arthrofibrosis, periarticular ossification or multiple skin scars. In addition, the surgeon may face problems related to achievement of proper soft tissue balance, as well as skin healing or septic complications. Preoperative planning is essential to achieve good implant placement. Furthermore, prior knee surgeries could be considered a clinical condition predisposing the patient to a greater chance of postoperative complications [4].

The aim of the study was to analyze results of different implants used for TKA performed after previous tibia and/or femur fractures, resulting in axial limb deformities. We hypothesize that this operative procedure can be successfully performed without additional osteotomies using preoperative computer planning and standard offsets.

Materials and Methods

The study group comprised 36 knees from 34 patients operated on between the years 2007 and 2011 for knee osteoarthrosis with concomitant axial limb deformity related to previous isolated fractures of the tibia (25 knees) or femur (9 knees). Two patients (2 knees) had experienced fractures of both the tibia and femur. There were 27 male and 7 female in the study group, with mean age of 65.5 years (range from 40 to 84 years). Twenty-two procedures were performed on the left and 14 on right side. Thirty-three knees, demonstrated posttraumatic malalignment in the coronal plane, 24 varus and 9 valgus, and the remaining 3 knees presented a deformity in the sagittal plain after malunion of the proximal tibia fracture. Table 1 presents the patient data before and after total knee arthroplasty with pre-existing fracture deformity. The study was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki. All patients gave their informed consent prior to their inclusion in this study. The mean follow-up period was 4.8 years (range from 3 to 7 years). Mean time between initial ORIF and subsequent THA was 15.2 years (range from 6 months to 65 years).

End stage degenerative knee joint disease coexisting with mechanical axis malalignment was an indication for surgical intervention in all the patients of the study group. This abnormality was documented on standing anteroposterior (AP) and lateral radiographs.

The Conflict of Interest statement associated with this article can be found at http://dx.doi.org/10.1016/j.arth.2014.07.007.

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Table 1
Demographic and Clinical Data of 34 Patients (36 Knees) Who Had Total Knee Arthroplasty with Pre-existing Fracture Deformity.

Parameter		*P* value
Femur fracture[a]	11 cases	
Shaft of femur (extra-articular)	6 cases	
Supracondylar (extra-articular)	2 cases	
Condylar (intra-articular)	3 cases	
Tibia fracture[a]	27 cases	
Shaft of tibia (extra-articular)	14 cases	
Condylar (intra-articular)	13 cases	
Preoperative axial malalignment		
Varus	24 knees; range from 10 to 50°, mean 21.4°, SD 10.8	
Valgus	9 knees; range from 10 to 40°, mean 18.6°, SD 12.1	
Limb coronal axis unchanged	3 knees	
Range of motion		
Properative	From 15 to 125°, mean 76.7°, SD 30.1	0.004
Postoperative	From 40 to 120°, mean 90.1°, SD 17.6	
Flexion		
Properative	From 20 to 130° mean 86.5°, SD 28.3	0.26
Postoperative	From 40 to 120°, mean 91.3°, SD 17.4	
Extension		
Properative	From 10° to (−30°) mean (−10.1°) SD 9.7	<0.00001
Postoperative	From 0 to (−5°), mean (−0,3°), SD 1.2	
KSS clinical		
Properative	From 0 to 52 points, mean 39	<0.0001
Postoperative	From 52 to 85 points, mean 78	
KSS functional		
Properative	From 20 to 61 points, mean 45	<0.0001
Postoperative	From 60 to 85 points, mean 80.5	

SD—standard deviation. Values marked in bold indicates statistical significance.
[a] Two patients had both tibia and femur fracture.

Pre-operative planning was done in every case with the use of orthopedic digital pre-operative planning software—Orthoview. This allowed for assessment, if limb axis correction can be done only by bony cuts. Surgeon assessed possibility of soft tissue balancing. The use of implant type was also related to the age of the patients, weight and activity level. Older, obese, no active patients were more likely to have CCK (constrained condylar knee) implanted. If full release of medial collateral ligament was necessary or there was severe joint destruction that made joint balancing impossible rotating-hinge implants were chosen. Implant selection used for total knee arthroplasty is presented in Table 2.

All operations were performed with mid-line incision and medial para-patellar approach. There was no need for lateral approach. In one case metalwork was removed before THA as a separate procedure. No patient had metalwork removal during TKA. For patients who had multiple procedures on the operated limb resorbable bone graft substitutes with antibiotic (Herafill beads G, Heraeus Medical) were inserted to medullary canals as an antibacterial prophylaxis. There were no allografts implanted, but in one case bone substitute BoneSave (Stryker) was needed. Moralized allografts were required in 11 cases with bone defects.

Before the operation, full extension or hyperextension to 10° was only noted in 8 knees. In the remaining 28 knees, a deficit of extension ranging from −5 to −30° (mean −13.9°) was found. The degree of flexion before the operation ranged from 20 to 130° (mean 86.5°). One oxynium and one ceramic TiN coated implant were used for two patients, who were found to be sensitive to Cr and Co. In another case, femur correction osteotomy together with CCK arthroplasty was performed due to the presence of severe axial malalignment.

Table 2
Type of Implant Used in Patients With Pre-existing Fracture Deformity.

	Number	Type of knee arthroplasty
Legion	1	Condylar constrained knee
Thriathlon TS (Stryker, Mahwah, NJ, USA)	8	Condylar constrained knee
Thriathlon (Stryker, Mahwah, NJ, USA)	13	Primary condylar total knee
Modular Rotating Hinge System (Stryker, Mahwah, NJ, USA)	5	Rotating hinge
AGC DA 360 (Biomet)	6	Condylar constrained knee
ACS PS with stem	1	Primary condylar total knee
Vanguard 360 (Biomet)	2	Condylar constrained knee

Both clinical and radiographic follow-up examinations were performed on all patients at 6 weeks, at 3, 6, and 12 months; and then each year after that. All patients were available for review. The Knee Society Clinical Rating System (KSS) was used for clinical assessment [5]. Radiological assessment was conducted according to The Knee Society Total Knee Arthroplasty Roentgenographic Evaluation and Scoring System [6]. At the final follow-up visit, all X-rays were assessed for loosening, alignment and implant migration (Figs. 1 and 2).

STATISTICA 10.0 PL software was used for all statistical analyses. Before an analysis of measurable features was undertaken, the λ-Kolmogorov test was applied to test for normal distribution. The Student's t-test for dependent samples was used to determine comparisons between preoperative and postoperative ranges of movement and KSS. *P*-values below 0.05 were regarded as statistically significant.

Results

At the final follow up, all but one patient displayed improvements in both KSS and range of motion (Table 1): this individual case experienced tibial component aseptic loosening after 2 years, and so revision TKA, replacing the implant for one with longer tibial stem, was performed. Table 3 presents the results of treatment depending on which bone was fractured. At the last follow-up, full extension of the knee was demonstrated by only 2 patients, both of whom had 5° of flexion contracture. Although one patient displayed a 40° of range of motion at the final follow-up, which had increased from 25° before TKA, she was satisfied with the result.

Despite improved knee function, flexion was not found to have changed significantly compared to preoperative status (Table 1). It was possible to achieve neutral varus/valgus knee axes within 0° of varus and 5° of valgus in all but four knees. Of these four cases, 8–10° of valgus deformity was noted in three, and 2° of varus in one case. One female patient was found to have a 2° tibial component anterior slope. In 3 knees, of the whole sample, patella baja was noted both before and after the operation, one of the patients requiring tibial tuberosity osteotomy to access the joint for TKA.

No other postoperative complications including postoperative deaths or septic events were noted. In two cases, it was necessary to recut and resuture the wound due to wound healing problems.

All X-rays were assessed by the third author who did not participate in the operative treatment of patients (MS). Tibiofemoral alignment was assessed to be appropriate at 4 to 7° valgus in all patients and did not change until the last follow-up visit. No subsidence or migration of the rest prosthetic components occurred.

Discussion

Extra-articular deformities of the femur or tibia increase through the knee and may eventually cause osteoarthritis, and it is important to choose whether to fix the deformity through soft tissue balancing alone, or combine this approach with an osteotomy at the malposition. Careful preoperative planning is required to determine which of