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Short-term results of the management of severe bone defects in primary TKA with cement and K-wires

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ABSTRACT

Objective: The aim of this study was to evaluate the results of cement and kirschner wire augmentation in the management of bone defects in primary TKA.
Methods: Twenty-four patients (10 male, 14 female; mean age: 66 years) with uncontained unilateral medial tibial articular bone defect who underwent TKA between 2010 and 2014 were included in this study. The average follow up time was 33.7 months. Patients were divided to two groups according to the size of the bone defect (Group 1: <20 mm, Group 2: >20 mm). The tibial defect was reconstructed by using cement and K-wires. We used posterior stabilized prosthesis with no tibial stem extension.
Results: The preoperative and postoperative lower extremity mechanical axis in Group I was in a mean varus of 15° and mean varus of 3°, respectively ($p < 0.001$). The preoperative and postoperative lower extremity mechanical axis in Group 2 was in a mean varus of 20° and mean varus of 3° respectively in Group II ($p < 0.001$). None of the patients neither suffered from failure of K-wires nor loosening.
Conclusion: The use of cement and K-wires augmentation appears to be a simple and cost-effective treatment option for the tibial bone defects in primary TKA.

The goal of total knee arthroplasty (TKA) is to obtain a stable, painless knee with proper limb alignment and joint line.[1] Bone defects in TKA are a significant challenge to the surgeons with regard to maintaining proper alignment of the implant and extremity for establishing a stable bone-implant interface. Instability of the trial implants are indications of management of bone defects in primary TKA at the time of trial reduction. This situation generally occurs when 40% or more of the bone-implant interface is not supported by the host bone. Treatment alternatives for bone defects in TKA -depending on the location, configuration (contained or non-contained) and magnitude- are bone cement, bone cement with screw reinforcement, metal augmentation, impacted bone grafts, structural allografts and tantalum.[1–9]

The bone cement with screw reinforcement technique was first used by Freeman et al[9] in 1982 and was first described in the literature by Ritter[8] in 1986. The usually accepted indication for this technique is the presence of small contained bone defects.[1] The use of this technique in large uncontained bone defects is not recommended[1]; however, Berend et al[10] had reported successful results at long-term follow-up periods (up to 20 years) when screw and cement were used to correct large uncontained tibial defects (5–20 mm). Nevertheless, the literature remains controversial.[11–13] The operative technique was first described by Ritter where 6.5 mm diameter and 35-mm long two stainless steel AO cancellous bone screws were inserted parallel to the tibial cortex.[8] We have modified the original description of the operative method by using smooth Kirschner wires (K-wire) instead of screw, for the reinforcement of the cement and management of the medial tibial defect to reveal that the original technique could be performed with K-wires, in order to decrease the cost and to facilitate the surgical procedure.

The aim of our study was to evaluate the results of uncontained medial bone defect reconstruction with cement and K-wire for primary TKA, especially in extra-large medial defects (>20 mm).

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Patients and methods

Seventy-one patients who had undergone primary TKA between the year 2010 and 2014 and had varus deformity and uncontained medial tibial defect were evaluated in this retrospective cohort study. Twenty-four patients' defects, reconstructed using cement and K-wires and had instability of trial components after trial reduction during evaluations of varus-valgus stress test or flexion-extension of the knee joint, were included in this study. These patients were operated by the same surgeon at the same center and a single type of prosthesis was used on them (Sigma; DePuy Synthes, Inc.,Warsaw, IN, USA). We used posterior stabilized prosthesis without any tibial stem extension in for all patients. The minimum follow-up period was two years.

Patient data were retrieved from their medical files, operative reports and regular follow-up records. Demographic information such as age, sex, height, weight, body mass index (BMI), side of the operated knee and primary diagnosis were recorded (Table 1). Medial tibial defect classification was made according to the classification system described by Insall.[14] According to this classification system, uncontained defect has segmental bone loss with no remaining cortex. Lotke et al have defined the size of the uncontained defect as 'large' (<20 mm) (Group 1) or 'extra-large' (>20 mm) (Group 2).[15] In our study, the patients were divided into two groups. Patients with a defect <20 mm comprised Group 1 and those with a defect >20 mm comprised Group 2. We administered spinal or combined spino-epidural anesthesia in all patients. A proximal pneumatic tourniquet was inflated to a pressure of 150 mm-Hg above systolic blood pressure and maintained throughout the procedure. Midline longitudinal skin incision and medial parapatellar arthrotomy was performed. Soft tissue releases were carried out to obtain balance of the deformities. The extramedullary tibial cut was applied to the tibia and the tibia was cut at 8–10 mm from the lateral plateau surface. After the tibial cut, the defect size was measured in width and depth and was recorded in millimeters. The defect was prepared as described by Ritter.[8] According to this, the defect at the resected tibial plateau were debrided of the surface granulation tissue, exposing the irregular sclerotic and cancellous bone, and the reaming sclerotic bone was drilled to enhance cement fixation. After thorough lavage, pulsed normal saline was used and the prepared surface was left to dry out. Then, 3-mm K-wires were passed almost perpendicular to the defect area, while paying attention to avoid crossing the central and peripheral peg holes on the prepared tibial surface and contacting the tibial component. One pack of bone cement mix (Biomet, Inc., Warsaw, IN, USA) was applied to both the tibial plateau and tibial component, including the component peg and femoral component. Thus, the defect was repaired and the tibial and femoral components were placed. A final check for soft tissue tension, alignment, patellar tracking and range of knee motion were carried out before closing the wound. The time elapsed from the beginning of the incision to the end of the surgery (skin to skin) was recorded as 'surgery duration' (Figs. 1, 2).

Low-molecular-weight heparin (enoxaparin sodium 0.4 ml, Clexane; Sanofi Aventis, Istanbul, Turkey) was used for thromboembolism prophylaxis. Prophylaxis was discontinued 12 h before surgery and restarted 6 h after surgery and continued up to 3 weeks postoperatively. Antibiotic prophylaxis was administered to all patients (one gram intravenous first-generation cephalosporin (cefazolin sodium, Sefazol; Mustafa Nevzat, Istanbul, Turkey)). Range of motion exercises and weight-bearing walking with a walker was started on the first postoperative day. Patients were discharged once straight leg raising and 90° of knee flexion was achieved. The patients were given follow-up appointments for their postoperative 15th day, 1st month, 3rd month, 6th month, 1st year and after that once a year. During the follow-up period, the patients were invited for clinical and radiographic evaluation by an independent observer (orthopedics assistant).

The Knee Society Clinical Rating System (KSCRS) was used for functional assessment.[16] An orthoroentgenography of the lower extremity of the operated site, standing anteroposterior and lateral views were taken and The Knee Society Total knee roentgenographic evaluation and scoring system were used for all evaluations.[17] Based on these radiographies, the measured radiolucent periprosthetic lines and focal osteolysis were concluded to be evidence of component subsidence. Radiolucent lines (RLL) at the implant-bone interface were measured in millimeters. Focal osteolysis was defined as any progressive osteolytic lesion at the bone-implant or cement-bone interface.[18] Loss of fixation was defined as a continuous RLL >1 mm in all zones or a change in implant position.[19] Complications were also noted.

Statistical analyses with Student's t and chi-square tests were performed using the SPPS 18.0 software (SPSS Inc., Chicago, IL, USA). A p value <0.05 was considered statistically significant.

Table 1
Demographic data.

	Group 1	Group 2	p
Number	12	12	>0.05
Gender			
Female	8	6	>0.05
Male	4	6	>0.05
Side			
Right	10	8	>0.05
Left	2	4	>0.05
BMI	29.9	30.3	>0.05
Etiology	12 OA	10 OA, 1 RA, 1 TA	>0.05
Defect size (mm)			
Width	14	38	**<0.05**
Depth	12	32	**<0.05**
Surgery duration (min)	95	105	>0.05
Follow-up period	34.8	32.6	>0.05

Defect size is statistically different between two groups, defect size is greater in Group 2.
BMI: body mass index, OA: osteoarthritis, RA: rheumatoid arthritis, TA: traumatic arthritis.

Results

This study included 24 patients; 10 males (41%), 14 females (59%), with a mean age of 66 (range: 54–83) years. Group 1 consisted of 12 patients; 8 females (66%) and 4 males (34%) with a mean age of 62 (range: 54–75) years and Group 2 consisted of 12 patients; 6 females (50%) and 6 males (50%) with a mean age of 70 (range: 58–83) years.

The etiologies were osteoarthritis in 22 patients (92%), rheumatoid arthritis in one patient (4%), and traumatic arthritis in one patient (4%). The operated knee was the right knee in 18 patients (75%) and the left knee in 6 (25%). There was no statistically significant difference between the groups in terms of BMI ($p > 0.05$) (Table 1).

After the tibial cut, the mean mediolateral width and depth of the medial tibial defects were 26.0 (range: 10–40) mm and 22 (range: 10–40) mm respectively. In Group 1 and Group 2, the widths of the defects were 14 (range: 10–20) mm and 38 (range: 21–40) mm and the depths of the defects were 12 (range: 10–21) mm and 32 (range: 21–40) mm, respectively. The mean follow-up period was 33.7 (range: 24–55) months (mean of 34.8 [range: 26–55] months for Group 1 and 32.6 [range: 24–52] months for Group 2) ($p > 0.05$). The mean duration of surgery was recorded as 100 (range: 80–120) minutes.

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