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Reconstruction of a Deficient Patella in Revision Total Knee Arthroplasty Results of a New Surgical Technique Using Transcortical Wiring

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ABSTRACT

This study aimed to report the results of a novel surgical technique for the reconstruction of a deficient patella during revision total knee arthroplasty (TKA). Twenty-eight patients (30 knees) with a deficient patella were treated with an onlay-type prosthesis and bone-augmenting procedure, using acrylic bone cement and transcortical wiring. The technique was indicated when the thickness of remnant patella was less than 8 mm with variable amounts of the peripheral rim. Mean follow-up period was 36.6 months (range, 24 to 55 months).The respective mean Knee Society scores for knee and function improved from 34.2 and 23 points, preoperatively to 73.5 and 61 points, at final follow-up. One patient experienced patellar fracture 1 week after surgery. There were no complications associated with implanted hardware.

Patellofemoral complications following resurfacing in total knee arthroplasty (TKA) is an uncommon yet disastrous and their incidence have been reported to range from 2.9 to 4% [1,2]. In particular, substantial loss of patellar bone stock secondary to bone resection during prior arthroplasty, osteolysis resulting from wear debris, or traumatic removal of a patellar component can pose significant technical challenges in revision knee arthroplasty. Although tibial or femoral bone defects can be reconstructed with contemporary modular revision systems, there are only a few ways to reconstruct the deficient patella. The traditional treatment options available in this setting had been patellectomy or patellar resection arthroplasty [3,4]. However, these procedures were shown to be associated with markedly inferior clinical results due to weakness of extensor mechanism, patellar maltracking, and persistent retropatellar pain [3–5].

Alternatives to these methods include the insertion of a biconvex patellar component [6], the use of a trabecular metal patella [7], patellar bone grafting [8], and gull-wing sagittal osteotomy [9]. Many authors have reported reasonable outcomes using these alternative options, but no one option has gained a wide acceptance. Definite indications of these techniques have not been established, and information on long-term follow-up results is sparse. However, a consensus is growing that preserving bone stock and supplementing the residual bony shell, if possible, offer superior outcomes.

The purpose of this study was to evaluate the early clinical results of a novel surgical technique for reconstruction of deficient patellae in revision TKA. This technique is a straightforward patellar bone-augmenting procedure using a conventional onlay-type prosthesis with cementing and transcortical wiring. This technique was introduced previously as a technical report [10], and this study is the first report documenting the effectiveness of the bone-augmentation technique using transcortical wiring for a deficient patella in revision TKA.

Materials and Methods

Between May 2009 and May 2011, twenty-eight patients (30 knees) underwent revision TKA in which a deficient patella was treated with an onlay-type prosthesis and a bone-augmenting procedure using transcortical wiring. This technique was indicated when the thickness of the remnant patella was less than 8 mm with variable amounts of the peripheral rim. All cases showed a magnitude of patellar bone loss that would not support a traditional patellar resurfacing prosthesis. The remaining patellar height ranged from 3.2 to 7.3 mm when it was calculated as the mean value of four cardinal points of the patella. This study was approved by the institutional review board at Samsung medical center (Seoul, Korea).

There were six males and twenty-two females, with a mean age of 68.8 years (range, 53 to 80 years) at the time of revision TKA. The mean body mass index was 26.4 kg/m^2 (range, 19.3–33.2 kg/m^2). Sixteen procedures were performed on the right knee, and fourteen procedures were on the left. The indication for the initial knee arthroplasty was osteoarthritis in all cases. The indication for revision knee surgery was periprosthetic infection in 20 knees, aseptic loosening of all three components in 4 knees, patellofemoral instability in 3 knees, and polyethylene wear with severe osteolysis in 3 knees. The patellae were revised because of infection (20 knees), patellar component

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loosening (4 knees), patellar malposition (3 knees), or polyethylene wear in the presence of a metal-backed patella (3 knees). Of the 30 patellar components retrieved, 26 were cemented all polyethylene components and four were of an uncemented metal-backed design. In all 20 knees with a history of infection, an articulating antibiotic laden cement spacer was first inserted. After an infection was considered to have resolved, reimplantation procedures were performed, including the patellar component revision.

All patients underwent concomitant revision of the femoral and tibial prostheses at the time of patellar component revision combined with bone-augmenting procedures. All prostheses of the femur and tibia were stemmed and fixed with acrylic bone cement. In this series, there were no additional procedures in the extensor mechanism such as rectus snip or quadriceps turndown. A lateral retinacular release was performed in 4 knees.

Full weight-bearing with crutches or a walker was encouraged as tolerated immediately after the drain was removed. For 6 weeks after surgery, the aid of crutches or a walker was recommended. Full range motion of the knee was allowed in all patients except for three who developed wound hematoma. Thromboprophylaxis using lower-molecular heparin had been applied in all patients for 2 weeks after surgery.

Postoperatively, all patients visited our outpatient clinic at 3, 6, and 12 months and annually thereafter. Clinical and radiographic evaluation was performed preoperatively and at each follow-up visit by an independent investigator (SSL). Clinical performance was evaluated using motion arcs and American Knee Society (AKS) knee-scoring system [11]. The patellofemoral status was evaluated as described by Stern and Insall [12]. Standard anteroposterior (AP), lateral, and merchant views were taken to assess the position [13] and status of patella and prosthesis. Mean follow-up period was 36.6 months (range, 24 to 55 months). No patients were lost to follow-up.

Surgical Technique

After the midline skin incision and medial parapatellar arthrotomy proposed by Insall et al [14] are made, granulation scar is removed with associated synovectomy. Upon sufficient surgical exposure, the prostheses are removed using an oscillating saw and a flexible osteotome. After implant removal, residual cement that adhered to the surface of the remnant patellar bone is meticulously removed with a high-speed burr (Fig. 1A). After the amount of patellar bone loss and status of the peripheral cortical rim were assessed, the need for the bone-augmenting procedure using transcortical wiring for support of the patellar component revision is determined.

The new, size-matched patellar component is placed on the undersurface, implant location is decided and the contact points for 3 pegs are marked (Fig. 1B). Three points for the pegs are drilled and bone holes are placed for wire passage. Then, twisting 24-gauge steel wires are connected to each peg of the patellar component (Fig. 2). These wires are passed from the undersurface of the patella to the outer surface through the bone holes. Before the prosthesis is brought into contact with the patella, the space between the bone bed and the polyethylene is filled with cement (Fig. 3). The prosthesis is compressed and the cement is given time to cure. Subsequently, sufficient tension is applied on the three wires on the outer surface and the wires are twisted together above the cortex (Fig. 4). The ends are pressed with an impactor to prevent mechanical irritation (Fig. 5). Radiographs are taken immediately after surgery (Fig. 6). A more detailed description of this procedure can be found in the previous report [10].

Statistical Analysis

Data were analyzed with the Student's paired t-test. Statistical significance was accepted at a *P*-value less than 0.05.

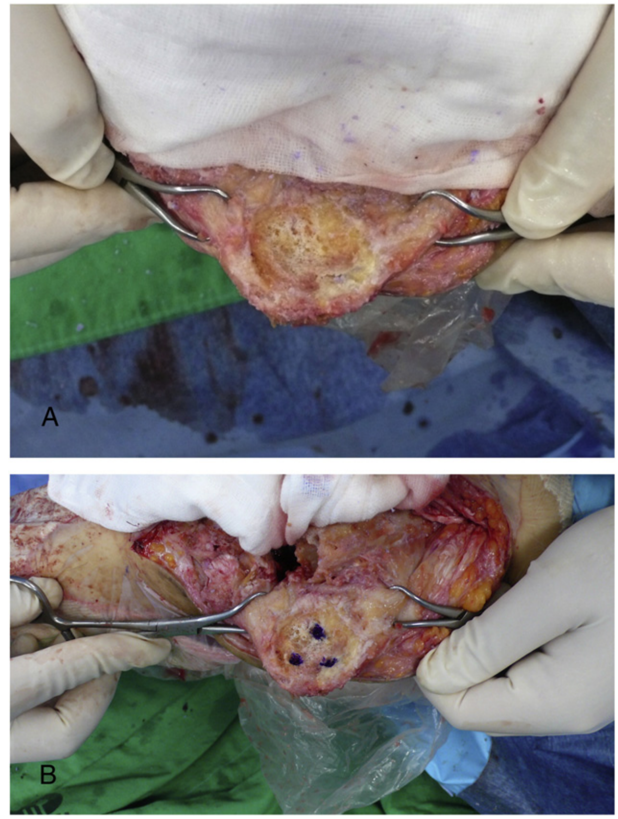

Fig. 1. (A) Patellar bone bed preparation was performed meticulously using a high-speed burr. (B) After properly sized patellar prosthesis was placed on the undersurface, the contact points of 3 pegs were marked.

Source of Funding

There was no external funding for this study.

Results

The mean Knee Society knee score improved from 34.2 points (range, 18 to 65 points) preoperatively to 73.5 points (range, 30 to 88 points) at the final follow-up ($P = 0.006$). The mean Knee Society function score improved from 23 points (range, 18 to 46 points) preoperatively to 61 points (range, 34 to 80 points) at the final follow-up ($P = 0.009$). The mean preoperative motion arcs of the knee increased from 89.2° (range, 38 to 126°) preoperatively to 98.1° (range, 42 to 124°) at the final follow-up ($P = 0.282$). The patellofemoral status was graded as 0 in 18 knees with no symptoms related to the patellofemoral joint

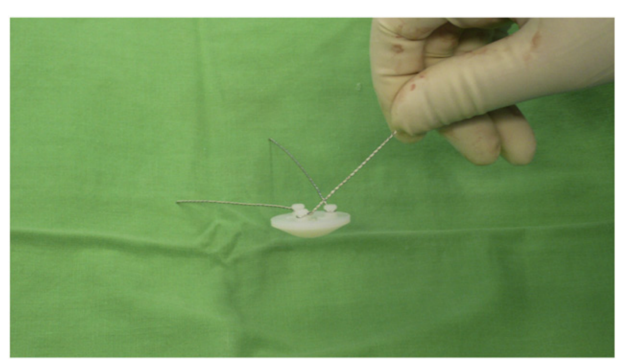

Fig. 2. A wire was wound around the narrow part of the neck under the peg head and fixing it to the peg. Then, the wire was twisted like a two-stranded rope. The same procedure was repeated for the other two pegs.