

2-Stage Revision Knee Prosthesis Application Results in Infected Primary Knee Prosthesis, 5 –Year Follow-Up

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ABSTRACT

Only 5% of the total knee prosthesis applications necessitate revision in the following period. Upon performing total knee prosthesis placement, the rate of being contracted with deep infection is found as 1-2%. After knee prosthesis implantation, infections develop as a result of the microorganisms reproducing within the biofilms. It is difficult to diagnose and treat these infections and they reduce the life span of the prosthesis. Since the infection will upset the success of primary knee prosthesis placement it is necessary to eradicate it. Besides, single or two-stage revision treatment is applied in the fight against the infection that can lead to serious morbidity and permanent injury in the patient. The success of the revision treatment is directly related to obtaining proper lower extremity axis, placing the implants in the suitable position, achieving sufficient soft tissue balance in flexion and extension, restoration of joint line, supply of appropriate patellar axis and providing the joint range of motion at a level which will meet the daily needs of the patient. We shared 100% success that we obtained by the two-stage revision knee prosthesis application we performed due to prosthesis infection developed following primary total knee prosthesis surgery that we performed in 33 patients due to osteoarthritis and some complications arisen.

KEYWORDS: Total knee prosthesis placement, Infection associated with prosthesis, Single and two-stage revision.

INTRODUCTION

Deep infection that arises following total knee prosthesis is one of the most important reasons for revision. It is identified that following primary application 0.5-5% infection occurs [38, 45, 46]. The treatments performed by protecting the prosthesis should only be preferred if the case is diagnosed at a very early period, if good fixation is available and when microorganisms are sensitive against antibiotics [3]. Success rate is determined as 15% in this way [42]. Revision, an intervention performed by removing the prosthesis, has two types as single and two-stage. The superiority of the single-stage technique is the reduction in hospital stay and decrease in morbidity by saving the patient from another surgery. However, it is claimed that it is less successful compared to the two-stage one in terms of infection eradication. When one-stage revision is being applied, technical features should be meticulously observed [8, 16, 29]. Single-stage revisions are performed by replacing the antibiotic cement with a new prosthesis in the same session following the extensive debridement of the infected arthroplasty. It is noted that %90-100 success rate is achieved with two-stage revisions [21]. For the success of this method, the debridement that will be performed in the first session and removal of the prosthesis is of great importance. While removing the prosthesis, not taking care results in undesired bone losses [11]. However, it is claimed that it is less successful compared to two-stage technique in terms of infection eradication [53]. According to this technique, all foreign materials (prosthesis, cement), middle membranes, necrotic tissues should be removed, and culture samples should be picked from them. Later, the joint should be washed with a plenty amount of physiological serum or antibiotic liquids, should be packed with skin approximation sutures by being filled with gases sucked in povidone-iodine (baticon). If the active substance is known beforehand, antibiotic should be applied for active substance, if not known antibiotic should be applied for S.aureusa. Tourniquet should be opened and it is necessary to wait for 30 minutes. Later on, new prosthesis should be fixed with antibiotics containing cement. Antibiotics treatment should continue for three months. In cases which require allograft use and when immunodeficiency is present, single-stage revision is not recommended. Also, single-stage revisions are not recommended in prostheses without cement [37]. As a result, if active substance gram is (+), if antibiotics containing cement can be used, if antibiotics can be used for three months and if it is inconvenient for the patient to undergo anesthesia twice single-stage revision can be applied by conforming to the technical properties described [8, 16, 17]. The success of the single-stage revision is lower compared to two-stage revision. However, single-stage one has some advantages. Patient endures only one operation and it necessitates a shorter hospitalization in total [24]. 2-stage revision surgery is an effective method in the treatment of the infection that developed after primary total knee placement. It is necessary for the restoration of the joint line in conformity with the anatomical structure [5]. Eradication of the infection in the treatment of infected knee prosthesis is quite difficult due to both disturbed anatomy and surgical technique. Extensive debridement in the

first step, careful removal of the prosthesis and antibiotics loaded cement spacer placement, administering parenteral antibiotics for a sufficient amount of time, repairing the bone losses at the second stage are definitely required for the clinical success [11]. Two-stage revision was performed by Install et al., in 1983 for the first time [9] and revision technique is the most commonly applied technique in the prosthesis infections. In two-stage technique, success rate can be between 57% - 100% in infection eradication [8, 29]. In the first stage of this technique, all foreign bodies (prosthesis, cement, polyethylene tap, wire, screw etc.), necrotic and infected tissues are removed as in the single-step revision and living and well- blood forming tissues are obtained. Samples for culture are sent from these materials removed. Debridement of the infected tissues is performed effectively. Intraarticular region is washed with plenty amount of physiological serum and antibiotic solutions and following the prosthesis removal, gap fillers prepared with antibiotics loaded bone cement are applied and closed for filling the gaps and local antimicrobial effect [8, 52]. Many surgeons prefer placing antibiotics containing cement spacer into the joint gap which is emptied [6, 17]. If spacer is not used, second operation becomes more difficult because of the fact that potential gap arisen is filled with fibrous tissue and due to periphery muscles and ligament contractions. However, it should be noted that even tough antibiotics containing spacer makes the fight against the infection easier, what matters is performing the surgical debridement in a satisfactory way [8, 43]. Skeleton traction, plaster splint, external fixators can be used in order to eliminate the instability in the knee in the period between these two stages. The spacer that will be placed between femur and tibia should definitely contain antibiotics or the cements with ready- made antibiotics can be used. Additionally, termostable antibiotics could be inserted within the cement in the operation room or fabricated spacers available in the market can be used. After the first stage, following the cement placement, it is necessary to wait for 6-12 weeks with antibiotic treatment so that reimplantation is achieved again. Two-stage revision is finalized with the placement of the new prosthesis [11, 41]. Besides, if the time is extended it brings about muscle atrophy, bone weakness, and therefore rehabilitation delay. At the end of the waiting time, it is important to decide the revision. Generally patients are evaluated with ESR, CRP and white blood cell results when antitherapy time is finalized. A decrease of 50% should be achieved in ESR and CPR according to antibiotherapy parameters [34]. The results of the cases where patella height and joint line has moved less than 8mm are better in terms of the effects on primary total knee placement results [5, 12]. During the restoration femur epicondyle is at 2-2.5 cm proximal of the joint line during the restoration of the joint line [5], metal support blocks, metal nets and bone grafts are used to this end [19]. In this way, it is aimed to keep the distance between joint line and epicondyle at these levels [5, 30, 33, 36]. The recommended ideal entry is to reach the joint through anterior mdi line longitudinal skin incision and medial parapetallar approach. After the joint is opened, a thickened capsule and intra-capsule adhesions are seen frequently. In case that these initiatives also don't yield fruitful results, V-Y plasty popularized by Coonse-Adams could be tried. If it is not desired to perform an incision as extensive as V-plasty, rectus snip technique defined by Install can be applied. In this technique, quadriceps tendon can be pulled to the lateral [7, 10, 35]. Another technique that can be used in order to lateralize the patella is tuberositas tibia osteotomy [7, 47]. The benefits of two-stage revision can be as follows [4]:

1. The microorganism that infect with intraoperative cultures can be identified for certain.
2. The clinical and functional results are better.
3. It allocates time for the infection to heal (if the recovery is suspected, indium marked leucocyte or CRP follow-up can be performed and even the second debridement can be performed if necessary.)
4. In the presence of insufficient bone stock, bone transportation can be performed while the cements are cleaned in the second operation.

In revision operations compared to primary knee arthroplasties, more limitative type prostheses are used because it is difficult to achieve sufficient stability with standard prosthesis in case there is bone loss or bad bone quality and posterior cruciate ligament is generally injured [47]. If posterior cruciate ligament is solid during revision and ligament balance is achieved in good way posterior cruciate ligament protective type should be preferred, if not, limitative type prostheses should be preferred. If ligament instability is very obvious and bone loss is so intense, hinged type prostheses should be considered. However, in young patients the least limitative type of prosthesis should be preferred [39]. Prosthesis fixation can be enhanced with the use of long stems determined with methods containing cement or methods without cement [2, 18, 20, 28, 50]. Goldberg reports the maximum flexion gap following the revision surgery as 84, Benin as 100 degrees [14, 15, 42]. In two-stage revision, cement has some advantages like making a quick and safe fixation, compensating small surgical errors and bone disorders, allowing for applying force very quickly [26, 48]. However, a deformation happens in the cement due to the histological reactions arising in time and fixation can be loosened. Therefore, cemented prostheses are not used in young patients with the potential of living long [51].

METHODOLOGY

Two-stage exchange protocols for the treatment of the chronically infected total knee arthroplasty remain the standard of care in the United States. Thorough debridement, use of antibiotic spacers, treatment with

parenteral antibiotics, and delayed reimplantation have resulted in treatment success rates greater than 90% [13]. Significant improvement in the Knee Society Score (KSS) is seen after two-stage protocol for revision of an infected total knee replacement [25]. 33 patients who underwent primary knee prosthesis with osteoarthritis diagnosis in various clinics and who developed prosthesis infection were included in the study. Two-stage revision knee prosthesis was applied in all patients (Image 1). All patients applied to our clinic with complaints including excessive pain in the knee, difficulty in walking, swelling in the knee etc. The mean age of our patients is 58,6. 9 patients had bilateral total knee joint prosthesis but have unilateral infection. 8 patients have diabetes mellitus and don't use insulin. 7 patients are chronic smokers. Prosthesis irrigation, debridement and polyethylene insert change were applied in 6 patients in the clinics where primary surgeries took place, but the infection couldn't be eradicated. All patients received active substance sensitive antibiotherapy but the results were not positive. The time passed from primary prosthesis surgery applied to our patients to our first step revision surgery is approximately 7,4 months.

Infection following total knee arthroplasty can be difficult to diagnose and treat. Diagnosis is multifactorial and relies on the clinical picture, radiographs, bone scans, serologic tests, synovial fluid examination, intra-operative culture and histology [22]. A thorough history and physical, complete set of radiographs and appropriate labs including C-reactive protein and erythrocyte sedimentation rate are essential in the initial evaluation. Ancillary tests such as aspiration and nuclear imaging may be helpful in unclear cases or when labs are concerning for infection [27]. Sedimentation, CRP and leukocyte follow-ups were made in all patients. All patients were evaluated with physical examination, arthrography, joint liquid examination, culture antibiogram, and scintigraphy. Upon performing the necessary preparations (antibiotherapy, heparin with low molecule weight) the legs of the patients were prepared and covered in a sterile way with spinal or general anesthesia. Arthrotomy was performed by making use of the old anterior incision. Patella was transferred to lateral. All old suture materials were removed. Polyethylene insert of the prosthesis was removed. Soft tissue debridement was performed. Baticon pads were inserted and a certain time passed. After intense irrigation, prosthesis components were removed by protecting the bone tissues. Bone curettage was performed, baticon containing pads were placed again and a certain time passed. Following intense irrigation, teicoplanin-containing polymethylmethacrylate was placed in the joint gap after being shaped and hardened slightly in a way which will preserve joint gap and ligament tension. All layers were closed. Hinged braces that allow the joint to move 40 degrees were placed in the patients post-operatively and they were allowed to walk. All patients were followed up from the polyclinic following the discharge from hospital. Our patients were followed with infection consultation and when their infection markers become normal (in average 3 months), prosthesis implantation, which is the following step, was initiated. Prosthesis's implantations that cut the posterior cruciate ligaments and preserve joint level and movement range were applied in a way which contains antibiotics and cement. All the patients were enabled to walk by helping them apply total force on their feet in the 1st post-operational day. In 7 patients, serohematic containing liquid drainage which is going away on its own was observed from their incisions. Over 90-degree flexion was achieved in all patients. In average, 600 mg aspirin prophylaxis was administered to all patients for 3 months. For the follow up, we used Knee Society Score (KSS). Mean Knee Society Score was 34.23 (clinical) and 36.54 (function) on presentation; it improved to a mean of 73.86 (clinical) and 79.08 (function) at the end of treatment. No infection recurrence or complication was observed within the 5-year follow-up of our patients. Range of motion remained unchanged or improved after the treatment. Patient satisfaction was achieved in all patients.

Our patient in whom we applied 2-stage revision due to infected primary total knee arthroplasty:

- a) Stage 1: We placed cement spacer containing antibiotics upon removing infected prosthesis.



Image 1 (our patient, after stage 1 revision):
Cement spacer containing antibiotics upon removing infected prosthesis.

- b) Stage 2: Upon eradicating the infection, we applied revision prosthesis by the removing spacer.



Image 2 (our patient, after stage 2 revision):

Revision prosthesis by the removing spacer upon eradicating the infection

DISCUSSION

Deep infection that occurs following total knee prosthesis placement is one of the most important reasons for revision. It was determined that infection occurs between % 0.5-5 following the primary application [38, 45, 46]. Prosthesis joint infection should be considered in a patient with prosthesis and who applied to the hospital with fever complaint [1]. Eradication of infection with two-stage revision knee surgery and clinical success was reported as %97-100 [46]. Two-stage reimplantation remains gold standard for treatment of infected total knee arthroplasty [32]. 100% success rate that we obtained in our study is in conformity with the literature. The success rate that we obtained despite the chronic smokers and diabetes mellitus patients in our study is very important. Intraarticular parts are washed with plenty amount of physiological serum or antibiotics containing solutions and gap fillers prepared with antibiotics loaded bone cement are applied and closed in order to fill the gaps following the removal of the prosthesis and for local antimicrobial effect [8, 52]. We think that use of teicoplanin soaked bone cement that we applied in our surgical method is of importance. Following the placement of cement, it should be waited for 6-12 weeks with antibiotic treatment so that reimplantation is achieved again and two-stage revision is completed with the placement of the new prosthesis [11, 41]. 3 months of average waiting time between two surgeries is in conformity with the literature. Some authors recommend ceasing antibiotherapy for two weeks and repeating the laboratory results at the end of this period [8, 19]. We did not cease antibiotherapy in our application and we did not take this risk. Prosthesis fixation can be increased with the use of long stems that are determined with the methods containing cement and not containing cement [2, 18, 20, 28, 50]. For a successful revision, an appropriate technical background, personal skills and a well-functioning bone bank is unavoidable. For the management of tibial defects, authors highly recommend the usage of long stem extensions [44]. We believe that the stems that we use in our revision application are significant with regard to prosthesis stability and life span. We used cemented long stems in our patients. Cemented stem fixation in revision total knee arthroplasty provides good clinical results with durable fixation at an average of 10 years' follow-up [49]. We think that low mean age of our patients, which is 58.6, makes positive contribution to the result. In our opinion, the infection eradication we achieved and successful revision surgeries we performed are significant despite the fact that all patients had primary surgeries in different centers and application sensitivity and meticulousness in the surgery method is important. The mean Knee Society knee score increased from 33.8 points to 85.3 points. The mean Knee Society function score increased from 35 points to 87.5 points [23]. Mean Knee Society Score was 34.23 (clinical) and 36.54 (function) on presentation; it improved to a mean of 73.86 (clinical) and 79.08 (function) at the end of treatment in our cases. Our results of Knee Society Score is lower than literature, it may be because of our patients' primary surgeries done by different surgeons. Two-stage revision with interval prostheses represents a safe and reliable method of treating infected knee prosthesis; however, there may be a role for one-stage revision in selected cases [31]. We think that 2-staged revision is safe way for total knee arthroplasty infection.

CONCLUSION

Knee osteoarthritis is a common condition and total knee prosthesis surgeries performed for this condition are successful. We see implant infections after prosthesis surgeries. Prosthesis infection is a serious problem for the doctor and patient. The treatment must be effective for the success. We believe that 2-stage revision surgery

is very effective in prosthesis infections. We believe that the revision performed following the removal of all prosthesis, infection eradication and obtaining healthy tissues will be successful. We think that 100% success rate we obtained in the 5 year -follow-up reveals the importance of 2-stage revision surgery. We recommend 2-stage application instead of single-stage application in infected prosthesis revisions. In order to get a functional and salvaged limb in high rate, we advice 2-stage revision surgery for the infected knee prosthesis. Major sement spacer problems were seen in 12 %: in 3% of the knees the spacer had dislocated, in 5% the spacer fractured [40]. We didn't have any sement spacer problems in our cases.

ON IMAGES: We obtained the concent from our patient for image 1 and image 2

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