Acute Primary Total Knee Arthroplasty for proximal Tibial Fractures in Elders

Abstract

**Purpose:** Proximal tibial fractures in elderly patients with osteoporosis or knee osteoarthritis (OA) are challenging. In current study, we present our experience with uncommon acute primary total knee arthroplasty (PTKA) in this patient population.

**Methods:** Between 2005 and 2009, we performed PTKAs following a proximal tibial fracture for 30 consecutive patients aged over 60 years with osteoporosis or knee OA. Three condylar constrained knees (CCK) and no hinged knee prosthesis were used. Patients were followed for 4.5±1.1 years.

**Results:** Patients discharged after 4.6±1.2 days. The postoperative Tegner activity scale improved significantly compared to preoperative scale (3.5±1.3 versus 2.5±1.2; p<0.001). The range of knee flexion was significantly greater in operated side compared to uninjured knee (106±13 degrees Vs 120±8 degrees; p<0.001). The knee and function scores of the knee society knee score averaged 90.7±6.5 and 69.6±8.8, respectively. All of the patients returned to their previous activities. Based on visual analogue scale, the patients' satisfaction and pain at final visit determined 8.1±1 and 1.5±1.2, respectively. There was no patient with infection, thromboembolic events and loosening.

**Conclusions:** PTKA following a proximal tibial fracture in elderly patients with osteoporosis or knee degeneration can be considered as a safe alternative for open reduction and internal fixation. PTKA resulted in immediate weight-bearing, improved functional status and patients' satisfaction. However, functional outcomes were dependent on the general condition of the patient. Also,
constrained knee prosthesis were not necessary for a vast majority of the patients.

**keywords:** proximal tibial fracture, knee osteoarthritis, osteoporosis, total knee arthroplasty

**Introduction**

Tibial plateau fractures are common injuries represent about 8% of all fractures in over 65 year old population [9]. Due to the significant soft tissue damage, severe comminution, displacement, poor bone quality and cartilage injury, these intra-articular fractures challenge the orthopedic surgeons, especially in elderly patients with osteoporosis or knee osteoarthritis (OA) [3,15,21,23].

Tibial plateau fractures can be treated nonoperatively. Also there are different methods for tibial plateau fracture treatment such as close reduction and external fixation, percutaneous screw fixation, open reduction and internal fixation (ORIF), less invasive stabilization system, double osteosynthesis, staged external and internal fixation [5,10,16,21,28], all of them have own advantages and disadvantages; however the best choice remains controversial [3,21].

In spite of these attempts, failure of obtaining anatomical reduction and restoration of proper alignment, cartilaginous injury, intra-articular step-off and other abnormal anatomical changes made many patients to experience development of post-traumatic knee OA [4,8]. Posttraumatic knee OA seriously interferes with patients’ activities of daily living and disturbs their normal life indicating early future total knee arthroplasty (TKA) [4,24].

Although, TKA is the definite treatment knee OA, but authors have indicated that TKA is complicated and technically demanding in patients with a history of an intra-/extra-articular distal femoral or proximal tibial fracture [4,22,25].
Based on the poor outcomes following treatment of tibial plateau fractures, high rate of complications in TKA for post-traumatic OA and short time-interval between primary treatment of the fracture and required TKA, it has been advocated limitedly to perform acute primary TKA (PTKA) in older patients with osteoporosis or knee degenerative changes [1,7,11,12,13]. Satisfactory outcomes in previous reports and limited data regarding this treatment method suggested us to evaluate the results of acute PTKA in elders with tibial plateau fractures in this study.

**Materials and Methods**

Between 2010 and 2015, there were 30 consecutive patients with close tibial plateau fracture included in current prospective study. All patients aged above 60 years old and suffered from osteoporosis or knee OA. The study was approved by the research ethics committee and before the operation, all patients signed informed consent. Arbeitsgemeinschaft für Osteosynthesefragen (AO) system was used to classify the fractures utilizing preoperative x-rays and CT scans. After preoperative planning, all patients underwent acute PTKA. All the surgeries performed by the same surgeon (M. M. S) through the same approach (medial prepatellar approach). There were three patients required condylar constrained knee (CCK) due to medial collateral ligament avulsion in two of them and very severe fracture (type C) in one another. Hinged type prosthesis was not required for none of the patients. After the operation, routine physical therapy was performed. Patients were allowed to walk using assistive devices such as crutches (partial weight bearing) at the first postoperative month. The time of surgery and the time of hospital stay were recorded. After the operation, patients were followed at least for 3 years. At the final visit, the knee society knee score (KSS) was completed for all of them to determine the functional results.
of the surgery. The scores from 80 to 91 100 were graded as excellent, from 70 to 79 as good and from 60 to 69 as fair. The scores <60 were considered as poor outcomes.

Also, Tegner activity scale was determined before and after the operation to compare the pre- and post-operative activity level. Knee range of motion (ROM) (flexion) was measured by an orthopaedic surgeon utilizing a goniometer. The knee ROM measurements were repeated consecutively three times for each patient, and the data were documented. The average of the above 3 values was recorded as the ROM. To investigate subjective outcomes, patients were asked about returning to their previous job or sporting activity and severity of pain using a visual analogue scale (VAS). Zero indicated no pain and 10 indicated most severe pain. In addition, the patients were asked to mark their satisfaction with the outcomes of the surgery using VAS. In this scale, 0 considered as no and 10 as maximal satisfaction. We recorded any early or late complications such as deep vein thrombosis (DVT), death (within first postoperative month), infection and loosening of the prosthetic components (figure 1, 2, and 3).

Statistical analysis

Statistical analysis was performed with SPSS statistical software (version 16.0; SPSS, Chicago, Illinois). Wilcoxon test was utilized to compare the pre- and post operative Tegner activity scale. Also, the range of knee flexion was compared between injured and uninjured limbs using independent samples t-test. P-value <0.05 was considered significant.

Results

The characteristics of the patients are presented in Table 1. The time of surgery and the time of hospital stay averaged 66.6±6.7 min (range d from 55 to 78) and 4.6±1.2 days (ranged from 3 to
7 days), respectively. Table 2 shows the outcome of the surgery based on the KSS which was not poor in any of the patients. The postoperative Tegner activity improved significantly (p<0.001) (table 2). Also the range of knee flexion was significantly improved in operated knee compared to contralateral side (106±13 degrees Vs 120±8 degrees; p<0.001).

In current study, 100% of the patients returned to their previous job or recreational activities within 2 months after the operation. The severity of pain at the final assessment averaged 1.5±1.2 (range:0-4) and three patients needed to consume some analgesics for pain relief. The patients were satisfied with the outcomes of the surgery and VAS for satisfaction averaged 8.1±1 (range:6-10). There was no patient with infection, thromboembolic events and other perioperative complications. Also, the final x-rays showed no case of septic or aseptic loosening.

**Discussion**

The principal finding of the present study was that at a midterm follow-up, PTKA is an efficient and optimal treatment for elderly patients with proximal tibial fractures with knee OA or osteoporosis. This treatment method is safe and associated with good clinical, radiological and functional outcomes which seem to be appropriate for this patient population.

Proximal tibial fractures are challenging injuries with severe complications and devastating outcomes. Post-traumatic knee OA is an important complication following these fractures [4,8] resulting in severe pain and deterioration of the function necessitating joint arthroplasty as definite treatment. Honkonen reported 44% knee OA after 7.6 years following surgery which was higher in elderly patients [8]. Recently, Wasserstein et al investigated the risk of TKA after tibial plateau fractures in 8426 patients and compared the results with those of matched
controls. They found that the rate of TKA after 2, 5 and 10 years in patients and controls were 0.39% versus 0.29%, 5.3% versus 0.82% and 7.3% versus 1.8%, respectively. Also, they demonstrated that older patients were more likely to require TKA after tibial plateau fractures [24].

Although surgical treatment of tibial plateau fractures in elder population had led to satisfactory outcomes [1,9,14,20] but low bone quality, osteoporosis and unfavorable condition of the joint surfaces make it more difficult to restore articular anatomy through stable fixation [6,20]. In addition, Schatzker et al showed that osteoporosis adversely affects the outcomes of treatment of tibial plateau fractures [18]. Fatigue failure of the bone-implant construct remained a challenging problem in elder patients with osteoporosis [17]. Su et al found that older patients had poorer clinical and self-assessment outcomes [20]. Some authors found collapse and joint depression after some few postoperative years in elder subjects while reported good outcomes [1,9]. Roerdink et al observed secondary displacement at 12 weeks postoperatively in 30% of the patients aged over 55 years [14].

Based on these findings, it seems that TKA can be an appropriate treatment option in elder patients with knee OA or osteoporosis who suffered a tibial plateau fracture. Furthermore, according to severe degenerative changes, many of these patients require TKA early after the fracture. Acute PTKA can prevent from complications with fracture healing and undergoing two major orthopedic surgeries (ORIF followed by TKA for post-traumatic knee OA) in elder patients with high risk of perioperative morbidity and mortality. Surgical treatment of tibial plateau fractures require long lasting postoperative immobilization, non weight bearing ambulation (8-12 weeks) [5,16] and long-term rehabilitation, while like our study, acute PTKA allows weight bearing ambulation at the first postoperative month or earlier based on the
patient's condition. In addition to above-mentioned points, many of elder patients suffer from knee OA and should undergo TKA for relieving pain and functional improvement.

At first in 1982, Wolfgang reported a case of PTKA following an intercondylar fracture of the femur in a patient with rheumatoid arthritis (RA) [26]. Then, Bell et al performed PTKA for treatment of supracondylar and intercondylar femoral fractures in 13 elder patients and recommended it for all type C and those type A fractures in which there is associated disease, osteoporosis or degenerative changes. In 10 patients, they performed the operation utilizing hinged knee prosthesis because collateral and cruciate ligaments were removed [2].

Thereafter, some surgeons performed acute PTKA for old patients with knee OA or osteoporosis who suffered from perigenicular fractures. Shah et al reported two patients with RA who sustained distal femoral fractures and treated with primary resection TKA [19]. Yoshino et al presented 3 women aged over 80 years in which femoral fractures and preexisting painful arthritic knees were treated utilizing PTKA with a stemmed femoral implant. All fracture healed within 3 months and all patients were able to walk with a cane within 2 months [27]. Nau et al performed PTKA in 6 elder women with osteoporosis or osteopenia who sustained a perigenicular fracture in proximal tibia (3 cases) or distal femoral (3 cases). They used hinged prosthesis in 5 cases and unconstrained prosthesis in another patient with cementing technique for all of the patients. Patients initiated full weight bearing immediately and functional outcomes were satisfying. They recommended PTKA with some degree of constraint in osteoporotic or osteopenic patients with perigenicular intra-articular fractures [12].

Rosen and Strauss treated 22 geriatric distal femoral fracture using PTKA and after an average of 11 months, found that 71% of them (17 patients) had resumed their preoperative level of
ambulation. They concluded that PTKA offers many advantages over ORIF in this patient population with poor bone quality, osteoarthritic knees and comorbidities [15]. Nourissat et al demonstrated that early TKA using a cemented long-stem tibial component is a realistic opinion in elder patients with poor bone quality who suffered a comminuted proximal epiphyseal tibial fracture and allows early weight-bearing before bone healing.

The functional status was dependent on the patient’s general status. Also, they expressed that use of a constrained knee or hinged prosthesis can be questioned but overcomes the need for troublesome ligament balance on an osteoporotic bone [13].

Also, recently, Vermire and Scheerlinck and Malviya et al presented the good results of PTKA in 11 and 26 patients with peri-articular knee fractures and demonstrated that this method of treatment can be used in elder patients with osteoporosis or arthritic knees [11,23]. Vermire et al used all-cemented posterior stabilized prosthesis and condylar constrained prosthesis (one patient) [11].

Like above-mentioned studies, the present study showed that PTKA can be a realistic and reasonable treatment option in aged population with osteoporosis and or arthritic knee who sustained a proximal tibial fracture. The early TKA has led to excellent knee score in near all of the patients. About half of our patients have yielded fair and poor functional score which seems to be resulted from pre-existing poor general status and low functional capacity. Furthermore, the preoperative low Tegner activity scale (2.5) explains this fact clearly. However, the Tegner scale improved significantly after the operation which reflects the effects of PTKA on improvement of functional status of the patients. Fortunately, we did not encounter any complication such as infection, DVT or component loosening and patients were highly satisfied with the outcomes of the surgery. Our results demonstrates that constrained knee prostheses are not necessary for a
large number of these patients. Studies have shown that the results of TKA in patients with previous history of periarticular fractures are less satisfactory and these procedures are associated with higher risk of perioperative complications. Suzuki et al showed that previous history of fracture and remnants of internal fixation as major risk factors of infection after TKA [22].

At the Mayo clinic, Weiss et al performed investigated the results of TKA in 62 patients with previous plateau fracture treated operatively or non-operatively and reported similar findings. Reoperation was required in 13 patients (20.9%) including 5 component revisions. Intraoperative and postoperative complications were observed in 10% and 26%, respectively [25]. And finally, Civinini et al demonstrated that TKA in patients with previous history of tibial plateau fracture requires particular technical solutions and is associated with higher rates of complications (32%) [4].

The current study was a prospective case series which to our knowledge, investigated the largest number of PTKA in elder patients with proximal tibial fracture, however, like previous studies, had some limitations. In our opinion, the most important limitation of the current study was descriptive nature. In other word, we did not compare the results of PTKA with those of ORIF for proximal tibial fracture which is vital for decision making and selection of the superior treatment method. Also, our study was limited by its mid-term follow up. However, we wish to follow the patients to evaluate the long-term results in this patient population.

Conclusion

Our findings demonstrated that acute PTKA can be considered as an appropriate and safe alternative for ORIF in aged patients with poor bone quality and/or severe degenerative changes
of the knee who sustained a proximal tibial fracture. The Knee score was optimal and patients were satisfied with the outcomes. Also, immediate weight-bearing was possible. The final functional status was dependent on the general condition of the patient and improved postoperatively. CCK prosthesis may be necessary in some certain patients with injuries increasing the risk of postoperative instability, but not for all of them. However, future comparative studies with larger sample sizes are required.

References


Figure legends

**Figure 1.** A 64 years old female with proximal tibial fracture AO type B associated with MCL avulsion. a) preoperative x-rays and b) X-rays 3.5 years after TKA.

**Figure 2.** A 67 years old male suffered from proximal tibial fracture AO type A treated with TKA. a) Preoperative anteroposterior and lateral x-rays and b) Anteroposterior and lateral x-rays taken 4 years Postoperatively.

**Figure 3.** A 62 years male with proximal tibial fracture AO type B. a) preoperative anteroposterior x-ray; b) preoperative posteroanterior CT scanning; c and d) postoperative anteroposterior and lateral x-rays after 4 years.