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Research Article

Total Knee Arthroplasty in Post-Traumatic Arthritis-Case Series of 15 Patients

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Abstract

Introduction: Post-traumatic arthritis is one of the leading causes of joint disability. It limits the activities of active patients, and the compromised joint must be endured for a long time. This study aims at outlining the outcomes of total knee arthroplasty in post-traumatic arthritis as well as technical difficulty of the procedure.

Study Design: A prospective case-series study.

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Type of study/level of evidence: Therapeutic IV.

Patients and Methods: In this prospective case series study, we analyzed the outcome of total knee arthroplasty following post-traumatic arthritis in fifteen patients with unilateral involvement (12 males and 3 females). Ten patients had stable arthritic knees and all treated with posterior stabilized (PS) implant knee prosthesis (Insall-Burstein II; Zimmer), while five patients with post traumatic unstable arthritic knees treated as follow: 3 patients with ligamentous instability managed by constrained condylar knee prosthesis (Zimmer, Warsaw, Indiana) and two patients with osseous deficiency grade IIA where metal augmentation was used together with stemmed constrained condylar knee prosthesis (CCK) implant (Zimmer, Warsaw, Indiana). The average duration of follow-up was 6 years (range, 4 to 10 years). The mean age was 49.8 years (range, 32 to 65 years) at the time of the arthroplasty. The patients outcomes were evaluated the on the basis of the knee society score.

Results: In our series of 15 post-traumatic knees, the mean clinical knee society scores (CKSS) at the latest follow up was improved from 43.6 ± 11.66 points preoperatively to 77.3 ± points postoperatively while the mean functional knee society score (FKSS) improved from 40. ± 6.3 preoperatively to 76.6 ± 84 postoperatively. Patients with preoperative stable knees had a higher mean value, for both clinical and functional KSS, while those with preoperative unstable knees were poorer. Complications occurred in 3 cases, one cases with wound dehiscence with prolonged drainage for more than seven days and treated by oral antibiotics and daily sterile dressings until the wound closed completely. Another case complicated by infection and improved by serial debridement. The third case had aseptic loosening and required revision surgery.

Conclusion: Total knee arthroplasty for post-traumatic arthritis decreases pain and improves knee function, as reflected by the post-operative improvement in knee clinical and functional scores. However; the procedure is not as simple as total knee arthroplasty for primary osteoarthritis as it is technically demanding and requires adequate preoperative planning.

Keywords: *Total Knee Arthroplasty; Unstable Arthritic Knee; Post Traumatic; Arthritis; Bone Defects*

Introduction

The majority of post-traumatic arthritis cases are considered types of osteoarthritis. However, the cartilage degeneration that occurs in post-traumatic arthritis results from sudden injury and not gradual wear and tear as is the case for osteoarthritis. Knee Joint arthritis can occur due to many causes. Trauma to the knee is a common predisposing factor for knee OA. This trauma extends from internal derangement of knee to intra-articular fractures and fracture Dislocation [1].

The injury could be from sports, a motor vehicle accident, a fall, or any other source of physical trauma. Such injuries can damage the ligaments, cartilage and/or the bone, changing the mechanics of the joint [2]. Post-traumatic knee OA accounts for 12% of all knees OA [3]. And it always occurs in young patients which will affect activity of daily living. A combination of factors most likely contributes to the development of PTA following injury to the knee. First, mechanical imbalance may be due to ligamentous laxity, meniscal tears and malalignment [4]. Second, the release of pro-inflammatory cytokines into local tissue leads to imperfect remodeling of the cartilage. Lastly, non-unions and malunions following fractures may lead to PTA [5].

The treatment of Post traumatic knee OA varies from a combination of non-pharmacological and pharmacological modalities, to operative interventions. Activity modification, anti-inflammatory medications, ambulatory assist devices, and physical therapy are the mainstay of non-operative treatment [6].

With failure of conservative treatment, surgical options become an alternative tool ranging from arthroscopic debridement to Arthrodesis [6]. Total knee arthroplasty (TKA) is an option for the treatment of end-stage post traumatic knee OA [7]. It is not so simple but often more technically challenging due to previous surgeries and scarring [8], problems related to secondary deformity, poor bone quality, bone loss and ligament incompetenc, and it is always associated with higher complication rate. In addition it accounts for more consumption of hospital resources, and incurs a higher cost [9].

Aim of the Study

The study aims at outlining the outcomes of total knee arthroplasty in post-traumatic arthritis as well as the technical difficulties of the procedure.

Patients and Methods

Between 2006 and 2014, fifteen patients (twelve males, three females) with unilateral post traumatic knee OA were enrolled in this study. The study was initiated after receiving approval from the institutional ethics committee for research in accordance with the ethical standards laid down in the 1964 declaration of Helsinki and its later amendments. Also, a written consent had been obtained from the patient for participating in the study. All review authors independently performed study selection. Two authors independently assessed the included study and performed data extraction. Four cases had intra-articular distal femoral fractures and eleven had tibial plateau fractures. The mean age was 49.8 years (range, 38 to 65 years). Causative injuries were fall from height (9 patients), road traffic accidents (4 patients) and in one case drop of heavy box over the knee while working and one case due to heavy sporting. The average duration from trauma to presentation to our clinic was 19.5 months (range 11 to 36 months). Inclusion criteria involved patients below 55 years with severe pain and disability due to intra-articular fractures around the knee and exclusion criteria involved patients above 55 years age, skeletally immature, pathological fractures, Neuropathic Arthropathies, mental illness, significant surgical contraindications, osteoporosis, patients refusing to sign informed consent and patients with signs of infection or degenerative OA. Primitive intervention varied between conservative measure by POP (3 patients), application of ring fixation (7 patients)and open reduction and internal fixation (by plating in 4 patients and only screws in one patient).Two cases had infection following the primitive surgery which had been eradicated completely (evidenced by normalization of ESR, CRP and total leukocytic count (before implantation). Five cases had frontal laxity >15º while 4 cases had stiffness upon flexion. Full clinical examination achieved to evaluate deformity both at rest and during weight-bearing, range of motions, ligament balancing, presence of previous scarring, swelling, peripheral neuro-vascular status and knee stability. There were 10 patients with stable painful knee and 5 patients with unstable painful knee. This instability was due to ligamentous (real instability), bony (pseudo-instability) or combined (Table 1).

Full laboratory investigations including complete blood cell count (CBC), erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) liver and kidney functions had been done.

Pre-operative plain imaging Studies (Figure 1) were done to assess: the fracture pattern, intra-articular chondro-osseous defects and limb axis and deformity whether extra-articular deformities or intra-articular deformities through antero-posterior, lateral and patellar axial view long-standing weight-bearing radiographs. Preoperative computed tomography scans were obtained for all cases to assess bone quality and possible defects (Figure 2).

	No	%
Group (1): Post traumatic stable painful knee	10	66.7%
Group (2): Post traumatic unstable painful knee (ligamentous, bony or combined)	5	33.3%
Total	15	100%

Table 1: *Distribution of patients with post traumatic OA knee.*

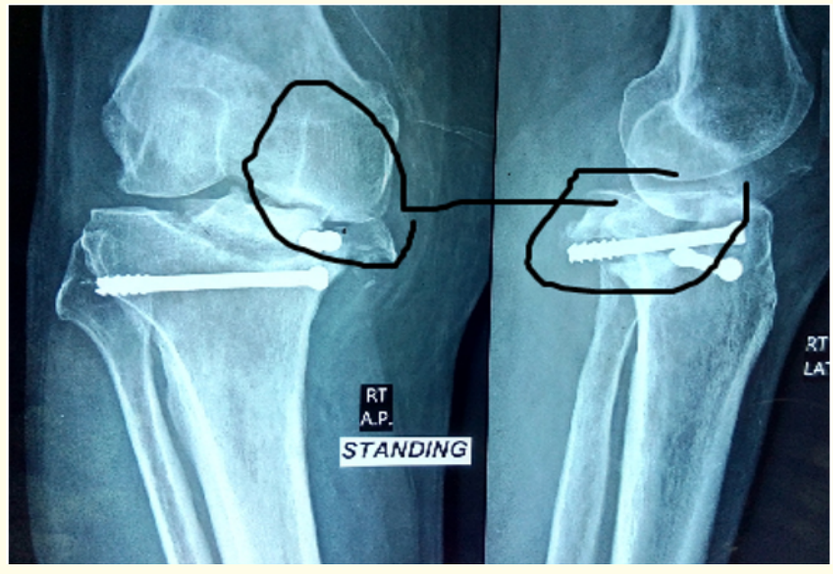

Figure 1: *Intra-articular chondro-osseous defects.*

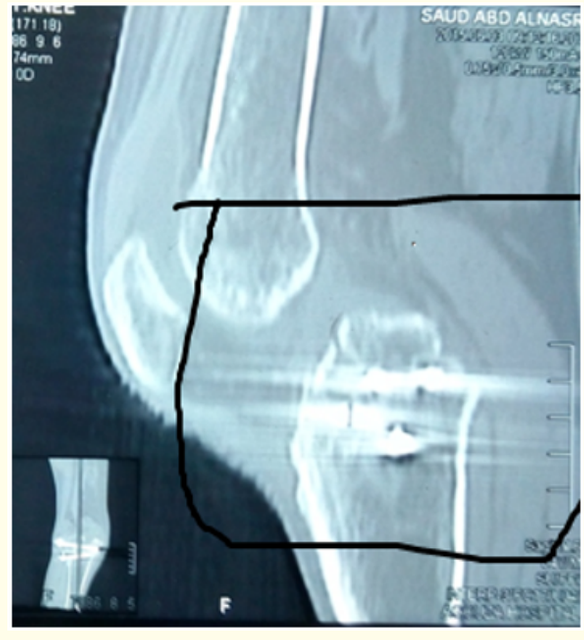

Figure 2: *CT scan of posttraumatic unstable knee.*

Surgical Procedure Following pre-operative clinical and radiological evaluation, approach, limb axis, degree of bone loss, choice of prosthesis and level of constraint were planned. Low molecular weight heparin (Enoxaparin) given twelve hours before surgery in a dose of 40 mg S C and started again 12 hours postoperative and then given daily until the patient was discharged from the hospital and continued for 35 days.

Prophylactic Pre-operative I.V antibiotic (1 gm 3rd generation cephalosporin) was administered to all patients. Preparation of two units of whole fresh blood to be ready for use according to intra-operative blood loss and preoperative patient hemoglobin level.

Epidural anesthesia was used in most of patient (9 cases), spinal anesthesia in 4 patients and general anesthesia utilized in 2 patients. Pneumatic tourniquet was used in 11 cases and was deflated by the end of the procedure to perform meticulous haemostasis before wound closure.

Hip joint center was marked by a prominent mark (airway) over the palpable pulsations of the femoral artery one inch below the mid-inguinal point, the value of which was to guide the intra-operative check of limb alignment by alignment rods.

The tourniquet was placed high at the root of the limb and the remainder of the limb washed with betadine solution and draped in a sterile towels.

A well-planned midline incision was utilized in 10 cases and lazy S shaped incision was used in 5 cases (Figure 3). We tried to involve the old scar within the new one. Fixation implant had been removed at the time of arthroplasty and in one case screws were removed through skin snips with lateral plate left without removal. Peri-patellar scarring with difficult eversion of the patella was evident in seven patients with open reduction. Limited quadriceps release was performed in three patients and lateral retinacular release was performed in another two cases.

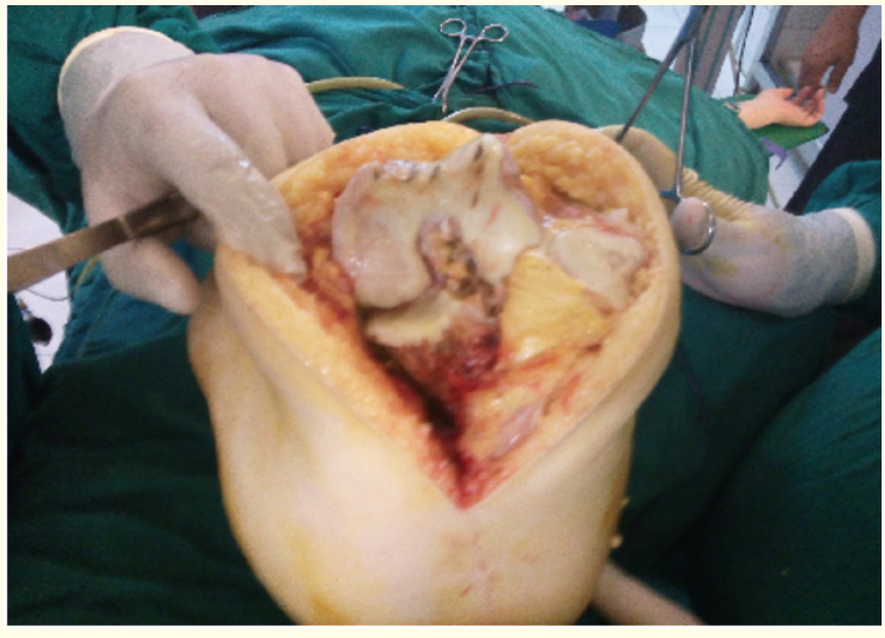

Figure 3: *Medial parapatellar approach.*

Five patients with post-traumatic varus deformity required medial release while one patient with valgus deformity requiring lateral release.

An extra-medullary guides was used in 8 cases owing to distorted landmarks of upper tibia for proper tibial component orientation while meticulous reference using intramedullary guide was used in 7 cases. The tibial cutting guide (left or right) was fitted over the extra-medullary rod.

Seven (out of 10 patients) with painful stable arthritic knees had no tibial defect after initial resection of the tibia so they did not need any augmentation. The other three (20%) patients had grade I defect (according to Anderson Orthopedic Research Institute classification) [10] which was augmented by autologous impaction bone graft in two patients and cement augmentation in one patient. All these patients were treated with posterior stabilized (PS) implant prosthesis (Insall-Burstein II; Zimmer).

Those with unstable painful knee patients (5 patients), three had ligamentous instability and they were managed by constrained condylar knee prosthesis (Zimmer, Warsaw, Indiana).

The other two patients had osseous deficiency grade IIA in which metal augmentation was used together with stemmed constrained condylar knee prosthesis (CCK) implant with CCK liner to increase the level of constraint (Zimmer, Warsaw, Indiana) (Figure 4). The distribution of the cases is shown in table 2.

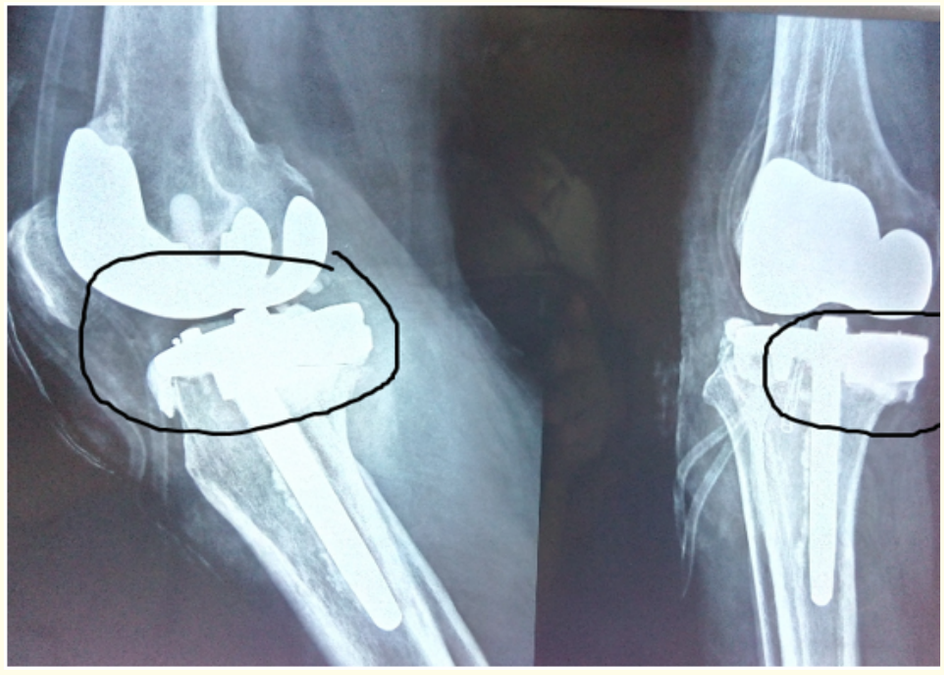

Figure 4: *Stemmed constrained condylar knee prosthesis.*

No. of cases		Description	Augmentation	Implant
10 cases	7 cases	Stable knee with no defect	No augmentation	PSA
	2 cases	Grade (I) defect	Impaction Bone graft	
	1 case	Grade (I) defect	Impaction Bone cement	
5 Cases	3 cases	Ligament instability		CCK
	2 cases	Grade IIA osseous deficiency	Metal augment	Stemmed CCK

Table 2: *Distribution of the cases according to chosen implant.*

PSA: Posterior Stabilized Arthroplasty; CCK: Constrained Condylar Knee.

To minimize the risk of infection, we used antibiotic impregnated bone cement for implants fixation in all patients. No patella replacements had been done and only Shaving of pathological cartilage with Denervation of the periphery of the patella and Removal of osteophytes. After completion of surgery the patient's knee was immobilized in a Jones compressive bandage and a knee immobilizer immediately post operatively.

Postoperative care: Careful monitoring of the vital signs, urine volume, drains, and distal circulation. A thin pillow applied below the ankle to avoid postoperative flexion deformity and for slight elevation of the limb to decrease edema.

First dressing after 48 - 72 hours according to the amount of blood drained. Antibiotic and anticoagulant medications were continued. Static quadriceps and hamstring strengthening exercises and straight leg raising from the first postoperative day. Weight bearing started next day of operation. Patient was trained to bear as much weight as he can bear with the aid of the walker for 3 weeks then using a cane for another 3 weeks then full weight bearing without any aid.

Patients were followed up clinically and radiologically at 6 weeks, 6 months, 1 year and periodically every 2 years with average duration of follow-up 6 years (range, 4 - 10 years).

Clinical assessment at follow up included both the knee society clinical and functional rating systems.

The function score based on patient's ability to walk and climb stairs (each rated 50 points), with 20 points subtracted when walking aids used.

Radiological assessment done through Standing anteroposterior and lateral radiographs as well as tangential radiographs of the patella. The radiographic scoring system of the Knee Society [11] was used to determine the over-all alignment of the limb, the respective size, fit and positions of the prosthetic components relative to the bone, and the presence of radiolucent lines in zones adjacent to the cement mantle. Femoral and tibial component alignment were assessed radiologically according to the knee society score with special emphasis on four angles: (α) Angle: Angle between a line tangential to the femoral component at the joint line and the anatomical axis of the femur in the antero-posterior view. (β) Angle: the angle between line tangential to the tibial tray and the anatomical axis of the tibia in the antero-posterior view. (σ) Angle (the tibial posterior slope angle): the angle between line tangential to the tibial tray and the anatomical axis of the tibia in the lateral view and (γ) gama Angle: Between the anatomical axis of the femur and a line perpendicular to the center of the femoral component in the lateral view (Figure 5).

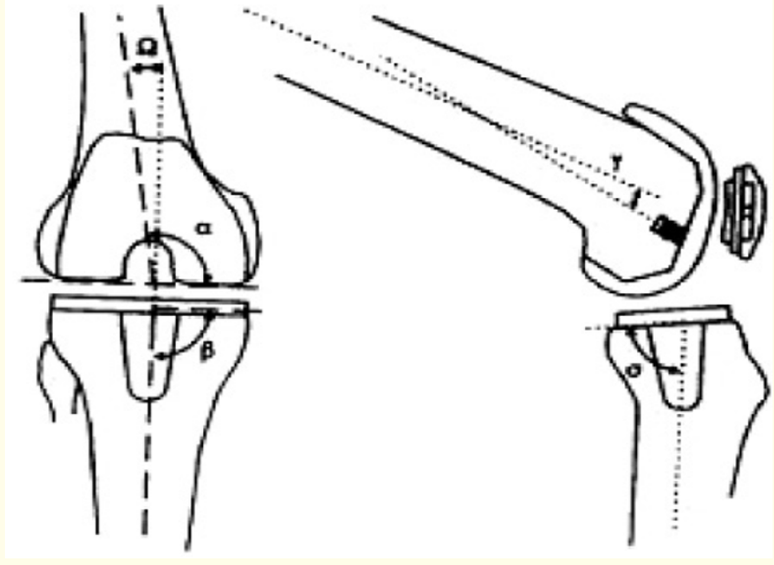

Figure 5: *Schematic representation of aforementioned angles.*

Also, Changes in thickness of polyethylene or asymmetry between the heights of the lateral and medial spaces on the anteroposterior radiograph made with the patient bearing weight were considered as possible evidence of polyethylene wear. The radiographs were evaluated for changes in the bone that were consistent with osteolysis and for progression and location of radiolucent lines. The presence or absence of radiolucent lines was evaluated with the system of the Knee Society, which involves seven tibial and seven femoral zones (Figure 6).

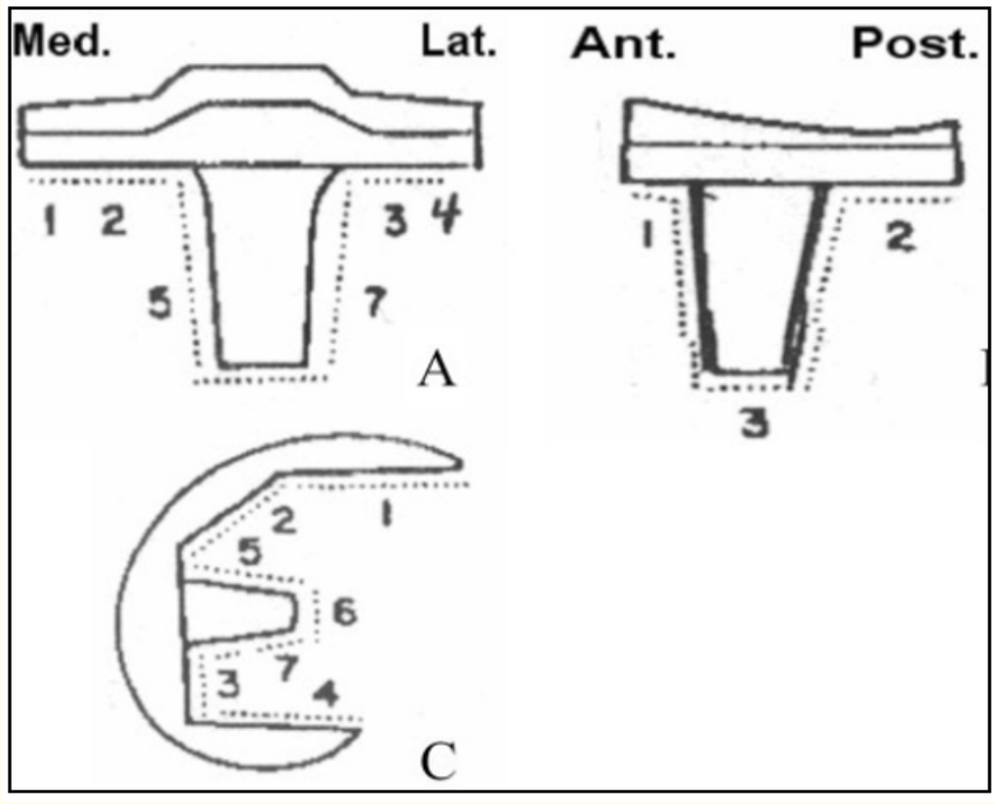

Figure 6: *The Knee Society Roentgenographic Evaluation System. A: Anteroposterior view of representative tibial component. B: Lateral view of representative tibial component. C: Lateral view of representative femoral component.*

Diagnosis of loosening of a component was made on the basis of three radiographic criteria: (1) a global radiolucent line, more than one millimeter thick, about the entire bone-cement interface; (2) a progressing radiolucent line, more than one millimeter thick, in any one zone; or (3) gross subsidence or shift of the component.

Statistical analysis

Descriptive data were expressed as frequency and percentages, and means with SD. A value of $p < 0.05$ was considered statistically significant. Statistical analyses were performed using SPSS 20.0.

Results

This prospective case series study was conducted to evaluate the outcomes of total knee arthroplasty following post-traumatic arthritis in fifteen patients (12 males). There was a male predominance (80% of the patients) in our study with male to female ratio of 4:1. The mean age was 49.8 years ± 13. Ten patients had stable post-traumatic knee arthritis while five patients had unstable knee either due to ligamentous insufficiency (3 cases) or due to bony defect(2 cases). The mean preoperative flexion was 71 ± 23 ◦ and the mean preoperative extension was 6 ± 6 ◦ (range, 0 - 20 ◦) with mean joint range of motion 66 ± 23 ◦ . The mean operative time of the patients was 65.9 ± 8.0 minutes. Mean blood loss was 450 ± 12.6 ml. The mean hospital stay was 5.1 ± 1.26 days. According to clinical knee society scoring

system; mean pain score of the overall series at the last follow-up had significantly improved from 19 ± 9 preoperatively to 47 ± 16 ($p < 0.001$) (mean gain 28 points). The mean preoperative clinical knee society score (CKSS) was 43.6 ± 11.66 points which was increased to an average postoperative score of 77.3 ± 13.88 points at the latest follow-up (mean gain 34 points). According to the knee society clinical scoring system 11 patients (73.3%) assessed as excellent, 2 patients (13.3%) good, one patient (6.7%) fair and 1 patient (6.7%) poor result (Table 3). The mean functional knee society score (FKSS) improved from 40 ± 16.3 points preoperatively to 76.6 ± 84 points at last follow-up (mean gain 36 points) and according to the knee society functional scoring system, 10 patients (66.6%) assessed as excellent, 3 patients (20%) good, one patients (6.7%) fair and one patient (6.7%) poor results as in table 4.

Knee clinical score	Frequency (%)
Excellent	11 patients (73.3%)
Good	2 patients (13.3%)
Fair	1 patients (6.7%)
Poor	1 patients (6.7%)
Total	15 patients (100%)

Table 3: *Grading of knee clinical score.*

Knee functional score	Frequency (%)
Excellent	10 patients (66.6%)
Good	3 patients (20%)
Fair	1 patients (6.7%)
Poor	1 patients (6.7%)
Total	15 (100%)

Table 4: *Grading of knee functional score.*

The mean clinical knee society score (CKSS) was improved in stable knee patients from 48.5 ± 16 points preoperatively to 81 ± 11 points in last follow-up, while the unstable knee patients improved from 31.6 ± 14 points preoperatively to 70.7 ± 12 points at last follow-up. The mean functional knee society score (FKSS) was improved in stable knee patients from 45.22 ± 13 points preoperatively to 79.5 ± 16 points postoperatively while in the unstable knee group it was improved from 30.6 ± 14 points pre-operatively to 72.7 ± 13 points at last follow-up (Table 5).

	Society Score	Preoperative	Post-operative
Stable Knees (10 patients)	CKSS	48.5 ± 16	81 ± 11
	FKSS	45.22 ± 13	79.5 ± 16
Unstable knees (5 patients)	CKSS	31.6 ± 14	70.7 ± 12
	FKSS	30.6 ± 14	72.7 ± 13

Table 5: *Results of stable and unstable knee groups.*

CKSS: Clinical Knee Society Score; FKSS: Functional Knee Society Score.

Association between knee functional score and knee clinical score was documented preoperatively and at last follow-up. Out of 11 patients who had excellent knee clinical score, 10 patients (90.9%) had excellent knee functional scores while one patient (9.1%) had good knee functional scores. The 2 patients who had good knee clinical score; also had good knee functional score. One patient had fair score for both clinical and functional scores owing to development of infection. Another one patient had poor result for both clinical and functional scores owing to development of aseptic loosening which required revision (Table 6).

Knee clinical score (KCSS)	Knee Functional Score (KFSS)				Total
	Excellent	Good	Fair	Poor	
Excellent	10	1	----	----	11
Good	-----	2	----	----	2
Fair	----	----	1	----	1
Poor	----	----	----	1	1
Total	10	3	1	1	15

Table 6: *Association between knee functional score and knee clinical score.*

Statistical analyses were performed using SPSS 20. and the association between functional and clinical knee scores with Spearman rank correlation coefficient. The value of spearman was 0.319 preoperative reaching 0.658 ($p < 0.05$). This signified that there is a significant association between knee clinical and functional scores.

Complications

There were 3 cases (20%) in our study with complications, one patient complicated by wound dehiscence and prolonged drainage for more than seven days and was treated with oral antibiotics and daily sterile dressings until the wound closed completely. Another case complicated by infection and improved by serial debridement. The 3th case had aseptic loosening and required revision surgery.

Discussion

Post-traumatic arthritis (PTA) defined as structural damage following an injury to a joint minor or major, repetitive or single. It commonly affects more active individuals as they are more likely to participate in such activities that may cause injury (i.e. sports, blunt trauma, motor vehicle accidents, etc.) and it is often more notable in weight-bearing joints [12]. From radiological and pathological point of view it is similar to primary osteoarthritis and it is estimated that 12% of all symptomatic osteoarthritis (OA) of the hip, knee, and ankle are due to post-traumatic arthritis PTA with a varied prevalence of 21% - 44% reported in the literature [13]. These injuries are usually intraarticular or extraarticular fractures of distal femur, tibial plateau or complete dislocations of the knee, which often have required operative treatment [13]. The end result can be an arthritic knee with problems involving joint instability, stiffness, bony defects, mal alignment secondary to intra or extraarticular deformity, surgical scars, soft tissue abnormalities, and retained internal fixation devices. The lack of knowledge pertaining to the incidence of posttraumatic arthritis is due partly to the limited availability of long-term follow-up studies. The lack of control groups, variations in fracture classification and treatment methods, and different diagnostic criteria for the development of significant arthritis also make comparison of reports difficult [7].

Nowadays, total knee arthroplasty is becoming a standard treatment for arthritic knee in terms of relief from knee pain as well as it stabilizes the knee with an appropriate range of motions and associated with substantial functional improvement and an improvement in the quality of life of patients. However; evidence on outcomes is sparse and there is a paucity in the literature regarding the outcome of TKA performed for the treatment of PTA [7]. Also; implanting knee prosthesis in such cases involves realigning the lower limb to ensure that the fixation of the implant components remains stable and minimizes long-term insert wear.

Different scoring systems had been utilized by several studies to judge the functional outcomes of TKA in PTA patients. The most valid and widely accepted is Knee Society Scoring criteria, which is composed of a functional and clinical knee scores. The functional score includes a patient assessment of walking distance, ability to climb stairs, and need for assistive devices; while the clinical knee score incorporates patient reported pain, ROM, alignment, and stability [14].

Literature reports show poorer results with TKA in post-traumatic arthritis than with primary arthritis. However, such studies [7,13] are few and involve a very limited number of patients. This is at odds with recent studies which report no difference in outcome scores between TKA after a fracture of the tibial plateau and TKA for primary osteoarthritis [14,15].

Other studies reported an improvement in the functional and clinical knee scores of patients following TKA for PTA. Lizaur-Utrilla., *et al.* [16] further reported that there were no significant differences in knee or pain scores of patients treated with TKA for PTA vs primary OA. Lunebourg., *et al.* [9], while reporting significant improvement in scores, noted lower post-operative scores for patients with PTA vs primary OA.

Collectively; these results indicate that TKA is an effective treatment for patients with PTA with functional improvement, as well as increased range of motion and reduction in pain. With regards to the lower post-operative scores noted above, despite significant improvement, it is reasonable to infer that this difference compared to patients undergoing TKA for primary OA may be due to differences in the pre-operative status of the patients [17]. Thus, the post-operative difference observed in patients with PTA vs primary OA, is not due to the intrinsic success of the procedure itself, but rather the poorer pre-operative status of patients with PTA [18].

In our study, we presented a series of 15 post-traumatic knees in 15 patients, at a mean follow-up of six years, clinical KSS improved from a pre-operative mean of 40.6 points to 77.3 points; the functional KSS improved from a preoperative mean of 40 to 76.6 points at follow-up.

We also present a classification not mentioned before in various studies regarding the choice of the prosthesis. The patients in our study were divided into two groups: stable painful arthritic knee group and unstable painful arthritic knee group. The results of patients with stable painful arthritic knee were comparable to those of unstable painful arthritic knee; we showed that patients with stable painful arthritic knee had a higher mean values, but the pre-operative state of those with unstable painful arthritic knee was poorer.

Lonner., *et al.* [17] studied 30 patients with post traumatic knee arthritis after intra-articular or metaphyseal fractures. At a mean follow up of 46 months, an improvement of Knee Society Score (from a pre-operative mean of 36 points to a post-operative mean of 78 points) was reported. Knee scores were considered excellent or good in 71% of cases.

The complication rate in our study was (26.7). In Lonner., *et al.* [17] study there was complications in 57% of cases (aseptic failure 26%, septic failure 10% and other complications 20%). Tibial loosening occurred mainly in cases where no stems were used or in cases with cementless tibial components. The authors therefore recommended the use of stems in cases of compromised metaphyseal bone stock.

Weiss., *et al.* [15] in their study stated that the most common problems in patients with previous tibial plateau fracture were related to soft-tissue healing, post-operative stiffness and intra-operative extensor mechanism disruption. The authors showed that in patients for whom the goal is ideal limb and implant alignment; the results were similar to those of routine primary TKA. They also identified the single most important factor influencing outcome to be initial fracture treatment (correct incision, minimal periosteal stripping, anatomical reduction, use of bone graft).

They suggested that the outcome of TKA may be improved further by making special efforts to restore limb alignment, to ensure correct component positioning, and to manage soft tissue balance [18].

Limitations of the Study

The limitations of our study include its small sample size. This is a consequence of the rarity of TKA after fractures around the knee. It is however, the first study (to our knowledge) classifying the patients into stable posttraumatic arthritic knee and unstable posttraumatic arthritic knee.

Conclusion

Post-traumatic knee arthritis is particularly demanding for the surgeon and could be considered as a revision knee surgery. Every case needs good clinical and radiological evaluation. Planning is essential as latent infection (especially in cases of device in situ) must be excluded. Choosing the type of the prosthesis is corner stone in treating such cases and must be decided upon according to bone defect and ligament competence whether stable or unstable knee. The operation is difficult with higher rate of possible complications compared with routine primary total knee arthroplasty majority of which occur in the perioperative period. Scarring from the initial trauma and

prior surgeries, as well as the inherent technical difficulty of the operation, likely contribute to this complication rate. The technical challenges encountered can require skills, prosthetic systems, and methods usually reserved for complex revision arthroplasty.

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