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Correction of Deformity and Improvement of Functional Outcomes in Neglected Tibial Fracture with Post-Traumatic Osteoarthritis Through Long Stem Total Knee Arthroplasty: A Case Report

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ABSTRACT

Background: Tibial plateau fractures, which account for 1% of all fractures, can lead to significant complications such as post-traumatic osteoarthritis (PTOA). This case report describes the management of a neglected tibial plateau fracture leading to PTOA treated with total knee arthroplasty (TKA).

Case report: A 55-year-old male presented with severe pain and impaired mobility in the right knee, seven months post a fall that resulted in a tibial plateau fracture. The patient had not sought medical treatment initially due to fear of surgery. Physical examination and imaging confirmed a malunion fracture with associated PTOA. The patient underwent right total knee replacement (TKR) with a long stem prosthesis. Postoperative care included antibiotic prophylaxis, anticoagulation, and early rehabilitation.

Discussion: Neglected tibial plateau fractures can lead to malunion and PTOA due to altered biomechanics and joint incongruency. Surgical intervention aims to restore joint stability and alignment, crucial for functional recovery. This patient's postoperative outcomes demonstrated significant improvement in pain, mobility, and knee function, highlighting the efficacy of TKA in managing advanced PTOA secondary to neglected fractures.

Conclusion: This case illustrates that TKA can effectively correct deformity and enhance functional outcomes in patients with neglected tibial plateau fractures complicated by PTOA. Early diagnosis and appropriate surgical intervention are critical in preventing long-term joint dysfunction.

Keywords: neglected fracture dislocation, hinged external fixator, interposition arthroplasty, early mobilization, case report

INTRODUCTION

Located medially to the fibula, the tibia is the leg's weight-bearing bone. The distal portion of the knee joint is compromised by the proximal portion of the bone. The medial and lateral tibial condyles, commonly referred to as the medial and lateral plateaus, are two articular surfaces on the tibial plateau. One percent of all fractures are tibial plateau fractures. Tibial plateau fractures occur 10.3 times per 100,000 people each year [1].

Acute post-traumatic arthritis (PTA) is a common result of joint injuries, whether or

not there is a corresponding disruption of the articular surface. PTA is a severe, debilitating disorder that progresses over time. Post-traumatic osteoarthritis (PTOA) is the most prevalent type of chronic PTA. With 700 000 cases each year in the USA and 12.5% of PTOA, knee injuries continue to be the most common injury in the world. PTOA may manifest quickly, in less than a year, or it may take a long time to manifest, even 10 to 20 years after the event [2].

Tibial plateau fractures can lead to the development of post-traumatic osteoarthritis, which is a chronic condition. The incidence of this condition ranges from 21% to 44% after fractures of the proximal tibia, patella, and distal femur. This condition has been linked to different causes, including mechanical imbalance caused by loose ligaments, rips in the meniscus, and improper healing of fractures. The management of post-traumatic osteoarthritis can be categorized into conservative and surgical approaches. The conservative care options include modifying activity, using anti-inflammatory drugs, utilizing ambulatory assist devices, and undergoing physical therapy. The potential surgical options range from arthroscopic debridement to arthrodesis. ORIF may be less advantageous in elderly individuals with decreased demand, as it can lead to delayed mobilization and knee stiffness. Total knee arthroplasty (TKA) is a viable choice for managing advanced stages of patellofemoral osteoarthritis (PTA) [3,4]. In this case, we wanted to report a post traumatic osteoarthritis that developed less than a year due to neglected tibial plateau fracture managed with total knee replacement. This case report followed the SCARE guidelines 2023 [5].

CASE PRESENTATION

A 55-year-old man came with chief complain of pain on his right knee. He had history of falling at his house 7 months ago. He did not go to the hospital because he was afraid of surgery. He had never gone massage his leg and he only applied herbal medication. Right now, he was unable to walk properly. He used two crutches to help mobilize daily. He did not have any systemic disease nor allergy. He was referred by the orthopaedic surgeon with the diagnosis of neglected closed fracture right tibia plateau and post traumatic osteoarthritis.

Generally, he was hemodynamically stable. Local physical examination on his right knee showed deformity and swelling. Tenderness could be palpated minimally around the knee. His knee range of flexion was decreasing with the range of 105°. Physical examination could be seen in Figure 1. A, B. From x-ray, it was seen displaced fracture right proximal tibia bone until right intraarticular femorotibial joint with callus formation, malunion fracture, subluxation of patella bone bilateral, disused osteopenia, soft tissue swelling, knee joint effusion. X-ray figure could be seen in Figure 1.C-E. He was diagnosed with neglected closed fracture right tibia plateau et cause post traumatic osteoarthritis et cause malunion knee. Right TKR Tibia Extension was scheduled for this patient.

Figure 1. (A, B) The pre-operative clinical picture and (C, D, E) the pre-operative radiological examination (Source: internal documentation)

Surgical Procedure

Surgery was done with medial parapatellar approach. Osteophyte was seen in the lateral and medial condyle of femur. Osteophyte was excised. Then, implant TKR PS was applied after preparing the femoral and tibial component. Implant can be seen in Figure 3. Surgical procedure can be seen in Figure 4. Wound was sutured and strain was placed. (Figure 2.A-G)

Figure 2. The intra-operative clinical picture: (A) Implant with femoral component size #3.0 and tibial component size #2.5. Insertion thickness #8mm and length #120 and (B-G) Process of setting the implant and evaluate the condition post-surgical. (Source: internal documentation)

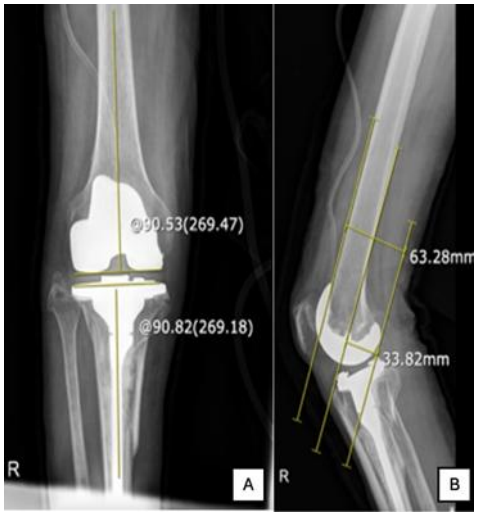

Figure 3. The post-operative X-ray documentation of (A) AP-view and (B) lateral view. (Source: internal documentation)

Post-operative

He was given ceftriaxone 1g twice a day and lovenox 0.4 cc start 12 hours after surgery. From the post operative x-ray, there was no notching on the femoral component and measurement could be seen in Table 1, Figure 3. Rehabilitation was started after the day of surgery collaborating with the medic rehabilitation. Patient was trained to use walker and able to walk in the third month. Follow up figure can be seen in Figure 4.

Figure 4. The post-operative evaluation in (A) after surgery., (B, C) 3 months follow-up (Source: internal documentation)

DISCUSSION

Injury to the articular cartilage can range from a slight one that results in chondrocyte death to a noticeable mechanical disruption of the cartilage and the bone, which is known as an intra articular fracture. Different healing mechanisms are triggered by different types of injuries. In addition to resulting in mechanical dysfunction, intra articular fractures may leave behind persistent residual abnormalities that, if sufficiently extensive and/or involving a crucial joint area, may raise the risk of degeneration. Tibial plateau fractures (TPF) frequently result in malunions, which can cause stiffness, pseudo-instability, and posttraumatic osteoarthritis [6]. In this case, patient had TPF in the last 7 months ago and it resulted malunion fracture. He felt pain and stiffness on his right knee.

According to Schenker et al., the probability of developing post traumatic osteoarthritis (PTOA) after suffering a substantial joint injury can be as high as 75%, and the risk is multiplied 20 times if there is an intra articular fracture [7]. PTOA develops more as a result of changed biomechanics than from prolonged joint depression. Although the risk of developing PTOA varies between joints and between people, clinical experience has demonstrated that variances do exist. It has been suggested that the single biggest risk factor for getting PTOA is age [8]. In this case, patient developed PTOA due to the malunion fracture. His bone condition either was not good enough since on the x-ray we could see disused osteopenia and he was already 55 years old. This could higher the potential of PTOA.

It was discovered that a 3 mm step-off only resulted in a local peak pressure that was 75% higher than normal and that the point loading of the joints was not significant until the step-off was more than 1.5 mm which double than a local pressure that typically might be tolerated by the tibial articular surface [9]. According to the recent literature on management suggestions for tibial plateau fractures, a step off should be smaller than 2 mm [8]. The majority of patients with residual articular incongruence of 3–10 mm, or even >10 mm, had a satisfactory functional outcome seven years after the injury, according to Lutch et al. analysis of 109 cases of tibial plateau fractures. The authors came to the conclusion that surgically treating an articular depression less than 10 mm could not be justified. A study found out that 30 out of 53 patients with residual articular displacement of more than 10 mm and 23 out of 41 patients with articular displacement between 5 mm and 9 mm had excellent or good results [10].

To restore joint stability and joint congruency in tibial plateau fractures, surgery is used. The continuity of the rim, the stability of the joint, and the alignment of the metaphyseal segment are all restored by reducing anatomically and buttressing the split wedges. The weight-bearing region is

restored, leading to joint congruency, through anatomical reduction and stable stabilization of the depressed and fractured articular surface. Congruence and stability go hand in hand. It is essential for early mobilization and rehabilitation that a joint is stable and well-aligned. Perfect congruency might not be possible in cases of severe comminution with considerable articular cartilage fragmentation. However, a functional knee can be attained if the surgeon can just return the broken wedge fragments to their normal anatomical three-dimensional orientation, along with the continuity of the tibial plateau rim and the axial alignment of the joint. Post-traumatic osteoarthritis may result from loss of congruency. However, this is a late occurrence. Restoring stability opens up a window for rehabilitation that is impossible if the joint is unstable and subluxated [11]. In this case, we decided to did total knee replacement to restore joint stability and joint congruency. Congruency could be achieved in the end of surgical and functional knee can be attained.

In this study, the postoperative Medial Distal Femoral Angle (MDFA) was measured to be 90.53°. This value is slightly different from the findings of Moubarak & Brilhaut (2014) research, where the average postoperative MDFA, using patient-specific cutting guides (PSCG), was 89.9° ± 1.6. The deviation from the target MDFA was approximately 1.07° ± 1.15. Although there is a slight discrepancy, the MDFA value observed in this study remains within the acceptable range for therapeutic use. The discrepancies in MDFA outcomes observed in prior research studies highlight the intricate nature and difficulties associated with attaining complete consistency in total knee arthroplasty through the use of PSCG. According to a study by Palanisani et al., in 2018, the average MDFA (Medial Distal Femoral Angle) in the group with bowed tibia (MDFA < 3) was 90.46°, while in the group with straight tibia (MDFA > 3) it was 90.12°. However, there was no statistically significant difference between the two groups ($p = 0.390$). The comparison between the obtained result (90.53°) and the theoretical findings demonstrates a substantial degree of closeness, with a numerical discrepancy that can be deemed as not clinically relevant. Furthermore, the accompanying discussion emphasizes the need of taking into account the extent of tibial curvature while placing the tibial jig. This aligns with the suggestion to modify tibial jig placement according to notable tibial curvature traits [12,13].

In this study, the Medial Proximal Tibia Angle (MPTA) obtained a postoperative value of 90.82°. Existing research indicates that persons of Chinese origin exhibit a greater varus inclination in comparison to other populations. The study conducted by Bellemans et al. demonstrated that the average MPTA in a group of young, healthy Caucasian individuals aged 20-29 years was 87.04 + 2.07. Tang et al.'s study conducted on the Chinese population revealed that the average MPTA was approximately two degrees more acute. Shetty et al. examined extended limb radiographs of 388 physically fit individuals between the ages of 20 and 40. The study included 100 participants from India and 94 participants from Korea. The researchers discovered that the mean performance test score (MPTA) in this particular sample was 86.7 ± 1.9. The study found that the average MPTA (measured using TCAx as the rotational reference) was 87.0 + 2.2. Males exhibited more varus than females. The study's findings suggest that the postoperative MPTA in this specific demographic aligns with expectations, showing that there is no need to modify the ideal coronal alignment for TKA planning in the Asian population. Additional research is required, particularly in patients with severe varus deformities, to evaluate the prevalence and advancement of these deformities as a component of the osteoarthritis process. Consistent with prior studies, Ryu et al. reported that the average mTPA at the last follow-up was 88.3°±1.9°. While radiological outcomes may not always exhibit a statistical association with clinical outcomes, individuals who have smaller

disparities from their uninjured limbs generally experience improved clinical outcomes. This correlation is particularly noteworthy in the context of PPTA. It is advisable to assess the unaffected limbs in order to attain the best possible clinical outcomes [14,15].

The study reveals that the Posterior Condyle Offset Ratio (PCOR) among patients who have knee surgery is 0.46. In contrast, a prior study with 126 patients revealed that the majority of patients observed a rise in PCOR following knee replacement. However, there was no significant link between the increase in PCOR and the level of attained flexion. It is important to acknowledge that the PCOR value of 0.46 obtained in this study is indicative of a broader trend that may be observed in comparable investigations (Graan & Merwe, 2014). Additional studies have demonstrated consistent findings about PCOR values. When accounting for the theoretical thickness of femoral cartilage, the resulting value is 0.49 ± 0.04. This conclusion aligns with the outcomes of prior investigations carried out by Johal et al. (with a discrepancy of 0.03), Kim (0.04 ± 0.03), and Malviya et al. (0.05 ± 0.08), demonstrating a rise in PCOR following comparable surgical procedures. Hence, this modification might indicate structural alterations following the operation that were not accounted for in the first PCOR assessment [16-19].

CONCLUSION

This case highlights the consequences of delayed treatment for tibial plateau fractures, which in this patient led to malunion and the development of post-traumatic osteoarthritis (PTOA). The patient's initial decision to avoid medical evaluation and treatment resulted in progressive knee dysfunction, pain, and limited mobility. Clinical and radiological findings supported the diagnosis of a neglected intra-articular fracture with joint incongruity, disuse osteopenia, and signs of joint degeneration.

Total knee replacement (TKR) was successfully performed to restore joint alignment, congruency, and function. The surgical procedure followed standard principles, and post-operative rehabilitation enabled the patient to regain mobility within three months. Radiographic outcomes—including MDFA, MPTA, and PCOR—were within acceptable ranges, showing close alignment with previously published normative values. These findings support the effectiveness of TKR in managing late complications of untreated or mismanaged tibial plateau fractures. This case underscores the importance of early diagnosis and appropriate surgical intervention in intra-articular knee fractures to prevent long-term complications such as PTOA and functional impairment. It also emphasizes that even in neglected cases, favorable outcomes can be achieved through meticulous surgical planning, proper implant positioning, and comprehensive post-operative care.

Declaration by Authors
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