

Managing of Post-traumatic Knee Arthritis by Total Knee Arthroplasty: Case Report and Literature Review

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DOI: <https://doi.org/10.52403/ijrr.20241113>

ABSTRACT

Introduction: Post-traumatic knee osteoarthritis (PTOA) develops rapidly after injuries from sports, accidents, or falls. Unlike primary osteoarthritis, PTOA escalates quickly, causing severe joint damage and impairments. Early intervention is crucial to alleviate pain, restore function, and prevent further deterioration. Delayed treatment worsens symptoms and increases the need for invasive procedures like total knee arthroplasty (TKA).

Case Presentation: A 29-year-old patient with a year of left knee pain, swelling, and difficulty straightening had no history of rheumatic or autoimmune diseases. Examination showed osteophytes, indicating osteoarthritis. He underwent TKA with no complications, achieving a satisfactory outcome: good range of motion, improved quality of life, and an Oxford Knee Score of 42.

Discussion: PTOA typically follows trauma to the joint surface, with severity often correlating with the impact intensity. In this case, the patient's rapid development of osteoarthritis, despite his young age and lack of pre-existing conditions, may suggest a genetic predisposition. Knee arthroplasty was chosen to restore function, aligning with research showing comparable

outcomes for post-traumatic and primary osteoarthritis patients, though post-trauma cases can have higher complication rates due to comorbidities.

Conclusion: Effective management of PTOA is crucial due to its rapid progression and significant impact on joint function and quality of life. Early intervention is key to preventing severe damage and reducing the need for invasive treatments. While TKA can be effective, its success depends on the severity of the condition. Timely management and preventive strategies are vital to improving outcomes and maintaining joint health.

Keywords: *post traumatic osteoarthritis, total knee arthroplasty, quality of life, early intervention, case report*

INTRODUCTION

Knee osteoarthritis (OA) is a degenerative joint disorder characterized by progressive cartilage loss, subchondral bone changes, and joint inflammation, leading to pain, stiffness, and functional impairment. (Dieppe and Lohmander, 2005) While primary OA is primarily associated with aging and genetic factors, post-traumatic knee OA arises as a consequence of joint injury or trauma. Post-traumatic knee OA is a significant concern, as it

affects individuals across various age groups and significantly affecting their quality of life. (Felson and Lawrence, 2000) The development of post-traumatic knee OA (PTOA) is often preceded by a traumatic incident, such as sports-related injuries, motor vehicle accidents, or falls. The initial injury to the knee joint disrupts the normal biomechanics, leading to a cascade of pathological changes in the articular cartilage, synovium, and subchondral bone.(Brown *et al.*, 2006) These changes involve altered matrix synthesis and degradation, increased production of inflammatory mediators, and abnormal bone remodelling, ultimately resulting in cartilage breakdown and joint degeneration.(Lohmander *et al.*, 2007) Post-traumatic osteoarthritis (PTOA) represents a significant clinical challenge, primarily due to its complex etiology and the technical difficulties associated with its treatment. Unlike primary osteoarthritis (OA), which typically develops gradually due to age-related wear and tear, PTOA arises from previous trauma to the knee joint, such as fractures, ligament injuries, or meniscal damage.(Houdek *et al.*, 2016) These injuries initiate a degenerative process that includes cartilage breakdown, joint malalignment, and chronic inflammation, ultimately leading to the onset of osteoarthritis. Managing PTOA is particularly difficult because of pre-existing conditions such as soft tissue damage, scarring, bone deformities, and retained surgical hardware from previous interventions.(Anderson *et al.*, 2011) The clinical presentation of PTOA may vary depending on the severity of the initial injury, the anatomical structures involved, and individual patient factors. Common symptoms include knee pain, swelling, joint stiffness, decreased range of motion, and functional limitations.(Brown *et al.*, 2006) Physical examination often reveals joint tenderness, crepitus, and signs of joint effusion. Radiographic assessment, such as X-rays and magnetic resonance imaging (MRI), is crucial for confirming the

diagnosis, evaluating the extent of joint damage, and guiding treatment decisions.(Punzi *et al.*, 2016)

Management of PTOA is multifaceted, encompassing both conservative and surgical interventions. When conservative measures fail to alleviate symptoms, surgical options such as arthroscopy, osteotomy, or joint arthroplasty surgery may be considered.(Lotz and Kraus, 2010) Total knee arthroplasty (TKA) is considered the most effective treatment for end-stage PTOA, providing substantial relief from pain and restoring joint function. However, performing TKA in patients with PTOA requires careful preoperative planning and technical expertise. Soft tissue scarring and joint stiffness often necessitate extensive releases, while ligamentous instability may require the use of constrained or specialized prosthetic implants.(Lizaur-Utrilla *et al.*, 2015; Houdek *et al.*, 2016) Bone loss from prior trauma or surgeries can complicate implant fixation, leading to the need for bone grafts or the use of augments. These factors contribute to longer operative times, increased blood loss, and higher complication rates compared to TKA for primary OA.(Lunebourg *et al.*, 2015)

Multiple studies have demonstrated that patients undergoing TKA for PTOA face increased risks of complications such as infection, thromboembolism, prosthetic loosening, and revision surgery. (Lizaur-Utrilla *et al.*, 2015; Dexel *et al.*, 2016; Kester *et al.*, 2016)Despite these challenges, TKA remains the most viable option to restore function and relieve pain in patients with PTOA. Although short-term outcomes may be less favourable compared to primary OA, long-term results in terms of pain relief and function can still be achieved when appropriate surgical strategies are employed.(Kester *et al.*, 2016)

This case report aims to present a detailed clinical account of a patient with post-traumatic knee OA, highlighting the challenges in diagnosis, management, and the impact on the individual's daily life. By exploring the unique features of this case,

we aim to contribute to the growing body of knowledge regarding post-traumatic knee OA and provide insights into the complexities of its clinical course and treatment outcomes.

CASE PRESENTATION

A 29-year-old patient came to our orthopaedic clinic with a complaint of left knee pain since 1 year ago. The patient felt pain accompanied by swelling that got worse in the last 5 months ago. He also complains about being unable to straighten his leg and forces him to use walking aid to walk. The pain was felt continuously, gets worse during activities, and gets better during rest. He has a history of trauma caused by falling from motorcycle and his knee collided with the ground. He has no history rheumatic autoimmune, nor developmental disease. He has no remarkable family history of chronic diseases.

Upon physical examination, patient's right knee is normal, while his left knee appeared to swell around the knee joint with a deformity of flexion contracture and valgus deformity. When palpated tenderness was found over the knee. Neurovascular function of patient's limb was normal. Functionally, his knee range of motion is severely compromised of 35° for the knee, with an Oxford Knee Score of only 9 pre-operatively.

The patient's x-ray reveals osteophyte formation in the medial and lateral condyle of tibial and femoral bone, left tibial intercondylar, narrowing of medial femorotibial joint aspect, subchondral cyst and sclerosis of the medial and lateral condyle of left femur and tibia, which suggestive for an osteoarthritis of the knee joint. The patient's knee also shows malalignment of valgus deformity of 9.26° (Figure 1).



Figure 1 – Patient's pre operative x-ray; A) AP View, B) Lateral View of the left knee, and C) Bilateral skyline view.

He was then diagnosed with post traumatic osteoarthritis of the left knee, with Kellgren-Lawrence classification of grade 4 and was

planned for a total knee arthroplasty (TKA) to relieve pain and correct malalignment of the knee (Figure 2).

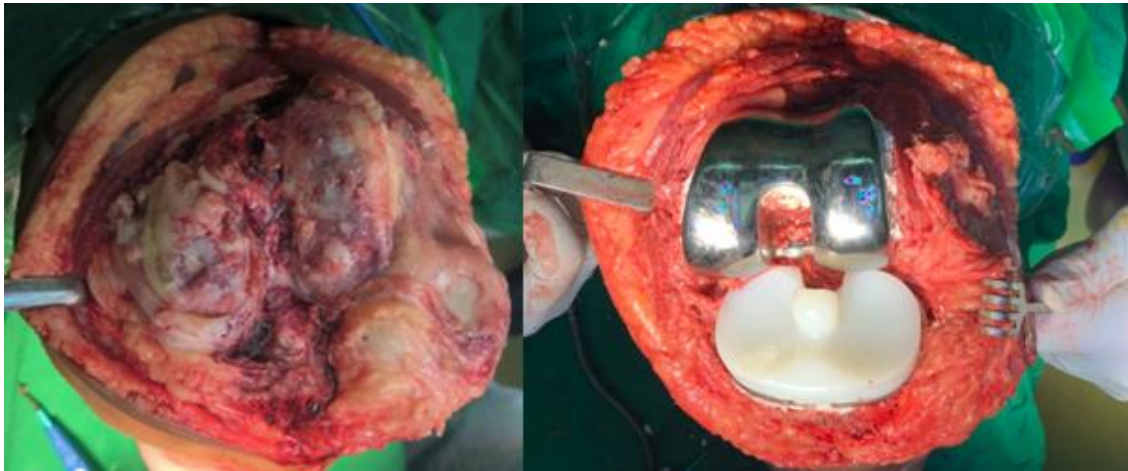


Figure 2 – Intra operative findings of joint destruction (left); Implant placement (right)

The surgery went well without any remarkable complication. Joint stability in varus, valgus, extension, and flexion was assessed intra-operatively and the result was satisfactory. Post-operatively, another x-ray was taken and patient's medial distal femoral angle is 84,35°, and medial

proximal tibial angle is 90,71° showing restored alignment of the knee. The patient then discharged after 3 days and monitored closely on outpatient follow-up. He was planned for a physical therapy to aid his recovery.

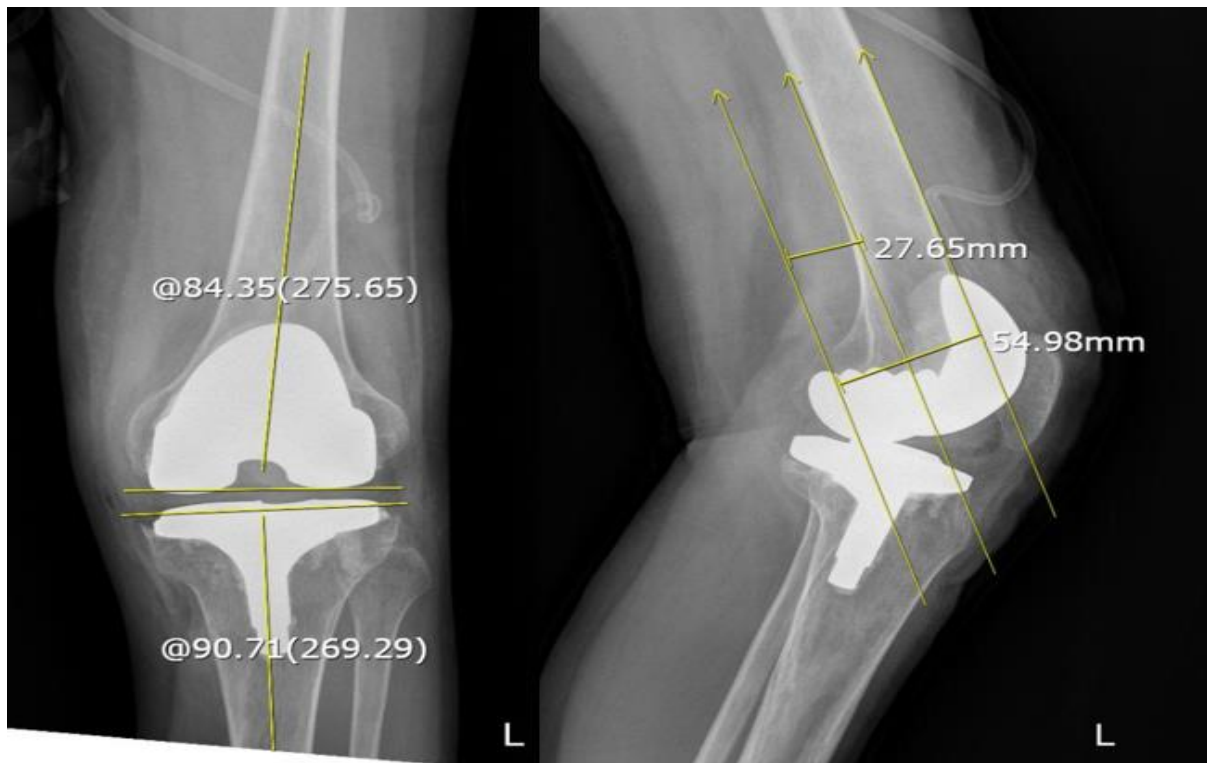


Figure 3 – Post-operative alignment showing medial distal femoral angle and medial proximal tibial angle.

Upon follow-up, there is no remarkable complication such as infection, loosening, nor periprosthetic fracture. His functional outcome is satisfactory with good range of motion, quality of life and Oxford Knee Score of 42.

DISCUSSION

It has been common knowledge for clinicians around the world, especially orthopaedic surgeon that trauma especially one causing disruption in articular surface will cause devastating complication of post traumatic arthritis. One proposed factor that contributes to the development of post-traumatic osteoarthritis (PTOA) in joint injuries is the sudden application of mechanical force, or impact, to the surface of the joint. The severity of the damage to any structure depends on the intensity of the impact. Studies conducted on removed joints have demonstrated that higher-energy impacts result in greater local tissue damage, as indicated by experimental measurements such as the release of reactive oxygen species by cells, death of chondrocytes (cartilage cells), and disruption of the matrix. Three different levels of impact energy lead to distinct types of injuries to the articular surface, each with varying repair responses and healing potential: (1) Injuries that damage cells

and/or the matrix without causing macroscopic structural disruption of cartilage or bone. (2) Injuries that damage cells and/or the matrix along with macroscopic structural disruption of the articular cartilage, without any bone fractures that are displaced. These injuries may involve microfractures in the calcified cartilage and, in some cases, the subchondral or trabecular bone. (3) Fractures of the articular surface that displace through both cartilage and bone. Low-energy injuries like joint contusions, dislocations, and ligamentous injuries commonly result in the first two types of articular surface damage, while higher energy injuries cause displaced fractures within the joint. (Punzi *et al.*, 2016)

As time goes, this arthritis may recur and develop a chronic arthritis either post traumatic osteoarthritis or post traumatic inflammatory arthritis, which both causing permanent destruction of the joint. Acute symptoms of post traumatic arthritis include swelling, synovial effusion, pain, or even hemarthrosis. It will resolve spontaneously and will recur in an unrecognized pattern. The timeline of development of post traumatic arthritis to its end stage osteoarthritis can be seen in fig. 4. (Punzi *et al.*, 2016).

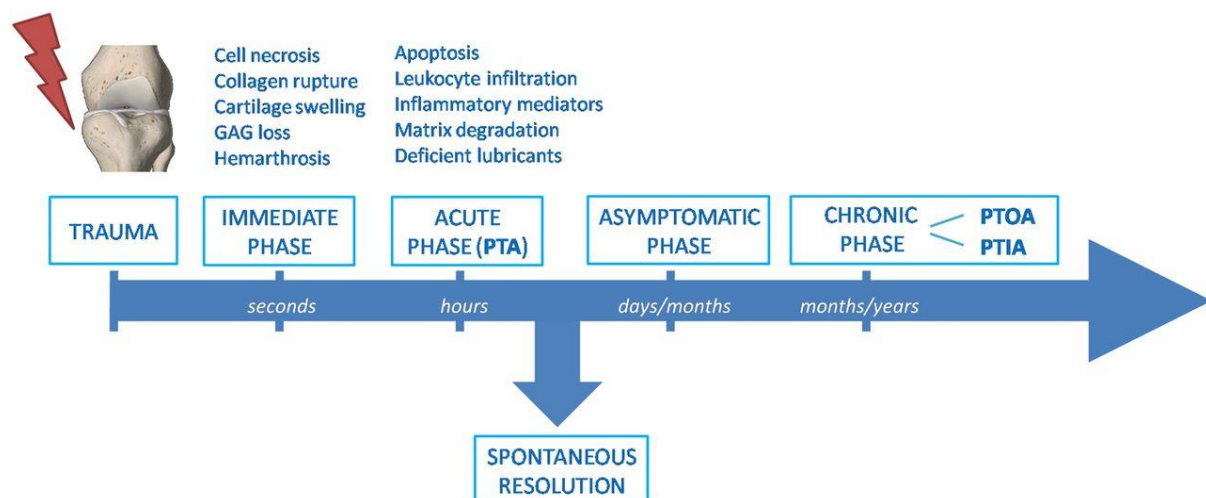


Figure 4. – Timeline of the development process from trauma to post traumatic osteoarthritis.

The exact pathogenesis of post traumatic osteoarthritis hasn't been known, however

there are several mechanisms proposed in the process such as, cell necrosis, collagen

rupture, cartilage swelling, glycosaminoglycan loss, heme deposition caused by bleeding, cell apoptosis, inflammatory cascade of leukocyte infiltration, inflammatory mediator release,

degradation of joint matrix, hence causing permanent destruction (fig 5). This process is a long term continuing and repetitive process before end-stage joint destruction occurs. (Punzi *et al.*, 2016)

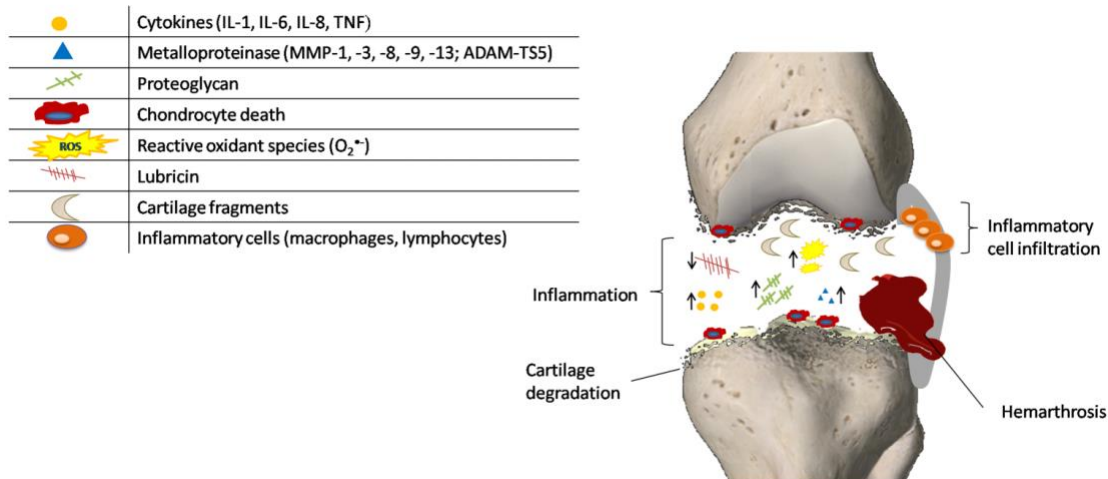


Figure 5. – Pathogenesis of post traumatic osteoarthritis

Our patient being only 29 years of age and 1 year history of trauma may felt to be too quick to develop an osteoarthritis, which make it an interesting case. A genomic study by Valdes et al. shows that the knee has higher risk of development of post-traumatic osteoarthritis compared to the hip. Due to lack of facility for checking the gene, the author may unable to confirm the presence of it. However, it can be suspected that our patient may have the gene contributing to the accelerated development of end-stage joint destruction. (Valdes *et al.*, 2013)

The decision to conduct an arthroplasty in outpatient is his young productive age that has been severely compromised due to his joint destruction. The author suggests that arthroplasty in a young age is a second chance for the patient to continue to be productive. Similar statement has been shown in research by Lutzner et al. which conducted a cohort on post traumatic osteoarthritis compared to primary osteoarthritis. The research suggest that even more challenge can be encountered during the surgery, but arthroplasty may give the similar excellent outcome in

alignment, patient reported outcome, functional score, and also patient's satisfaction report.(Lützner *et al.*, 2022) Over the contrary, a study by Hepp et al. shows that total knee arthroplasty in post-traumatic osteoarthritis resulting in worse functional and overall outcome for the patient, measured in higher revision rate. (Hepp *et al.*, 2013) Other study also found that post-trauma arthritis undergoing total knee arthroplasty shows higher complication rate, however in this research, patients with post trauma arthritis have higher prevalence of unhealthy lifestyle of drug and alcohol abuse, psychosis, or liver diseases, while primary osteoarthritis patient have higher prevalence of obesity, diabetes, and heart disease. So it hasn't been clear which comorbidity may contribute to the poor result of the surgery. (Brockman *et al.*, 2020)

CONCLUSION

In conclusion, even though there are mixed results regarding the outcome of joint arthroplasty in PTOA, there are no other option can be chosen for patients to restore their functional state. Perhaps the best

option for people around the world is to avoid the trauma by applying safe habits in driving, doing sports, and in occupational activities. This case adds to the body of evidence supporting its effectiveness when performed with careful planning and execution. Given the patient's young age, the decision to proceed with TKA offered him the opportunity to return to an active and productive life, aligning with other studies that highlight the potential benefits of early surgical intervention in select patients with post-traumatic arthritis. This case emphasizes the necessity for individualized treatment plans in managing PTOA and highlights the potential for successful outcomes with TKA, even in younger patients with severe joint degeneration.

Declaration by Authors

Acknowledgement: None

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

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How to cite this article: I Made Wira Kusuma, I Wayan Suryanto Dusak. Managing of post-traumatic knee arthritis by total knee arthroplasty: case report and literature review. *International Journal of Research and Review*. 2024; 11(11): 110-117. DOI: <https://doi.org/10.52403/ijrr.20241113>
