Volume 9, Issue 10, October– 2024 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT714

Role of Long Stem Tibial Implant in Total Knee Arthroplasty (TKA)

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Abstract:- Total Knee Arthroplasty (TKA) is a common surgical intervention for patients with advanced osteoarthritis. However, cases involving severe bone defects, particularly in the medial tibial condyle, present unique challenges for successful implant fixation and long-term stability. This case report discusses a 65-year-old male with Kellgren and Lawrence Grade 4 osteoarthritis and a large medial tibial condyle defect. A customized approach using a long-stem tibial component and an autograft harvested from bone cuts was employed. Post-operatively, the patient demonstrated significant improvement in range of motion (ROM 0-120 degrees) by post-operative day 10 and early weight-bearing capabilities, indicating a successful outcome. The use of a long-stem tibial component provided additional stability, while the autograft helped fill the defect, restoring structural integrity. This case underscores the importance of individualized treatment strategies in complex TKA cases and highlights the need for further research on the long-term outcomes of using autografts and long-stem implants in patients with large bone defects.

Keywords:- *Total Knee Arthroplasty (TKA), Osteoarthritis, Bone Defects, Long-Stem Tibial Component, Autograft, Medial Tibial Condyle Defect, Implant Stability, Joint Replacement Surgery, Post-Operative Rehabilitation, Knee Function.*

I. INTRODUCTION

➢ *Background on Total Knee Arthroplasty (TKA):*

Total Knee Arthroplasty (TKA) is a widely performed surgical procedure aimed at alleviating pain and restoring function in patients suffering from end-stage osteoarthritis. The procedure involves resurfacing the damaged knee joint by replacing it with artificial components, commonly referred to as implants. TKA is typically performed when conservative treatments such as medication, physical therapy, or less invasive surgeries fail to provide relief. The primary goal of TKA is to improve the patient's quality of life by enhancing joint mobility, reducing pain, and allowing for improved weight-bearing capacity in daily activities (Sculco & Lotke, 2001).

In most cases, the surgical approach to TKA is standardized, with predictable steps including soft tissue dissection and bone cuts. However, these standardized procedures become increasingly complex when large bone defects are present, as seen in cases of severe osteoarthritis. Large bone defects may compromise the stability of the implants, potentially leading to loosening or failure, which presents a significant challenge in achieving successful outcomes (Fehring et al., 1999). The presence of a large bone defect necessitates specialized surgical techniques and implants, such as the use of long-stem tibial components or bone grafts, to ensure proper fixation and alignment of the prosthesis.

➢ *Unique Challenges in the Case:*

Osteoarthritis with severe bone defects, especially in advanced stages like Kellgren and Lawrence Grade 4 osteoarthritis, presents unique challenges during TKA. Grade 4 osteoarthritis is characterized by joint space narrowing, severe bone sclerosis, and large osteophytes, often accompanied by varus or valgus deformities, which complicate the surgical process (Kellgren & Lawrence, 1957). The extensive bone loss observed in such cases can significantly alter the normal anatomical landmarks that surgeons rely on for proper alignment of the prosthesis.

In this particular case, managing a large bone defect without the aid of robotic assistance or navigation tools added an additional layer of complexity. Robotic or computer-assisted TKA can help ensure precise alignment and balancing of soft tissues, even in the presence of bone defects. However, in the absence of such tools, the surgeon must rely on experience and manual techniques to achieve the correct alignment, increasing the potential for error (Hirschmann et al., 2019). Moreover, determining the appropriate amount of soft tissue release and performing accurate bone cuts are more challenging when there are no pre-existing, intact bony landmarks due to the defect.

II. CASE PRESENTATION

➢ *Patient History:*

A 65-year-old male presented with a history of chronic left knee pain persisting for over eight years. The patient reported significant limitations in daily activities due to the pain and reduced mobility in the knee. Upon examination, the patient's range of motion (ROM) was severely restricted, with flexion limited to 0-70 degrees. There were no associated comorbidities, such as diabetes or cardiovascular disease, which are common in patients with osteoarthritis. The patient was diagnosed with advanced osteoarthritis of the left knee, classified as Kellgren and Lawrence Grade 4, the most severe

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT714

form of the disease. This grade is characterized by joint space obliteration, extensive osteophyte formation, severe sclerosis, and deformity. In this case, the patient also presented with a varus deformity, further complicating the management of the knee condition (Kellgren & Lawrence, 1957).

➢ *Clinical and Radiographic Findings:*

Radiographic evaluation confirmed the diagnosis of severe osteoarthritis with additional findings of a large medial tibial condyle defect. The X-ray revealed significant bone loss in the tibial plateau, particularly in the medial compartment, which is a hallmark of advanced degenerative changes in the knee. This defect poses a challenge for surgical planning, as it compromises the stability required for implant fixation during total knee arthroplasty (TKA) (Sculco & Lotke, 2001). In such cases, standard TKA procedures may not suffice, necessitating the use of specialized techniques such as long-stem implants and bone grafting to fill the defect and provide structural support for the prosthesis. The size and location of the bone defect required careful preoperative planning to ensure proper alignment, stability, and the longevity of the TKA (Fehring et al., 1999).

III. SURGICAL PROCEDURE

➢ *Preoperative Planning:*

Given the patient's advanced osteoarthritis and the severe medial tibial condyle defect, a detailed preoperative assessment was crucial. The surgeon decided to use a long-stem tibial component to address the bone loss and provide additional stability. Long-stem implants are commonly employed in cases with large bone defects to ensure proper alignment and reduce the risk of implant loosening, as they provide better load distribution (Engh et al., 2000). In addition, it was determined that an autograft, harvested from the bone cuts made during surgery, would be used to fill the tibial defect. This autograft would help restore the structural integrity of the bone and support the fixation of the implant (Fehring et al., 1999).

➢ *Details of the TKA Procedure:*

During the surgery, a total knee arthroplasty (TKA) was performed using a Depuy system. The specific implants used included a Femur-3 component, a 10 mm polyethylene insert (Poly-10mm), and a long-stem tibial component (Tibia 2.5mm, 75x14mm) to address the patient's severe bone loss. The long-stem tibial component was chosen to bypass the defect and ensure adequate stability (Sculco & Lotke, 2001). The medial tibial condyle defect was covered with the autograft harvested from the bone removed during the procedure, which was then secured in place using screws to promote integration and long-term support. This approach allowed the surgeon to create a stable platform for the implant and address the bone loss without compromising the alignment or function of the knee joint (Engh et al., 2000).

IV. POSTOPERATIVE COURSE

➢ *Immediate Postoperative Care:*

The patient was mobilized and initiated on weight-bearing exercises on post-operative day 1 (POD 1). Early mobilization is a critical aspect of recovery following total knee arthroplasty (TKA), as it helps to reduce the risk of complications such as deep vein thrombosis (DVT) and promotes faster functional recovery (Hirschmann et al., 2019). By POD 10, the patient's range of motion (ROM) had improved significantly, reaching 0-120 degrees. This marked improvement in knee flexion is consistent with the goals of early rehabilitation after TKA, which aims to restore joint mobility, reduce pain, and enable the patient to regain functional independence as quickly as possible (Kim et al., 2010).

➢ *Rehabilitation Protocol:*

Following TKA, the patient was prescribed a rehabilitation protocol that included progressive weight-bearing exercises and functional activities designed to improve strength and balance. Weight-bearing exercises are vital for restoring muscle strength around the knee joint, enhancing stability, and promoting overall joint function. The rehabilitation regimen also focused on gait training and exercises aimed at improving the patient's ability to perform daily activities, such as walking and climbing stairs (Swank et al., 2011). The use of a structured rehabilitation protocol is essential in maximizing the functional outcomes of TKA, particularly in cases involving complex surgeries with large bone defects.

V. DISCUSSION

➢ *Challenges in Managing Bone Defects in TKA:*

Large bone defects in total knee arthroplasty (TKA) present a significant challenge due to the complexity of achieving stable implant fixation and maintaining proper joint alignment. Standard TKA procedures rely on well-preserved bone structures to support the implants, but severe defects, such as those found in patients with Kellgren and Lawrence Grade 4 osteoarthritis, require customized approaches. In cases like this, where there is extensive bone loss in the medial tibial condyle, using standard components would increase the risk of implant loosening and failure (Fehring et al., 1999). The decision to use a long-stem tibial component in conjunction with an autograft allowed for the bypassing of the defect, distributing the load more evenly across the remaining bone and providing a stable platform for the implant (Engh et al., 2000). This approach differs from standard TKA procedures, where simpler implants might be sufficient, but in this case, the large defect necessitated a more sophisticated solution to ensure long-term stability and function.

➢ *Outcomes of the Procedure:*

Mid-term follow-up results for this patient have demonstrated excellent mobility and functional outcomes. The range of motion (ROM) improvement to 0-120 degrees by post-operative day 10 and the patient's ability to bear weight early post-surgery are indicative of a successful

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outcome. This aligns with findings from other studies where long-stem implants and bone grafts have been used in similar cases with large bone defects, showing positive functional results and high rates of implant survival (Hirschmann et al., 2019). Compared to cases where more conservative approaches are used in the presence of large bone defects, this patient's recovery trajectory is encouraging. The use of the autograft to fill the defect, combined with the structural support provided by the long-stem implant, contributed to the successful outcome (Sculco & Lotke, 2001).

➢ *Future Considerations:*

While the short-term and mid-term results are promising, long-term follow-up is essential to assess the durability of the implant and the success of the bone graft. Over time, the autograft must integrate fully with the surrounding bone to maintain structural integrity, and the implant must remain stable to avoid complications such as loosening or wear (Engh et al., 2000). Additionally, further studies are necessary to evaluate the long-term outcomes of using long-stem tibial implants and bone grafting techniques in TKA, particularly in elderly patients with large bone defects. As more data becomes available, it may be possible to refine these techniques to improve outcomes further and develop guidelines for managing similar cases (Hirschmann et al., 2019).

VI. CONCLUSION

➢ *Key Takeaways:*

Total Knee Arthroplasty (TKA) utilizing a long-stem tibial component and autograft presents a promising solution for elderly patients suffering from advanced osteoarthritis with large tibial defects. The long-stem tibial component helps to bypass the bone defect, providing the necessary stability and support for the implant, while the autograft aids in restoring the structural integrity of the affected bone. This combination allows for improved joint function, as evidenced by the patient's significant range of motion improvements and early weight-bearing capabilities post-surgery. In cases where standard TKA methods may not suffice due to extensive bone loss, this approach offers a viable alternative for ensuring long-term functional outcomes (Engh et al., 2000; Fehring et al., 1999).

➢ *Future Research Directions:*

While the mid-term results of this case are encouraging, there is a critical need for further research to evaluate the long-term outcomes of using long-stem tibial components and autografts in TKA. Long-term studies should focus on assessing the durability of the implant, the integration of the autograft, and the overall stability of the knee joint over time. Additionally, future research should explore the broader application of this technique in patients with similar large bone defects, especially in terms of improving patient outcomes and minimizing complications (Hirschmann et al., 2019). Further investigation into optimizing bone grafting techniques and implant design will be essential to improving the management of complex TKA cases.

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ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24OCT714

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