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Assessment of Patellofemoral Overstuffing on the Results of Total Knee Arthroplasty: An Observational Prospective Study

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Abstract

Background: For severe knee arthritis, total knee arthroplasty (TKA) is a successful surgical procedure. However, complications related to surgical technique, such as patellofemoral overstuffing, can impact postoperative outcomes.

Objective: This observational prospective study aimed to assess the influence of patellofemoral overstuffing on TKA outcomes, focusing on clinical parameters, functional scores, and patient satisfaction.

Methods: Patients undergoing primary TKA with patellar resurfacing and a patella thickness of 23 mm or less were included. Overstuffing was achieved by resecting less than 8 mm of the patella and placing an 8 mm thick patellar button. Patients were divided into two groups: Group A (with overstuffing) and Group B (without overstuffing). Clinical parameters, functional scores, and patient satisfaction were assessed preoperatively and at three and six months postoperatively.

Results: A total of 196 patients (266 knees) were included in the study. Group A comprised 185 patients with overstuffing, while Group B consisted of 81 patients without overstuffing. The differences in mean flexion, Knee Severity Score (KSS) (p-value = 0.4), and Oxford Knee Score (OKS) (p-value = 0.2) between the two groups at three and six months postoperatively were not significant. Furthermore, there were no reports of iatrogenic patellar fractures.

Conclusion: Patellofemoral overstuffing, within the parameters studied, did not adversely affect post-TKA outcomes. Further research is warranted to optimize surgical techniques and minimize complications associated with patellar management in TKA.

Key words: Total knee arthroplasty, patellofemoral overstuffing, knee function, clinical outcomes, surgical technique.

Introduction

Total knee arthroplasty (TKA) is a widely performed and highly effective surgical procedure for alleviating pain and restoring function in patients with severe knee arthritis.[1] Despite its success, complications and suboptimal outcomes can occur, often related to the technical aspects of the surgery. One such concern is patellofemoral overstuffing, a condition where excessive tissue or prosthetic material is introduced into the patellofemoral joint during TKA, potentially leading to anterior knee pain, altered knee kinematics, and impaired postoperative functions.[2]

The patellofemoral joint is vital to knee mechanics and must remain intact for the best possible knee function.[3] Overstuffing can disrupt the delicate balance within this joint, leading to increased patellofemoral pressures and subsequent complications.[4] This observational prospective study aims to assess the influence of patellofemoral overstuffing on the outcomes of TKA, focusing on clinical outcomes, functional scores, and patient satisfaction.

Previous research indicates that patellofemoral issues significantly contribute to postoperative pain and the need for revision surgery following TKA.[5] Additionally, the relationship between patellofemoral joint mechanics and overall knee function highlights the importance of addressing this issue during the surgical planning and execution phases of TKA.[4]

Understanding the impact of patellofemoral overstuffing is vital for improving surgical techniques and enhancing patient outcomes. This study aims to provide insights into the prevalence of overstuffing and its correlation with postoperative complications and overall knee function by prospectively evaluating patients undergoing TKA.

Aim

To determine the influence of patellofemoral overstuffing on the outcomes of TKA.

Hypothesis

Overstuffing the patellofemoral joint by 2 mm, achieved by resecting less than 8 mm of the patella, may not adversely affect clinical outcomes and could potentially reduce the incidence of patellar complications and fractures, especially in cases involving a thin patella.

Objectives

1. To correlate the presence of patellofemoral overstuffing with the functional outcomes of the knee using internationally approved knee scoring systems
2. To examine the relationship between patellofemoral overstuffing and the loss of knee flexion, and to assess its clinical relevance
3. To reduce the incidence of complications, such as patellar fractures, in patients with a thin patella

Material and Methods

This prospective observational study was conducted in the Department of Joint Replacement at Max Hospital, Delhi, over a period of six months from January 2023 to June 2023. The study population comprised patients who underwent total knee replacement (TKR) and received an Opulent Gold knee implant during this period.

Inclusion criteria- Patients with a patella thickness of 23 mm or less and primary TKR with patellar resurfacing met the inclusion criteria.

Exclusion criteria- Patients undergoing revision TKR, those with post-traumatic osteoarthritis, distorted patellar anatomy, infected knee replacements, previous patellar fractures, and patients lost to follow-up.

Upon admission, parameters measured included knee range of motion (ROM) using a goniometer, knee severity score, and Oxford severity score. All surgeries were performed by a senior surgeon, using the posterior-stabilized Meril Opulent Bionic Gold knee implant. Native patella thickness was measured using a calliper, with measurements confirmed by both the surgeon and an assistant. Post-resurfacing thickness was also measured and recorded.

Patients were divided into two groups: Group A consisted of patients with patella overstuffing of 1 mm or 2 mm, and Group B consisted of patients with no overstuffing (native patella thickness restored). Staple removal was performed after three weeks, and knee ROM, Knee Severity Score (KSS), and Oxford Knee Score (OKS) were rechecked at three and six months postoperatively.

The data was compiled in Excel, and observations and results were subsequently analysed and interpreted.

Observation and Results

A total of 214 patients, accounting for 290 knees, underwent TKR with patellar resurfacing. Eighteen patients were lost to follow-up, leaving 196 patients and 266 knees included in the current study. Among these 196 patients, 126 underwent unilateral TKR (65%) and 70 underwent bilateral TKR (35%) (Figure 1). The study cohort comprised of 64 males and 132 females, with a mean age of 62.3 years, ranging from 40 to 78 years (Figure 2).

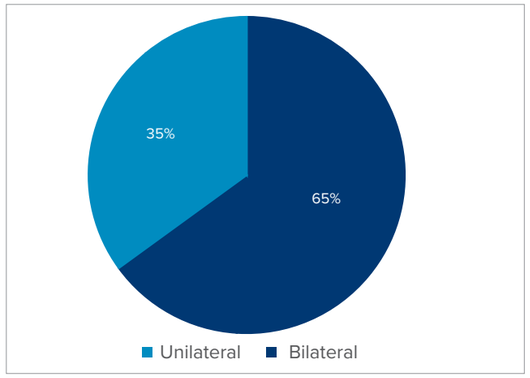


Figure 1: Showing the unilateral 126 (65%) and bilateral TKR 70 (35%) division within the study group of 196 patients.

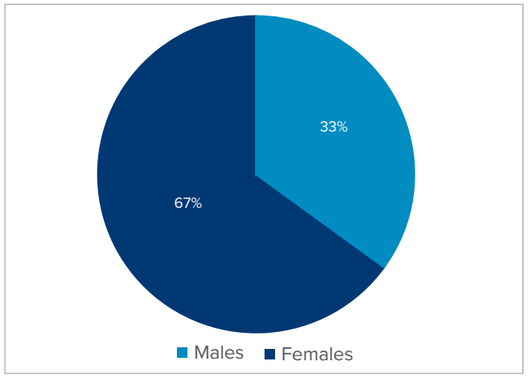


Figure 2: Showing the female preponderance in the study, with 132 out of 196 patients being female (67%) and 64 being male (33%).

According to our data, 70% of patients had a patella size of 23 mm or less. Resecting these patellae to restore their native thickness would reduce the patellar thickness to 15 mm or less after resurfacing, which could potentially lead to patellar fractures (Figure 3). To address this issue, we overstuffed these patellae by resecting less than 8 mm and then placing an 8 mm thick patellar button.

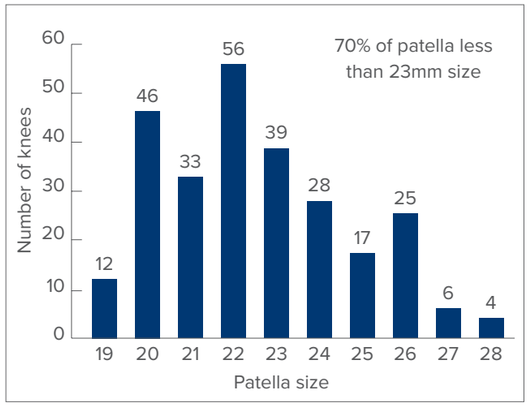


Figure 3: Showing the number of knees with average patella size

In Group A, overstuffing was observed in 185 patients, while Group B consisted of 81 patients in whom overstuffing was not performed.

Group A knees (Overstuffing present)	Group B knees (Overstuffing absent)
185	81

Regarding the ROM, the preoperative mean flexion was 83.3 degrees in both, Group A and Group B. Three months post-procedure, the mean flexion increased to 100.5 degrees in Group A and 102.3 degrees in Group B, yielding a clinically insignificant p-value of 0.16. Six months post-procedure, the mean flexion in Group A was 103.5 degrees and in Group B was 104.8 degrees, resulting in a p-value of 0.5, also considered clinically insignificant (Figure 4).

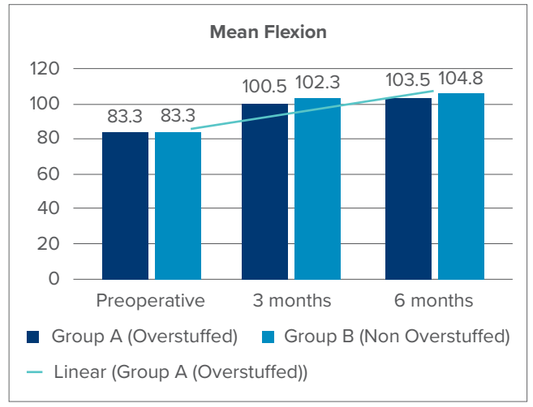


Figure 4: Showing the mean flexion in both the groups preoperatively, 3 months after the procedure and 6 months after the procedure.

The KSS showed a preoperative mean of 43.4 in both groups. Three months post-procedure, it increased to 68.1 and 70.1 in Groups A and B respectively, with a non-significant clinical difference indicated by a p-value of 0.3. Similarly, at six months post-procedure, the scores were 72.3 and 73.1 in Groups A and B respectively, with a non-significant clinical difference reflected by a p-value of 0.4 (Figure 5).

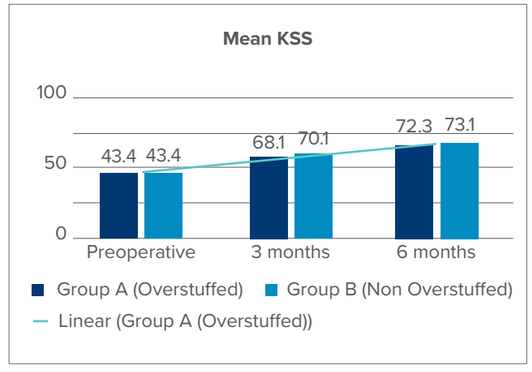
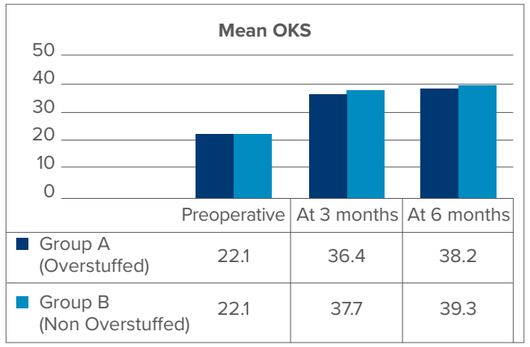


Figure 5: Showing the mean KSS in both the groups preoperatively, 3 and 6 months after the procedure.

The mean OKS demonstrated a preoperative mean of 22.1 in both groups. At three months post-procedure, it measured 36.4 and 37.7 in Groups A and B respectively, with clinical insignificant p-value of 0.1. Similarly, at six months post-procedure, the scores were 38.2 and 39.3 in Groups A and B respectively, with clinical insignificant p-value of 0.2 (Figure 6).



	Preoperative	At 3 months	At 6 months
Group A (Overstuffed)	22.1	36.4	38.2
Group B (Non Overstuffed)	22.1	37.7	39.3

Figure 6: Showing the mean OKS in both the groups preoperatively, 3 and 6 months after the procedure showing no clinical significance in both the groups.

No patients in the study incurred an iatrogenic patella fracture during the patella cut procedure. Statistical analysis comparing variables between Group A and Group B using paired t-tests revealed insignificant differences.

Discussion

For patients with severe knee arthritis, TKA continues to be a remarkably successful surgical intervention that significantly reduces pain and improves function.

However, despite its favorable outcomes, surgical complications and suboptimal results can occur, often due to various technical factors associated with the procedure.[6]

The patellofemoral joint's intricate mechanics are crucial for optimal knee function, and any disruption, such as overstuffing, can significantly impact joint dynamics and patient outcomes.[7] Understanding the implications of patellofemoral overstuffing is thus imperative for refining surgical techniques and enhancing patient satisfaction.

This observational prospective study aimed to evaluate the influence of patellofemoral overstuffing on TKA outcomes, focusing on clinical parameters, functional scores, and patient satisfaction. These findings revealed no significant differences in mean flexion, KSS, or OKS between groups with and without overstuffing. These results suggest that patellofemoral overstuffing, within the parameters studied, did not adversely affect postoperative outcomes. This aligns with the findings of Quoc et al., who reported that mild increase in patellar thickness did not significantly alter knee kinematics or patient-reported outcomes post-TKA.[8] In contrast, previous research has highlighted that excessive overstuffing can lead to increased patellofemoral pressure, anterior knee pain, and reduced ROM.[9] Our study mitigated this risk by limiting the degree of overstuffing to a 2 mm increase, a threshold supported as clinically tolerable by a study conducted by Merican et al. in 2014.[10]

In a study of 262 patients, Beldman et al. found no relationship between patient-reported outcome measures and radiological anteroposterior overstuffing.[11] According to Ghosh et al., soft tissue tension may allow for a 2 mm overstuffing of the patellofemoral compartment. The medial patellofemoral ligament was only extended by about 1 mm, according to their study, and the iliotibial band-patellar band was not greatly strained.[12]

Kemp et al. studied a total of 107 patients who underwent TKA and concluded that there was no relationship between the Western Ontario and McMaster Universities Arthritis Index (WOMAC) ratings and patellofemoral overstuffing values. Nevertheless, they found a statistically significant correlation between lower knee pain and function scores and a higher anterior trochlear offset.[13] According to Koh et al., patients receiving TKR did not experience worse clinical outcomes or a greater rate of complications if their residual patellar thickness was less than 12 mm.[14]

Pierson et al. argued against the notion that patellofemoral joint overstuffing leads to adverse outcomes after TKR. They proposed that the need for lateral release is multifactorial, involving a complex combination of factors. Thus, they do not recommend revision surgery solely for treating pain from an overstuffed knee joint unless other discernible causes of failure are present.[15]

Previous research has highlighted the significance of patellofemoral complications in post-TKA dissatisfaction and the need for revision surgery.[16-20] Furthermore, the association between patellofemoral mechanics and overall knee function underscores the importance of addressing patellofemoral issues during surgical planning and execution.[21]

The current study's objectives included correlating the presence of patellofemoral overstuffing with functional outcomes, examining its impact on knee flexion, and reducing complications, particularly patellar fractures in patients involving thin patellae. While the study did not find a significant correlation between overstuffing and functional outcomes, it may provide insights into other potential complications and guide future research in optimizing patellar management during TKA.

Patient satisfaction is a crucial outcome in TKA, encompassing pain relief, functional improvement, and overall quality of life. Our study reported no significant differences in patient satisfaction between the overstuffed and non-overstuffed groups. This is consistent with the results of Ali et al., who found that patient satisfaction is more closely related to overall knee function and pain relief rather than specific technical aspects such as patellar thickness.[22]

Furthermore, we observed no incidences of iatrogenic patellar fractures, suggesting that careful surgical technique can prevent this complication even when mild overstuffing is performed. This is particularly important given that patellar fractures are a known risk associated with TKA, especially when dealing with thin patellae.[23]

The absence of iatrogenic patellar fractures in this study is noteworthy and suggests that the surgical technique used—overstuffing thin patellae by resecting less than 8 mm and using an 8 mm thick patellar button—was effective in preventing this complication. However, further investigation into the long-term implications of this technique and its impact on other clinical parameters is warranted.

Limitations and Future Research

Although our study offers insightful information, there are certain drawbacks. The six-month follow-up period might not have captured the long-term effects and problems related to patellofemoral overstuffing. Future studies should aim for longer follow-up durations to assess the sustainability of the observed outcomes.

Additionally, our study focused on a specific patient population undergoing primary TKA with patellar resurfacing. The results may not be generalizable to all TKA patients, particularly those undergoing revision surgeries or with different prosthetic designs. Future research should explore the impact of patellofemoral overstuffing across diverse patient cohorts and prosthetic types.

Furthermore, although our study did not identify significant differences in functional scores or patient satisfaction, subtle biomechanical changes may have occurred due to overstuffing that were not detected by the measures employed. Advanced imaging and biomechanical analysis could provide more detailed insights into the impact of patellofemoral overstuffing on knee joint mechanics.

Conclusion

Patellofemoral overstuffing, as studied within the parameters of this observational prospective study, did not demonstrate significant adverse effects on postoperative outcomes following TKA. The absence of significant differences in mean flexion, KSS, and OKS between patients with and without overstuffing at three and six months postoperatively suggests that this surgical approach is clinically acceptable.

However, further research is warranted to optimize surgical techniques and minimize complications associated with patellar management in TKA. Long-term follow-up studies are needed to assess the durability of results and the impact of overstuffing on implant survivability. Additionally, prospective randomized controlled trials comparing different surgical techniques for patellofemoral treatment are essential for improving patient outcomes in TKA.

Despite the lack of a significant correlation between patellofemoral overstuffing and TKA outcomes, the study's findings highlight the need for more research to improve surgical methods to reduce problems and improve patient satisfaction after TKA.

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Periodontitis (Gum Disease) & its Risk Association in Diabetes, Pregnancy & Cardiovascular Disease

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The Global Burden of Disease (GBD) study [1990-2010] states that oral diseases have high prevalence rate affecting almost 3.9 billion people worldwide. Severe periodontitis and tooth loss being the 6th and 36th most prevalent conditions respectively.[1] "Their impact on individuals and communities is considerable in terms of pain and suffering, impairment of function and reduced quality of life and cost of treatment (FDI, World Dental Parliament, 2012)." World Health Organization (WHO)[1] has identified periodontal disease, including gingivitis and destructive periodontitis, as one of the three important dental diseases and one of the major causes of adult tooth loss.[2] Periodontitis is a chronic multifactorial infectious and inflammatory disease characterized by progressive destruction of the tooth supporting tissues which leads to tooth loss.[3]

The focal-infection theory, based on the principles of infectious disease established by Koch and Pasteur, put forth the notion that the invasion of the bloodstream by bacteria from a localised infection (such as periodontal diseases) could spread to distant organs and tissues to cause disease. The criteria for establishing a causal association between the two diseases have been further defined and is principally based on the Bradford Hill criteria which include biological plausibility, epidemiological association, and the impact of intervention on one disease affecting the second.[4] In recent years there has been keen interest in potential associations between periodontal disease and various chronic systemic diseases and conditions e.g. cardiovascular disease (CVD) , diabetes , adverse pregnancy outcomes (APO), respiratory disease, chronic kidney disease etc. Predominantly CVD, diabetes and APO (preterm low birth weight, preeclampsia) have been frequently documented in scientific literature. Three possible mechanisms have been postulated to play a role in the distant non-oral manifestations of oral diseases: dissemination of bacterial toxins, metastatic infections, and immunological injury. The word "metastasis is not limited only to cancer cells but infections and inflammation also have the potential to metastasize.[5] Periodontitis produces inflammatory responses beyond the periodontium. This oral inflammation triggered by the periodontal infection releases inflammatory mediators and increases the systemic inflammation.

Mechanism of association between periodontitis and cardiovascular disease

Atherosclerosis is an inflammatory condition.[6] Association between periodontitis and CVD is based on the inflammatory mechanisms triggered by periodontal microbes, locally or systemically, which then influence the initiation and propagation of the atherosclerotic lesions. Inflammatory stimuli as triggered by the inflammatory cytokines and chemotactic agents lead to changes in the endothelium. Lipid streaks, comprised of modified low-density lipoproteins (LDL) within macrophages and dendritic cells (DCs) in the intimal layer, can initiate and propagate this inflammatory response. These changes initiate interactions with monocytes that promote leucocyte migration into the intimal layer of the artery and release of chemotactic cytokines such as monocyte chemotactic protein-1 (MCP-1). MCP-1 attract additional monocytes or other cells that can transport bacteria into the lesion. The dendritic cells transform into foam cells, which release inflammatory cytokines and matrix metalloproteinase (MMPs), further amplifying the inflammatory response within the lesion. This further elevates the levels of the inflammatory mediators contributing to systemic inflammation. (Figure 1)[7]