

Original research article

## Evaluation of Soft Tissue Balancing at Midflexion in Total Knee Arthroplasty

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### Abstract

**Background:** Total knee arthroplasty (TKA) is one of the most common surgical procedures in orthopaedics. The aim of TKA is to achieve long-term implant survival and successful functional outcome with minimal complications and cost effectiveness. The aim of the study is to evaluate soft tissue balance at midflexion in addition to routine balancing of knee at extension and 90° flexion before and after placing final prosthetic components in total knee arthroplasty and to assess and look for reasons of variability of soft tissue balance at midflexion compared to balancing at full extension and 90° flexion.

**Methods:** A prospective study of maximum of 20 patients coming to the department of orthopaedics in teaching hospitals attached to AIIMS Patna, was done. Patients who are undergoing primary total knee arthroplasty for osteoarthritis knee and rheumatoid arthritis of knee were included. Patients with traumatic arthritis of knee, extensor mechanism dysfunction, vascular disease of lower limbs, recurvatum deformity of knee, remote source of infection were excluded. Posterior Stabilized Total Knee Replacement (Zimmer Knee) Prosthesis is used in all cases. The anterior fibers of MCL and ITB were preserved in all cases.

**Conclusion:** Significant improvement in knee function can be achieved with total knee replacement in a well balanced knee. Lateral laxity is commonly observed than medial laxity in midflexion, more common in early range of flexion (between extension and midflexion). Midflexion stability is not influenced by component sizes. Post operative function of weight transfer and climbing up and down the stairs is better with knees balanced in midflexion. Preserving anterior fibers of MCL and ITB is essential technique for obtaining midflexion stability.

**Keywords:** Posterior Stabilised knee, midflexion laxity, anterior tibial translation, HSS score, rheumatoid arthritis.

### Introduction

Total knee arthroplasty (TKA) is one of the most common surgical procedures in orthopaedics. It is the treatment of choice for advanced arthritis of the knee. The aim of TKA is to achieve long-term implant survival and successful functional outcome with minimal complications and cost effectiveness.<sup>[1]</sup> Total knee replacement is performed by anteromedial approach more commonly.<sup>[2]</sup> Symmetric ligament balance is considered a prerequisite for good function and endurance in total knee arthroplasty. This is achieved via the removal of any osteophytes that may hinder articulation, as well as the lengthening and dissecting of tight ligamenture.<sup>[2]</sup> In the current surgical practice, the soft tissue balancing is done in full extension and 90° flexion and after bone preparation is completed, the flexion and extension gaps should be evaluated for symmetry for equal height in flexion and extension.<sup>[1]</sup> Mid-flexion instability is an issue that has only recently gained the attention of knee arthroplasty surgeons.<sup>[3]</sup> Most of everyday

activities like sitting on a chair, getting up from sitting, climbing up and down the stairs, etc requires midflexion stability of knees. The goal of our study is to evaluate soft tissue balancing at Midflexion and assess variability compared to balancing at 90° flexion and extension.

### **Objectives**

To evaluate soft tissue balance at Midflexion in addition to routine balancing of knee at extension and 90° flexion before and after placing final prosthetic components in total knee arthroplasty.

To assess and look for reasons of variability of soft tissue balance at midflexion compared to balancing at full extension and 90° flexion.

### **Material and Methods**

This is a prospective study of maximum of 20 patients coming to the department of orthopaedics in teaching hospitals attached to All India Institute of Medical Sciences, Patna, Bihar. Study duration of Two Years. The study is begun after obtaining clearance and approval from the institutional ethical committee. Informed written consent is taken from all patients before including them in the study.

#### **Data collection**

Detailed history, clinical and radiological evaluation is recorded in study proforma. Assessment of alignment of the limb and coronal laxities were documented. The etiology of arthritis is ruled in with specific investigations.

#### **Inclusion criteria**

\*Patients who are undergoing Primary Total Knee Arthroplasty for Osteoarthritis Knee and Rheumatoid Arthritis of Knee.

\*Patients who have given Informed Written Consent for the proposed procedure.

#### **Exclusion criteria:**

\*Patients not willing to be part of the study.

\*Patients with traumatic arthritis of knee.

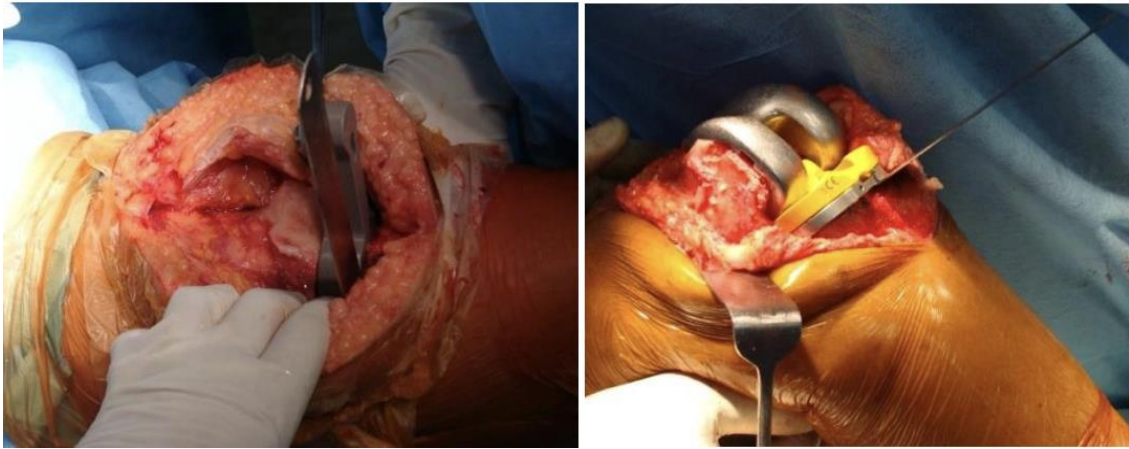
\*Patients with extensor mechanism dysfunction.

\*Patients with vascular disease of lower limbs.

\*Patients with recurvatum deformity of knee.

All patients were operated with a pneumatic tourniquet. After thorough painting and draping of the limb in sterile condition, limb exsanguinated with sterile esmarks bandage and tourniquet inflated. Anterior midline incision with parapatellar subvastus approach used to expose the knee. Anteromedial capsule and deep medial collateral ligament was subperiosteally elevated off the tibia till the posteromedial corner. Knee was extended and lateral patellofemoral ligament released to evert the patella. Patella was retracted laterally. Knee was flexed and anterior cruciate ligament, posterior cruciate ligaments, anterior horns of medial and lateral menisci were excised. Medial and anterior osteophytes were excised. Knee was externally rotated and lateral tibial plateau was exposed. Posterior Stabilised Total Knee Replacement with Zimmer Knee Prosthesis used in all cases. Distal femoral cut was made perpendicular to mechanical axis using an intramedullary cutting guide. Proximal tibial cut was made using an extramedullary guide. Limb alignment assessed. Soft tissue balancing assessed with laminar spreaders and spacer blocks and gap measured with a vernier calliper and balanced in extension. Posterior referencing of the distal femur was done and component size measured. Anterior, posterior and chamfer cuts were made with 3° external rotation with cutting guide. Knee was balanced in extension and 90° flexion with appropriate medial and lateral soft tissue releases if required. The anterior fibres of MCL and ITB are preserved to obtain stability in midflexion. The medial and lateral gaps were measured with spacer blocks in flexion and extension and balanced. Box cut was made in distal femur. Trial components were placed and

pre ordered varying thickness plates from 1 to 6 mm were tried to negotiate below tibial base plate and documented in extension, 90° flexion, and 45° flexion. Anterior translation of tibia with respect to base plate was assessed in 90° flexion and mid flexion. The anterior translation assessment was done manually by a single surgeon in all cases.



#### Measurement of joint opening by plates

Routine analgesics in the form of epidural top ups, paracetamol infusions and tramadol injections were given in all cases. Post Operative Thromboprophylaxis was started after 24hrs of surgery and given for 7 to 10 days to all patients. Quadriceps exercises were started on post op day1 and protected weight bearing ambulation was started from post op day 2. Postoperatively check x ray AP and Lateral view of knee taken on day 1. The drain was removed on day 2. Suture removal was done between 10 to 12days. Scannogram of both lower limbs was obtained before patient was discharged.

#### Results

Twenty patients were prospectively evaluated in present study for a period of 2 years. Seventeen female (85%) and 3 male patients (15%) were involved in present study.

**Table 1: Sex Distribution**

Sex	Number	Percentage
Male	3	15%
Female	17	85%

Equal number of either side was involved.

**Table 2: Side Distribution**

Side	Number	Percentage
Right	10	50%
Left	10	50%

Mean age of the patients was 57.8 years (Range 42 to 74 years). Most of study cases; 16 of 20 cases were diagnosed to have osteoarthritis (80%) and 4 cases were diagnosed of rheumatoid arthritis (20%).

**Table 3: Diagnosis**

Diagnosis	Number	Percentage
Osteoarthritis	16	80%
Rheumatoid arthritis	4	20%

Kellgren Lawrence radiological grading was used for assessment of osteoarthritic knees and 11 cases were noted to have grade 4 arthritis (68.75%) and 5 cases were diagnosed to have grade 3 arthritis (31.25%). Both valgus and varus deformities were noted in present study. Varus deformity was seen in 18 patients. Eight patients had 5° of varus (40%), 6 patients had 10° varus (30%), 15° varus in 2 cases (10%) and 20° varus in 2 cases (10%). Valgus deformity was seen in 2 cases, one each with 5° (5%) and 10° valgus (5%). In present study, medial opening was measured in three positions with trial in situ. In extension; 19 cases had no opening (95%) and one patient had 1mm opening (5%). In 90° flexion; there was no opening in 16 patients (80%), 1mm opening was noted in 3 patients (15%) and 2mm opening seen in 1 patient (5%). And at 45° flexion; 16 patients had no opening (80%), 2 patients had 1mm opening (10%) and 2 patients had 2mm opening (10%). There was no significant correlation of medial opening with varying angles of flexion ( $p=0.074$ ). Lateral opening at varying position of knee flexion was similarly assessed. In extension; no opening was seen in 18 patients (90%) and 1mm opening was seen in 2 patients (10%). At 90° of flexion; 15 cases had no opening (75%), 4 patients had 1mm opening (20%) and 1 patient had 2mm opening (5%). And at 45° flexion; 16 patients had no opening (80%), 1 patient had 1mm opening and 3 cases had 2mm opening (15%). There is a significant difference of opening laterally between different angles of flexion ( $p=0.042$ ). There is a significant difference of opening between extension and 45° flexion ( $p=0.034$ ). But, there is no significant difference of opening between extension and 90° flexion ( $p=0.102$ ) and between 90° flexion and 45° flexion ( $p=0.317$ ). The final follow up HSS score was recorded and was compared to pre operative HSS score. Sixteen patients had excellent function (80%), 2 cases had good function (10%) and 2 patients had fair outcome (10%). The mean post operative HSS score is 87.1. There was no statistically significant correlation of post operative HSS score with midflexion medial opening ( $p=0.117$ ), midflexion lateral opening ( $p=0.110$ ) and midflexion anterior tibial translation ( $p=0.201$ ). In present study, no soft tissue release was done in 15 of study cases (75%). Knee could be balanced after bony resection and excision of osteophytes. However, medial collateral ligament was released subperiosteally in 2 varus knees. Posterolateral capsule alone was pie crusted in two cases. Posterolateral capsule and iliotibial band was pie crusted in one case. The anterior fibres of MCL and ITB are preserved in all cases.

## Discussion

In present study, we have assessed the mediolateral stability and anteroposterior stability in different degrees of flexion of knee. We have operated all patients with same prosthesis (Zimmer) of knee. The median medial opening at 0°, 45° and 90° are 0mm (0 to 0), 0mm (0 to 0.5) and 0mm (0 to 0.5) respectively. And there is no statistically significant difference in opening in midflexion in a balanced knee in extension and 90° flexion. The median lateral opening at 0°, 45° and 90° are 0(0 to 0), 0(0 to 0.75) and 0(0 to 0.75) respectively. There was no statistically significant difference in opening in extension and 90° flexion, confirming knee to be balanced. We found a statistically significant difference in opening between extension and 45° flexion. There was 2mm lateral opening in 3 cases and 1mm difference from medial opening in 2 cases accounting for lateral instability in midflexion. The anterior translation assessment was done manually by a single surgeon in all cases. Assessment was done after achieving soft tissue balance in extension and 90° flexion. The median anterior translation at 45° and 90° were 4(3 to 4) and 3(2 to 4) respectively. And there was a statistically significant difference in translation between 45° and 90° flexion. They concluded that the joint gap after implantation was small in extension and deep flexion, and became the largest in mid-flexion. They noted that mid-flexion instability was shown during the position in which post and cam did not engage. They recommended use of another articulating surface design or post-cam

mechanism to deal with mid-flexion instability after TKA<sup>[4]</sup>. Hino et al assessed the midflexion varus – valgus laxity in 34 total knee replacements performed alternatively with cruciate retaining and posterior stabilised knees. The surgery was performed under computer navigation. Maximum manual varus-valgus stress to the knee was applied by investigator while steadily moving the leg from full extension to flexion. Postoperative measurements in their groups showed that varus-valgus laxity angles increased sharply for the flexion range of 0° to 20°, and changed gradually thereafter. They reported that knees treated with PS-TKR showed a tendency to increase in joint laxity after surgery in the range of flexion between 10° and 90° but differences between the pre-operative and post-operative values were only statistically significant for flexion angles of 10° and 20°.<sup>[5]</sup> Johnson et al studied the soft tissue balancing in total knee replacement and followed 193 patients operated for total knee replacement. Both varus valgus stability and anteroposterior stability was assessed in 4 groups with rheumatoid arthritis, osteoarthritis with or without ligament releases. They divided anteroposterior laxity as negligible if less than 5mm, slight if 5 to 10 mm and gross if more than 10mm. They reported no statistically significant differences in anteroposterior and varus-valgus laxity among groups.<sup>[6]</sup> And in the present study, there was a difference in mediolateral opening in midflexion in one patient with soft tissue release and one patient without soft tissue release. Out of the two cases, one patient had osteoarthritis and other had rheumatoid arthritis. Griffin et al studied accuracy of soft tissue balancing in 104 knees. In their study, after the cuts were made, lamina spreaders were placed medially and laterally and tensioned equally under maximal manual tension by the same surgeon in all cases. The height of the flexion and extension gaps was measured directly with a 10-cm ruler. In the 52 knees with extension gaps that were not perfectly rectangular, 63% (33 of 52 knees) had lateral gaps that were greater than medial gaps. When there were slight differences, the lateral gap tended to be slightly larger than the medial gap<sup>[7]</sup>. Yoshinori Ishii et al did a study on coronal laxity in extension in vivo after total knee arthroplasty. Stress arthrometric studies were performed on 77 knees (71 patients) with total knee arthroplasty to determine the presence and magnitude of femoral abduction and adduction in knee extension. They found no significant correlation between mediolateral laxity and postoperative ROM. However, a significant correlation was found between postoperative ROM and anteroposterior laxity.<sup>[8]</sup> The immediate postoperative mean coronal laxity was 2.9°, indicating that the lateral laxity was greater than medial laxity. The postoperative coronal laxity was positively corrected to the intra-operative coronal laxity at 0°, but not to the intra-operative coronal laxity at 90°.<sup>[9]</sup> The absolute tension value at 0° extension did not affect the postoperative extension angle. Likewise, the difference of tension between flexion and extension did not affect the postoperative flexion angle.<sup>[10]</sup> There is a significant lateral laxity in present study as comparable to above studies.<sup>[5, 7]</sup> The present study has more number of female patients and patients with grade 4 osteoarthritic changes in radiographs. The studies show no significant effect of laxity on functional scores and post operative range of motion.<sup>[10,8]</sup> There are few studies showing the presence of significant midflexion instability and further studies are needed for confirmation.<sup>[5,4,11]</sup>

## Conclusion

- \*Osteoarthritis is the most common diagnosis in patients operated for knee replacement.
- \*Female patients are commonly operated compared to male counterpart. \*Both right and left side can be equally involved in arthritic changes.
- \*Significant improvement in knee function can be achieved with total knee replacement in a well balanced knee.
- \*Lateral laxity is commonly observed than medial laxity in midflexion, more common in early range of flexion (between extension and midflexion).
- \*Preservation of anterior fibers of MCL and ITB is essential for midflexion stability.

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