

# Approach to Total Knee Replacement: A Randomized Double Blind Study between Medial Parapatellar and Midvastus Approach in the Early Postoperative Period in Asian Population

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## Abstract

The purpose of this randomized study was to compare clinical and surgical outcomes of total knee replacements (TKRs) in the early postoperative period using midvastus approach versus medial parapatellar approach in Asian population in a double blind manner. Forty-two knees each were operated using midvastus approach and the medial parapatellar approach. Clinical parameters that were evaluated included Knee Society score (KSS); knee pain using visual analogue scale (VAS) on day 1, 1 week, and 1 month; time required to straight leg raise (SLR); patellar tracking; mean extensor lag at 1 week and 1 month; and time of discharge from the hospital. Surgical parameters that were evaluated included tourniquet time, incidence of lateral retinacular release, estimated blood loss, and any complications during the surgery. KSS at 1 week and 1 month postoperatively were significantly higher in the midvastus group as compared with medial parapatellar group; though similar at 3 months, 6 months, and 1 year. The patients in midvastus group required fewer number of lateral retinacular releases; achieved SLR earlier; had less mean extensor lag at 1 week; had less mean VAS score at day 1, 1 week, and 1 month; and had shorter hospital stay. There was no significant difference in the mean tourniquet time and estimated blood loss. One patient had patellar maltracking in the medial parapatellar group as compared with none in midvastus group. Midvastus approach to TKR results in quicker functional recovery with early discharge and rehabilitation in the Asian population as compared with medial parapatellar approach.

## Keywords

- ▶ midvastus
- ▶ medial parapatellar
- ▶ total knee replacement
- ▶ approach
- ▶ Knee Society score

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Total knee replacements (TKRs) have become one of the most commonly performed and most successful surgeries to relieve knee pain in osteoarthritic knees.<sup>1</sup> Various modifications are being sought to further improve the results and the long-term outcomes of the procedure and decrease the hospital stay and bed occupancy by such patients. Some of the areas where improvements are being contemplated include implant design,<sup>2</sup> patient selection, and the surgical approach used for arthrotomy. Among all these factors, the surgical approach can be easily modified by the surgeon.

The classic medial parapatellar approach has been postulated as the time-tested, safe, reproducible, and most commonly used approach for TKR.<sup>3</sup> This involves an intra-tendinous sagittal incision in the quadriceps tendon proximal to its insertion into the patella in its medial third.<sup>3</sup> The disruption of the quadriceps tendon has been said to affect the extensor function adversely, resulting in inferior functional outcomes and delayed recovery.<sup>4,5</sup> Therefore, other alternative approaches were searched, which avoided damage to the extensor mechanism of the knee. In the early 1990s, midvastus approach became popular as the quadriceps sparing approach, which avoided disruption of the extensor mechanism. It involves detaching the vastus medialis fibers that attach distal to the patella from the patella, then splitting the muscle in its full thickness, parallel with these fibers, from the superior pole of the patella down to their origin on the femur by blunt dissection.<sup>6</sup> The reported benefits of this approach included shorter hospital stay, decreased blood loss, quick functional recovery, reduced postoperative pain, and decreased patellar complications.<sup>6</sup>

Various studies have compared the functional and clinical outcomes of the medial parapatellar and the midvastus approach with TKR; however, there is no definite conclusion as yet regarding the superiority of one approach to the other.<sup>7-9</sup> Moreover, only few of them were prospective randomized double blinded studies, and still less were related to Asian population. The aim of the present randomized study was to evaluate the clinical outcomes of TKR performed by the midvastus approach and compare results with those performed by the medial parapatellar approach in Asian population in a double blind manner.

## Materials and Methods

Between April 2010 and April 2012, patients presenting to our outpatient department with severe knee osteoarthritis (Kellgren-Lawrence grades 3 and 4) and willing for TKR were included in the study. The exclusion criteria included body mass index (BMI) > 40, fixed varus deformity > 30 degrees, fixed valgus deformity > 30 degrees, fixed flexion deformity > 30 degrees, severe visual impairment, inflammatory arthritis, active infection, comorbid conditions such as psychiatric illness, neuromuscular disorders, patients not motivated for physiotherapy, or not ready to undergo lifestyle modifications required after arthroplasty. The study was approved by the Institutional Ethics Committee. Written informed consent was obtained from all the patients before recruitment into the study.

A total 60 patients (84 knees) were enrolled in our prospective randomized study. Forty-two knees were randomly assigned to group I (medial parapatellar approach) and 42 knees were assigned to group II (midvastus approach) using computer-generated random numbers. Demographic data were collected preoperatively from all the patients and recorded on a prefixed proforma. Assessment of the clinical outcome was done for all knees preoperatively, at 1 week, 1 month, 3 months, 6 months, and 1 year. Each knee was evaluated using Knee Society scoring (KSS) system.<sup>10</sup> Evaluation of knee pain was done on day 1, 1 week, and 1 month by a 10-point visual analogue scale (VAS), with 10 points indicating worst pain and 0 point indicating no pain. All the knees were operated by the same surgeon. The implant used in each case was a posterior stabilized, fixed bearing, cemented design (Scorpio NRG, Stryker Co., Kalamazoo, MI). Patella resurfacing was not done in any patient. Surgical parameters that were evaluated included tourniquet time, incidence of lateral retinacular release, estimated blood loss, and any complications during the surgery.

## Surgical Technique

All TKR were performed using the medial parapatellar approach in group I and midvastus approach in group II. All the surgeries were done under combined spinal epidural anesthesia. After painting and draping the knee, surgical approach was decided using random numbers. The length of the skin incision was constant, 15 cm in all the cases so that patients as well as the assessor were blind as to the approach used. A longitudinal midline skin incision was used in each case. In group I, sagittal incision was given in the quadriceps tendon at the junction of the medial third and lateral two-thirds; proximal to its insertion into the patella. In group II, the fibers of the vastus medialis were split to the full thickness of the muscle by blunt dissection, without disruption of the quadriceps tendon. The tibial surface was prepared first followed by femoral surface with the help of an extramedullary jig for tibia and an intramedullary jig for the femur. The patellar osteophytes were removed and the articular surface of the patella was smoothed with a rasp to make it congruent with the groove over the femoral component; patellar resurfacing was not done. After a thorough joint lavage with saline, the closure was done over a suction drain.

Patient-controlled analgesia was used during the first postoperative day in both the groups. The postoperative physiotherapy regimen was similar in the two groups, involving incremental increases in the degree of flexion in the postoperative period. Patients were discharged once they achieved stair climbing and 90 degrees of flexion. Assessments were done regarding time required to straight leg raise (SLR), patellar tracking, incidence of infection, mean extensor lag at 1 week and 1 month, and time of discharge from the hospital.

Statistical analysis was done using SPSS 10.0 (SPSS Inc., Chicago, IL). The analysis for continuous variables was done using the student's *t*-test. Chi-square test was used for the analysis of dichotomous variables. Statistical significance was said to be obtained when *p* value was < 0.05.

**Table 1** Preoperative demographic characteristics

Groups	Group I	Group II
No. of cases	42 (30 patients)	42 (30 patients)
Male:Female	6:24	14:6
Mean age (y)	68.6	68.8
Mean weight (kg)	74.1	74.3
Mean height (cm)	157.2	156.4
Mean BMI (kg/m <sup>2</sup> )	30.1	30.6

Abbreviation: BMI, body mass index.

## Results

The patient's preoperative demographic characteristics (age, weight, height, BMI) were similar in the two groups (► **Table 1**). In the surgical parameters, lateral retinacular releases were required in five patients in group I as compared with none in group II. The difference in the number of patients requiring lateral retinacular releases was found to be statistically significant on applying Fisher's exact test ( $p < 0.05$ ). Although the mean drain output in group I (166 mL) was more than that in group II (157 mL), the difference was not statistically significant ( $p > 0.05$ ). There was no significant difference among the other surgical parameters. The mean tourniquet time was 86 minutes in group I as compared with 80 minutes in group II ( $p > 0.05$ ). There was no intraoperative complication seen in any of the patients in either group (► **Table 2**).

The mean preoperative KSS (knee and function) were similar in the two groups: 31.53 and 3.66 in group I and 31.04 and 3.4 in group II, respectively ( $p = 0.79$ ). KSS was evaluated at 1 week, 1 month, 3 months, 6 months, and 1 year. The minimum follow-up was 1 year in both the groups (mean: 18 months, range: 12–24 months). There was no loss to follow-up. KSS at 1 week and 1 month postoperatively were significantly higher in group II as compared with group I ( $p < 0.001$ ). However, the difference in the scores gradually became insignificant at 3 months follow-up ( $p = 0.71$ ), which remained so at 6 months and 1 year (► **Tables 3, 4**). The mean VAS score at day 1 was significantly less in group II (4.5) as compared with group I (6.1) ( $p < 0.05$ ), and the difference was significant ( $p < 0.05$ ) even at 1 week and 1 month (2.2, 3.8, and 1.5, 2.9; respectively). The mean amount of narcotic medication utilization on day 1 was also significantly less in group II as compared with group I ( $p < 0.05$ ).

**Table 2** Comparison of surgical parameters between the two groups

Groups	Group I	Group II
Tourniquet time (min)	86	80
Blood loss (drain output) (mL)	166	157
No. of lateral releases	5	0
Complications	Nil	Nil

**Table 3** Knee Society score (knee scores)

Groups	Group I	Group II
Preoperative score	31.53	31.04
1 wk	61.13	68.72
1 mo	82.4	87.28
3 mo	96.46	96.72
6 mo	97.33	97.35
1 y	98.37	98.19

**Table 4** Knee Society score (function scores)

Groups	Group I	Group II
Preoperative score	3.66	3.4
1 wk	12	18.8
1 mo	61	66
3 mo	88	89
6 mo	96.65	97.2
1 y	98.4	98.6

The patients achieved SLR earlier in the midvastus group as compared with those of medial parapatellar group. The mean time to achieve SLR was 2.02 days in group II as compared with 3.42 days in group I, which was statistically significant ( $p < 0.001$ ). Mean extension lag at 1 week was significantly less in the midvastus group (5.22 degrees) as compared with the medial parapatellar group (10.02 degrees) ( $p < 0.01$ ). On the other hand, although the mean extensor lag at 1 month was less in the midvastus group, the difference was not found to be statistically significant ( $p > 0.05$ ). There was significant difference in the average time of discharge from the hospital between the two groups; it was 8 days after surgery in group I as compared with 6 days in group II ( $p < 0.05$ ) (► **Table 5**). One patient of the medial parapatellar group developed patellar-maltracking postoperatively as compared with none in the other group. Three patients each of midvastus and medial parapatellar group developed pain over the proximal thigh postoperatively attributed to tourniquet application. Three patients of midvastus group and one patient of medial parapatellar group developed superficial skin necrosis and infection, which healed subsequently by daily cleaning and dressing. None developed deep infection.

**Table 5** Functional comparison between the two groups

Groups	Group I	Group II
Median day to straight leg raise (SLR)	3.42	2.02
Mean extensor lag at 1 wk (degrees)	10.02	5.22
Mean extensor lag at 1 mo (degrees)	4.1	3.31
Days before discharge	8	6

## Discussion

TKR aims to achieve a painless, stable, and functional joint, and the results are closely dependent on the surgical technique used. During the last few decades, the surgery has become highly successful, reproducible, and durable. With the advancement of the surgical techniques and implant designs, the approach for the surgery is also evolving. It requires complete exposure of the knee joint and the articulating surfaces of the femur, tibia, and patella, for precise instrumentation.

Medial parapatellar arthrotomy is generally considered the standard surgical approach in TKR; however, concerns were raised regarding the disruption of extensor function due to its intratendinous incision and the incidences of abnormal patellar tracking with the approach, which in turn can cause severe complications including patellar dislocation or subluxation, fracture of patella, osteonecrosis, and component erosion.<sup>11</sup> To deal with the above concerns, subvastus approach was proposed, which resulted in better patellar tracking and preservation of the quadriceps mechanism.<sup>12</sup> However, it had its own share of problems, including difficult exposure, increased chances of postoperative hematoma, muscle ischemia, and apprehension with detachment of patellar tendon from its insertion.<sup>13</sup>

The midvastus or vastus-splitting approach was then introduced as a compromise between the earlier two approaches, representing an effort to maintain the benefits of the medial parapatellar as well as the subvastus approach and preserving the integrity of the extensor mechanism and patellar blood supply without compromising exposure.<sup>6</sup> Since then, there have been many studies comparing the different approaches for TKR; however, there is paucity of literature comparing the functional and clinical outcomes of medial parapatellar and midvastus approach in Asian population. Therefore, the aim of our prospective randomized study was to detect differences in functional, clinical, and surgical parameters in Asian patients undergoing TKR with medial parapatellar and midvastus approach, in a double blind manner.

In this study, preoperative KSS (knee and function) were recorded and analyzed; the mean preoperative KSS were similar in midvastus and medial parapatellar groups. The postoperative KSS at 1 week and 1 month were significantly higher in the midvastus group as compared with the medial parapatellar group. However, the difference in KSS gradually became insignificant at 3-month follow-up. With these findings, we infer that the midvastus arthrotomy provided definite functional advantage in the early postoperative period; however, the long-term outcomes were similar to that of medial parapatellar group. Some of the previous studies also concluded that midvastus approach resulted in better short-term functional outcome.<sup>8,14-16</sup> On the other hand, other studies did not find any difference in the early functional scores between the two groups,<sup>17-20</sup> though only few of them were double blind randomized trials.

On comparing the midvastus and the medial parapatellar groups, we found that the patients achieved SLR significantly earlier in the midvastus group as compared with those of medial parapatellar group. This finding was in accordance with

similar previous studies.<sup>15-18,20,21</sup> Keating et al, however, did not find earlier SLR with the midvastus approach.<sup>19</sup> Mean extensor lag at 1 week was also found to be significantly less with midvastus approach in comparison with the parapatellar approach in our study, although no significant difference was found at 1 month.

In our study, there was no requirement of lateral retinacular release in the midvastus approach group as compared with five times in the medial parapatellar group demonstrating significantly increased risk of patellar maltracking in the latter. Although Keating et al did not find any difference in the incidence of lateral release with the midvastus approach,<sup>19</sup> most of the recent studies demonstrated significantly less amount of lateral releases with this approach.<sup>5,8,16,17,21,22</sup> Moreover, Ozkoc et al concluded that midvastus approach is better than medial parapatellar approach about late patellar tracking.<sup>11</sup>

In our study, we found significantly less postoperative pain in the midvastus group (as measured by the VAS score) on day 1, and this difference was maintained even at 1 week and 1 month. Most of the studies found that midvastus approach is associated with significantly less postoperative pain in the immediate postoperative period,<sup>8,14,16,21,23,24</sup> whereas few studies did not find any significant difference between the two groups with this aspect.<sup>17,20</sup> Most of the aforementioned studies evaluated postoperative pain within first week, however, and very few checked it at 1 month duration.

We found that the patients of the midvastus group were discharged from the hospital significantly earlier than those in the medial parapatellar group. This aspect has been very rarely compared between the two groups and never in Asian population. Mukherjee et al concluded that although the midvastus approach resulted in earlier SLR, it did not result in a shorter hospital stay in the British population.<sup>15</sup> Contrary to the aforementioned finding, Maru et al concluded that midvastus approach resulted in a significantly shorter hospital stay than the medial parapatellar approach in the British population.<sup>20</sup>

In our study, there was no statistically significant difference between the two groups regarding surgical time (equivalent to tourniquet time) and amount of blood loss, although midvastus approach resulted in less blood loss and reduced tourniquet time. Because these two factors have been described as indirect markers of exposure difficulty,<sup>16</sup> we conclude that, in contrast to the popular belief, midvastus approach does not pose significant difficulty in exposure for primary TKR. Song et al and White et al also had similar findings regarding the above parameters.<sup>17,21</sup> Kelly et al and Fu et al found significantly less blood loss with the midvastus approach as compared with the medial parapatellar approach, although tourniquet and surgical times were found to be similar, respectively.<sup>5,16</sup> In a meta-analysis, Liu et al found that midvastus approach was associated with longer operative time in comparison with the medial parapatellar approach.<sup>14</sup>

The main drawback to our study was a small sample size and a relatively shorter follow-up. Moreover, we did not look for kinematics of the knee in the two groups. Also, the study did not focus on the success of appropriate component placement using the two approaches, although there is a

concern that approaches that decrease the visibility of the joint during TKR may be associated with a higher rate of component malalignment—particularly tibial malrotation. In the future, a comprehensive prospective study with longer follow-up would be necessary.

## Conclusion

The study showed that TKR performed with midvastus approach in the Asian population resulted in better functional outcome in the immediate postoperative period with decreased pain, thereby reducing the hospital stay. It also required significantly less lateral retinacular release without causing difficulty in exposure. The time required to achieve SLR was also significantly less with reduced early mean extension lag resulting in rapid rehabilitation. There was no significant difference in the surgery time and amount of blood loss. We conclude from our study that midvastus approach is a compatible, patient-, and surgeon-friendly approach for modern-era primary TKR.

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