ORIGINAL ARTICLE

# Less invasive versus standard total knee replacement: Comparison of early outcome

Obaid-ur-Rahman, Muhammad Suhail Amin

## Abstract

**Objectives** To compare less invasive quads conserving (limited parapatellar) approach with standard medial parapatellar approach with respect to early functional outcome in cases of total knee arthroplasty.

**Methods:** The retrospective case-control cohort study comprised cases operated upon between June 2009 and March 2012 in Combined Military Hospitals in Pakistan by a single surgeon. Data related to osteoarthritis patients who underwent unilateral primary total knee replacement were included. They were divided into two equal groups of control who had standard total knee arthroplasty, and the test group where less invasive surgery method was employed. Patients were followed up for 3 months postoperatively. The outcomes recorded included mean hospital stay, time to assisted ambulation, time to independent ambulation, mean range of motion and Knee Society Scores [KSS] 1 and 3 months postoperatively.

**Results:** There were 120 subjects with 60(50%) in each of the two groups. Mean hospital stay was 3.2±0.6 days for the test group compared to 5.8±1.6 days for the control group. Most test group patients were walking with assistance on 2nd postoperative day (mean: 1.7±0.6 days), whereas control group on the 4th day (mean: 4.1±1.1 days). Independent ambulation was seen at 2.1±0.3 weeks and 4.0±0.7weeks respectively in the two groups. Postoperative range of motion at 1 month was 118±13 for patients in the test group, and 99±13 for control group, with Knee Society Scores of 87±6 and 72±9 respectively. The difference in all results was statistically significant ($p<0.05$).

**Conclusion:** Less invasive surgery for total knee arthroplasty was associated with faster recovery, earlier assisted and independent ambulation, shorter lengths of hospitalisation and better Knee Society Scores at 1and 3months postoperatively.

**Keywords:** Minimally invasive surgery (MIS), Less invasive surgery (LIS), Total knee arthroscopy, Surgical outcome. (JPMA 65: S-82 (Suppl. 3); 2015)

## Introduction

It is well established that total knee arthroplasty (TKA) alleviates pain, restores joint function, and allows patients with severe arthritis to return to varied activities of daily living.[1,2] However, prolonged postoperative pain and delayed return of function may contribute to patient dissatisfaction with the standard surgical approaches.[3] Minimally Invasive Surgery (MIS) technique of TKA, introduced more than a decade ago, is aimed at decreasing pain and helping in earlier return of function in the postoperative period.

There generally is no single definition of an MIS approach in TKA. Defining MIS based on only the incision size is inappropriate; the aim of minimally invasive arthroplasty is to minimise damage to soft tissues and consequently to quadriceps' function and knee stability. One study defined MIS TKA as an approach that was less damaging to the extensor mechanism and avoided eversion of the patella.[3]

Department of Orthopedics, CMH Rawalpindi, Pakistan.

**Correspondence:** Obaid-ur-Rahman. Email: drobaid@hotmail.com

Several MIS TKA techniques have been described: traditional mini (mini-medial parapatellar,[4] mini-midvastus,[3] mini-subvastus)[5] and fully innovative techniques (quad-sparing).[6] We have used the mini/limited medial parapatellar approach, referred hereto as Less Invasive surgery (LIS), to achieve the similar gainsas of quad-sparing MIS TKA. For quad-sparing TKA, special mini jigs are required. Because of non-availability of MIS instrumentation in Pakistan, we have used the standard jigs through limited medial parapatellar approach.

Advocates of MIS TKA commonly suggest that it allows patients' faster recovery time,[4,7] less blood loss,[3] decreased soft tissue trauma,[8,9] more pain relief, better cosmetic appearance,[4] and measurable improvement of function.[4,7] Critics of MIS TKA emphasise the length of the learning curve[10,11] and possible complications associated with long-term outcomes (e.g. lower survival rates).

It therefore is important to clarify the role and benefits of MIS TKA for surgeons who want to offer this option to patients.

The current study was planned to compare the "quads

conserving" less invasive approach with the conventional medial parapatellar (MPP) approach in terms of knee function up to three months after the surgery.

## Materials and Methods

The retrospective case-control cohort study of cases comprised cases of osteoarthritis who underwent primary total knee replacement (TKR) between June 2009 and March 2012 in Combined Military Hospitals by a single surgeon.

Sample size was calculated assuming type I error of 0.050 and Type II error rate of 0.200 with proportion of subjects in each group of 0.5.

The patients were divided into two equal groups; the control group comprised those undergoing standard TKA, while the test group underwent LIS TKA.

In order to avoid potential sources of bias, the study was designed to actively exclude or restrict confounding factors. Thus patients with a body mass index (BMI) over 35kg/m2, severe osteoporosis, valgus/varus deformation more than 10°, flexion contracture more than 5°, active flexion less than 70° or previous history of major knee surgery were excluded. Similar cemented implants were used in both groups (DePuy PFC Sigma PS/CR, DePuy RPF or ZimmerNex Gen LPS Flex with patellar component). A single experienced orthopaedic surgeon under spinal/epidural anaesthesia performed all the TKAs. All patients were followed up for 3 months post-operatively. No patient was lost to follow-up.

Our modifications for LIS approach included Skin incision up to 12cms; quad tendon cut up to 2.5cms; subluxation instead of eversion of patella; and tibiofemoral dislocation was avoided or minimised.

A tourniquet was inflated to 100mmHg above systolic blood pressure (SBP) and was deflated after the components had been implanted with cement. Midline incision was given in 90o flexion, from three fingers above patella till tibial tuberosity (10-12cm long). Arthrotomy was done using limited/mini (MPP) approach cutting up to 2.5cm of quadriceps tendon in midline. Patella was subluxed laterally and not everted. From proximal tibia, medial capsular release was carried till mid coronal plane. First distal femoral then proximal tibial cuts were taken, followed by resection of patella-creating space for the rest of resection. Further femoral cuts, posterior release and tibial prep were carried through mobile window technique in which the use of appropriate retraction drives the surgical window as and where desired.

At the end of the operation, all knees had a range of movement from full extension until the calf met the posterior thigh. A 14Fr drain was placed in the lateral gutter. The capsule was closed with interrupted sutures proximal to patella in extension and the rest in 90o flexion. The drains were kept for a period of 24 hours after TKA. The length of incision and operating time were recorded.

In the immediate postoperative period patient was advised passive followed by active ankle pumps soon after he/she regained motor functions in lower limbs. The patient was made to sit up with legs hanging down the bedside next morning and was encouraged to stand up in the afternoon of first-op day. On the second post-operative day the patient was allowed walking with support. As soon as the patient was able to walk upto the washroom with support, the urinary catheter was removed and the patient was ready for discharge. We did not give any chemical prophylaxis for deep vein thrombosis (DVT). All patients were followed up to three months postoperatively.

Knee Society Scores (KSS) were recorded at 1 and 3 months after surgery. Range of motion (ROM) measurement was made using a goniometer.

Student t-test was used to calculate the differences between the numerical variables in the groups. Microsoft Excel 2010 software was used for calculation and $p < 0.05$ was considered statistically significant.

## Results

There were 120 patients with 60(50%) in each of the two groups. The control group had 46(77%) females and


**Figure-1:** Single patient, two techniques showing scars of Standard total knee arthroplasty (TKA) on the right knee and less-investigative surgery (LIS) TKA on the left knee.

**Table:** Comparison of Standard and Less Invasive Surgery (LIS) total knee arthroplasty (TKA) results.

| | Standard TKA (n=60) | LISTKA (n=60) | Significance T-test p-values |
|---|---|---|---|
| Mean Hospital stay ± S.D. (days) | 5.8 ± 1.6 | 3.2 ± 0.6 | <0.0001 |
| Range | (5-12) | (3-6) | |
| Time to assisted walk ± S.D (days) | 4.1 ± 1.1 | 1.7 ± 0.6 | <0.0001 |
| Range (days) | (3-7) | (1-3) | |
| Time to independent walk ± S.D. (weeks) | 4.0 ± 0.7 | 2.1± 0.3 | <0.0001 |
| Range (weeks) | (2.5-5) | (1.5-3) | |
| Range of motion | 99 ± 13 | 118 ± 13 | <0.0001 |
| 1 month | (70-130) | (90-140) | |
| Range of motion | 109 ± 13 | 125 ± 11 | <0.0001 |
| 3 months | (75-140) | (90-140) | |
| KSS* | 72 ± 9 | 87 ± 6 | <0.0001 |
| 1 month | (58-87) | (68-93) | |
| KSS | 86 ± 8 | 92± 4 | <0.0001 |
| 3 months | (69-97) | (82-97) | |

*KSS: Knee Society Score
SD: Standard deviation

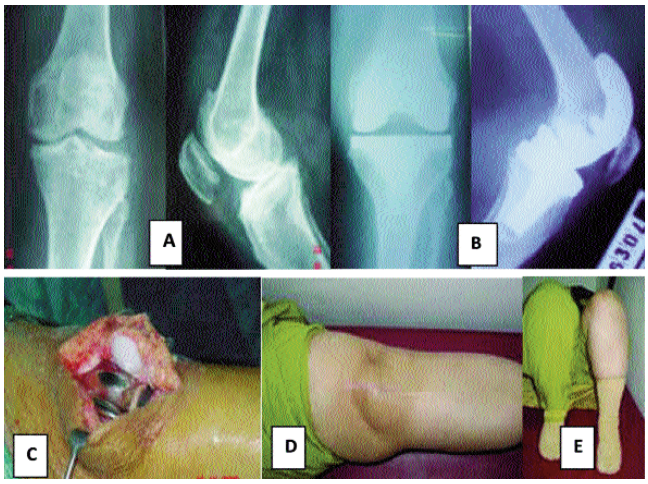


**Figure-2:** A) Preop X-rays of55-year-old female with osteoarthritis ofleft knee. B) Postop X-rays after total knee arthroplasty (TKA) with less investigative surgery (LIS) technique. C) Peroperative pictures just before closure of incision. D) Three months postop pictures showing healed scar. E) Complete flexion of operated knee at 3 months.

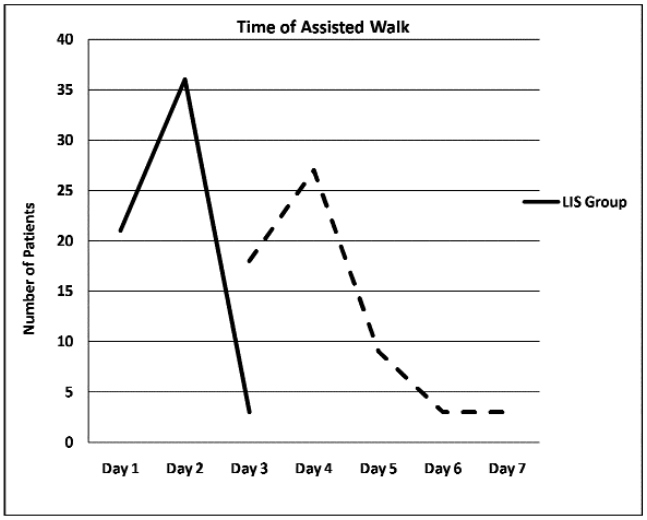


**Figure-3:** Time of assisted ambulation in standard total knee arthroplasty (TKA) and less investigative surgery (LIS) TKA patients.

14(23%) males with a mean age of 62±5.1 years (range: 55-68 years) while the test group had 45(75%) females and 15(25%) males with a mean age of 59.8±4.8years (range: 50-65 years). Both groups were well matched in demographic variables such as age, gender, BMI and preoperative ROM (p>0.05 each). Thus these potential confounding factors were also well controlled.

The mean length of incision for the standard group was 17.3±0.7 cm and for the LIS group 10.8±0.8cm (p < 0.05) (Figures-1-3). The mean operation time for TKA with standard technique was 67±6.9min and for the LIS 76±8.7min (p <0.05).

Detailed data of important outcomes of the study regarding mean hospital stay, assisted and independent ambulation, postoperative ROM at 1 and 3 months, and KSS objective and functional scores at 1 and 3 months were noted (Table-1; Figures-4-5). The difference between the groups in all these parameters was statistically significant (p<0.0001).

There were no wound healing problems, infection or implant notching in either of the groups.

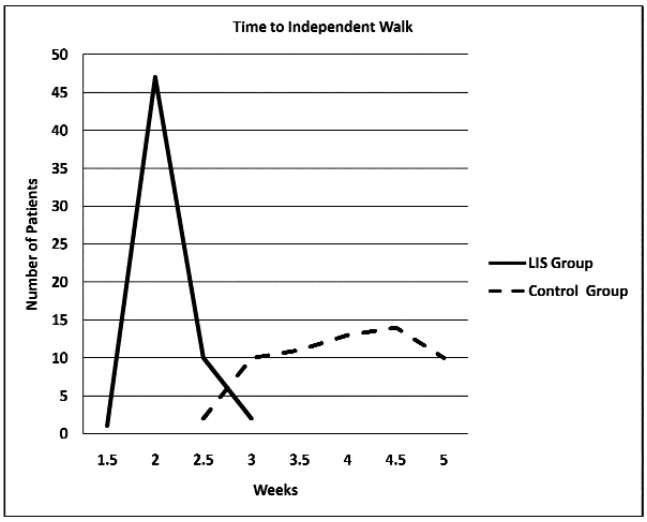


**Figure-4:** Time of independent ambulation in standard total knee arthroplasty (TKA) and less investigative surgery (LIS) TKA patients.

## Discussion

To the best of our knowledge, this is the first reported study from Pakistan on the subject. Use of MIS is an attractive surgical option for TKA candidates. No research has been carried in this context in our country. Globally, advantages of MIS TKA such as less postoperative pain, smaller scar and faster recovery of knee function are well established.[12] This has been supported by our study.

We found a statistically significant difference in early functional outcomes like early ambulation, ROM, KSS scores when comparing LIS and standard TKA for up to 3 months after the procedures. This is in concordance with other reports. Meta-analyses of 13, 18 and 32 different randomised controlled trials (RCTs) compared medial mid vastus (MMV) with MPP TKA and found significantly better postoperative ROM and KSS scores six weeks after TKA. The difference disappeared 12 weeks after TKA. Others report that KSS was better after MIS than after the standard procedure at 6 and 12 weeks postoperatively, but this difference no longer was significant after 6 months.[13-15] They have also documented similar results with significantly better outcomes in pain and postoperative ROM at 1-2 weeks post-operative after minimally invasive midvastus approaches compared to standard parapatellar approaches.

The shorter operation time for standard TKA in our studyis also documented in these meta-analyses with MIS approach taking more time.[13-15] This is because MIS techniques require more surgical steps to achieve adequate observation of anatomic landmarks in placing the instrument and implant which are time-consuming. There is a learning curve for each procedure; with time this difference is shortened. A learning phase was identified as approximately 10months or 21 knee arthroplasties using the MIS technique.[13] In one study, it took 50 operations before the surgical time equalled that of the open technique.[16] In our study too, the time for later 20-30 LIS TKAs was comparable to time for standard TKA.

Although we did not record the blood loss, but different comparative studies have shown no difference in blood loss between the two groups.[17]

Most of the parameters of early functional recovery (ambulation, ROM, KSS scores) are related to level of pain that patient feels in the postoperative period. Many studies have documented lower level of pain in early hospital stayin MIS group, thus requiring less analgesics (opioids and non-steroidal anti-inflammatory drugs [NSAIDS]) during hospital stay and in the month following discharge.[8,18] This has been our observation also. This lower level of pain enabled earlier assisted ambulation and earlier hospital discharge in our LIS TKA patients. Thus we found a significant difference in ambulation and hospital stay between the two groups. King et al. also have reported significantly better clinical outcomes with respect to length of hospital stay in patients who had minimally invasive surgery ($p< 0.0001$).[19] However, this is not well supported by other studies.[13,17]

An important consideration when a new surgical technique is introduced is the rate of complications. In a 3-monthfollow-up of our patients, we did not encounter any case of clinically significant case of DVT in either group. A meta-analysis of RCTs showed that postoperative DVT was more common in the standard approach group. MIS allows patients to have early postoperative mobilisation, which may improve venous blood flow, thereby decreasing the risk of DVT postoperatively.[13]

Some earlier papers have reported delayed wound healing and superficial wound infections to be common with the MIS techniques. The increased incidence of delayed wound healing in the MIS group have been related to forceful skin stretching and retraction as a result of limited operating field. In addition, the time the tissue is exposed to the outside environment is prolonged in the MIS group, which may lead to potential wound contamination and perioperative hypoxia.[20] However, other studies[13] as well as our study show no difference in rate of wound healing and superficial infections in the two groups.

The patients after TKA surgery expect a long-lasting and

pain-free knee. Thus, component alignment is of vital importance in the long-term results. There is a lack of evidence in literature that MIS can achieve the same results as the standard TKA approach in terms of component alignment precision. A meta-analysis of RCTs suggests no differences in radiographic implant alignment between minimally invasive and standard approaches.[13] However, assessment of radiological outcome in terms of positioning of implants was not intended in the present study.

## Conclusion

LIS technique was associated with better early functional results after TKA. Appropriate patient selection and precise operation technique are the key points of success in LIS TKA. Only a high-volume arthroplasty surgeon should perform MIS TKA in selected cases.

Declaration: No affiliations or grants to declare by any author.

## References

1. Laskin RS. Surgical exposure for total knee arthroplasty: for everything there is a season. J Arthroplasty 2007; 22(4 Suppl 1): 12-14.
2. Morgan SS, Bonshahi A, Pradhan N, Gregory A, Gambhir A, Porter ML. The influence of postoperative coronal alignment on revision surgery in total knee arthroplasty. Int Orthop 2008; 32: 639-642.
3. Karachalios T, Giotikas D, Roidis N, Poultsides L, Bargiotas K, Malizos KN. Total knee replacement performed with either a mini-midvastus or a standard approach: a prospective randomised clinical and radiological trial. J Bone Joint Surg Br 2008; 90: 584-591.
4. Han I, Seong SC, Lee S, Yoo JH, Lee MC. Simultaneous bilateral MIS-TKA results in faster functional recovery. Clin Orthop Relat Res 2008; 466: 1449-1453.
5. Kashyap SN, van Ommeren JW. Clinical experience with less invasive surgery techniques in total knee arthroplasty: a comparative study. Knee Surg Sports Traumatol Arthrosc 2008; 16: 544-548.
6. Kim YH, Kim JS, Kim DY. Clinical outcome and rate of complications after primary total knee replacement performed with quadriceps-sparing or standard arthrotomy. J Bone Joint Surg Br 2007; 89: 467-470.
7. Chotanaputi T, Ongnamthip P, Karnchanalerk K, Udombuathong P. Comparative study between 2cm limited quadriceps exposure minimal invasive surgery and conventional total knee arthroplasty in quadriceps function: prospective randomized controlled trial. J Med Assoc Thai 2008; 91: 203-207.
8. Lombardi AV Jr, Viacava AJ, Berend KR. Rapid recovery protocols and minimally invasive surgery help achieve high knee flexion. Clin Orthop Relat Res 2006; 452: 117-122.
9. Schroer WC, Diesfeld PJ, Reedy ME, LeMarr AR. Isokinetic strength testing of minimally invasive total knee arthroplasty recovery. J Arthroplasty 2010; 25: 274-279.
10. Lubowitz JH, Sahasrabudhe A, Appleby D. Minimally invasive surgery in total knee arthroplasty: the learning curve. Orthopedics 2007; 30(8 Suppl): 80-82.
11. Shankar NS. Minimally invasive technique in total knee arthroplasty: history, tips, tricks and pitfalls. Injury 2006; 37(Suppl 5): S25-S30.
12. Kolisek FR, Bonutti PM, Hozack WJ, Purtill J, Sharkey PF, Zelicof SB, et al. Clinical experience using a minimally invasive surgical approach for total knee arthroplasty: early results of a prospective randomized study compared to a standard approach. J Arthroplasty 2007; 22: 8-13.
13. Cheng T, Liu T, Zhang G, Peng X, Zhang X. Does minimally invasive surgery improve short-term recovery in total knee arthroplasty? Clin Orthop Relat Res 2010; 468: 1635-48.
14. Liu HW, Gu WD, Xu NW, Sun JY. Surgical approaches in total knee arthroplasty: a meta-analysis comparing the midvastus and subvastus to the medial peripatellar approach. J Arthroplasty 2014; 29: 2298-304.
15. Xu SZ, Lin XJ, Tong X, Wang XW. Minimally invasive midvastus versus standard parapatellar approach in total knee arthroplasty: a meta-analysis of randomized controlled trials. PLoS One 2014; 9: e95311. doi: 10.1371/journal.pone.0095311.
16. Kashyap SN, van Ommeren JW, Shankar S. Minimally invasive surgical technique in total knee arthroplasty: a learning curve. Surg Innov 2009; 16: 55-62.
17. Bonutti PM, Dethmers D, Ulrich SD, Seyler TM, Mont MA. Computer navigation-assisted versus minimally invasive TKA: benefits and drawbacks. Clin Orthop Relat Res 2008; 466: 2756-62.
18. Bonutti PM, Mont MA, McMahon M, Ragland PS, Kester M. Minimally invasive total knee arthroplasty. J Bone Joint Surg Am 2004; 86(Suppl 2): 26-32.
19. King J, Stamper DL, Schaad DC, Leopold SS. Minimally invasive total knee arthroplasty compared with traditional total knee arthroplasty: assessment of the learning curve and the postoperative recuperative period. J Bone Joint Surg Am 2007; 89: 1497-1503.
20. Galat DD, McGovern SC, Larson DR, Harrington JR, Hanssen AD, Clarke HD. Surgical treatment of early wound complications following primary total knee arthroplasty. J Bone Joint Surg Am 2009; 91: 48-54.