

Can the Surgical Approach to Total Knee Arthroplasty Influence Early Postoperative Outcomes? – A Comparative Study between Trivector and Medial Parapatellar Approaches

Abstract

Background: Trivector approach to total knee arthroplasty (TKA) is a quadriceps tendon sparing approach, whereas the medial parapatellar (MPP) approach involves making a longitudinal incision in quadriceps tendon. We postulated that quadriceps-sparing approach such as trivector should make postoperative rehabilitation easier and ultimately reduce the length of hospital stay. **Objectives:** The aim of the study is to compare the early postoperative outcomes of the TKA performed through the trivector and the MPP approaches. **Methodology:** We prospectively reviewed the results of 56 consecutive patients operated on by two knee surgeons: one routinely performs trivector and the other an MPP approach. Both the groups consisted of 28 patients each. We looked at operative times, the time taken to perform straight leg raise (SLR), range of movements achieved before discharge, and length of the hospital stay. **Results:** The mean time taken for performing the surgery through the MPP approach was 56 min, whereas, for the trivector approach, it was 54 min ($P = 0.31$). The mean time taken to perform SLR in the MPP approach group was 3.5 days, whereas in the trivector group, the meantime taken for SLR was 2.5 days ($P = 0.003$). The average extension at the time of discharge in the MPP group was 3.8° , and in the trivector group, it was 0.86° ($P = 0.007$). The average knee flexion at the time of discharge in the MPP group was 84.2° , whereas in the trivector group, it was 86.5° ($P = 0.199$). The average hospital stay in the MPP group was 5.96 days, whereas in the trivector group, it was 4.84 days ($P = 0.11$). **Conclusions:** The trivector approach patients took significantly less time to do SLR and achieved a better range of extension before discharge from the hospital. The patients with trivector approach were discharged early by one day, although it is not statistically significant, it is clinically significant.

Keywords: Medial parapatellar approach, postoperative rehabilitation, time to discharge, trivector approach

Introduction

Total knee arthroplasty (TKA) is one of the most common orthopedic procedures performed throughout the world. The National Joint Registry for England, Wales, Northern Ireland, and the Isle of Man alone recorded a total of 102,177 primary total knee replacement procedures performed in 2017,^[1] and every year, the number is increasing.

There are various surgical approaches used to perform TKA. The most common approaches are the medial parapatellar (MPP), trivector, midvastus, and subvastus. The midvastus and subvastus are not extensile and cannot be performed in every patient and got limitations. Although MPP is widely used in clinical

practice, the trivector approach has got certain biomechanical advantages.

The trivector approach, also called the trivector-retaining arthrotomy technique, is a quadriceps-sparing approach and provides extensile exposure for both primary and revision TKA. There are three vectors controlling the patella proximally along the axis of the heads of the quadriceps muscle, and to counterbalance this, one vector acts distally in the direction of the patella tendon, as shown in Figure 1. The resultant vector is directed medially, which helps patella tracking and prevents lateral subluxation of the patella. This approach spares the anatomic trivector arrangement. It is recommended that this approach be performed with the knee flexed 90° – 110° so that the quadriceps musculature is

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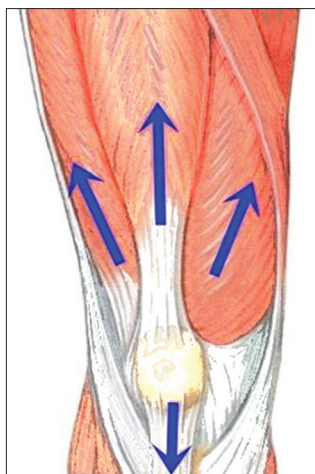


Figure 1: Vectors controlling the patella

under maximal tension and thinned out as much as possible during the incision.^[2]

The trivector approach begins proximally 2 cm medial to the quadriceps tendon and through the vastus medialis obliquus (VMO) fibers, then along the medial border of the patella and distally 1 cm medial to the patella tendon to the level of the tibial tubercle [Figure 2].

One of the most commonly noted complications following the knee arthroplasty is patellofemoral instability.^[3-5] Patellofemoral complications are reported in 5%–30% of all total knee cases.^[5] The most common complications are subluxation,^[3-8] component wear,^[7] dislocations,^[4,6,8] fractures,^[5-7,9-11] and pain.^[6,7]

Grace and Rand^[12] suggested that the four most common causes of patellar instability following TKA surgery were prosthetic design, quadriceps imbalance, surgical technique (most common), and trauma.

Merkow *et al.*^[8] supported this belief, suggesting that surgical technique, including inadequate soft-tissue balancing and prosthetic malposition and malalignment, was the most predominant cause.

Quadriceps muscle system malalignment is the most common cause of patellar dislocation or subluxation, according to Moreland *et al.* The trivector approach helps in the prevention of malalignment since all the quadriceps vectors are preserved in this approach. This approach can also be used for minimally invasive TKA as well.^[13]

Long-term clinical outcomes of the approaches to the TKA are well-documented; however, they do not focus on the early postoperative recovery and on how well the patients perform during the critical inpatient period.

This prospective study aimed to compare the early postoperative results of the MPP and trivector approaches. It focused on certain aspects of early rehabilitation such as range of motion and time to straight leg raise (SLR), and

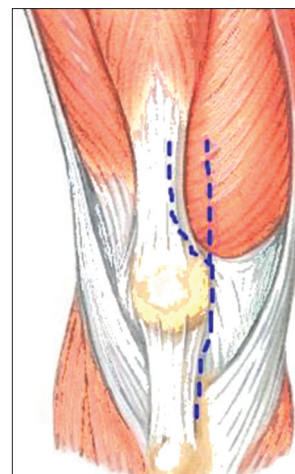


Figure 2: Trivector and MPP approaches

whether this, in turn, can influence the time to discharge of the patient from the hospital with the ultimate aim of improving patient care and reducing the economic burden.

Methodology

We prospectively reviewed 56 consecutive patients operated on by two experienced knee surgeons at a busy teaching hospital between January 2018 and March 2018. One routinely performs a trivector approach for the total knee replacement and the other uses a MPP approach. Patients who only had regional anesthesia (spinal) were included in the study. All of them had cruciate-retaining total knee replacements (DePuy Synthes).

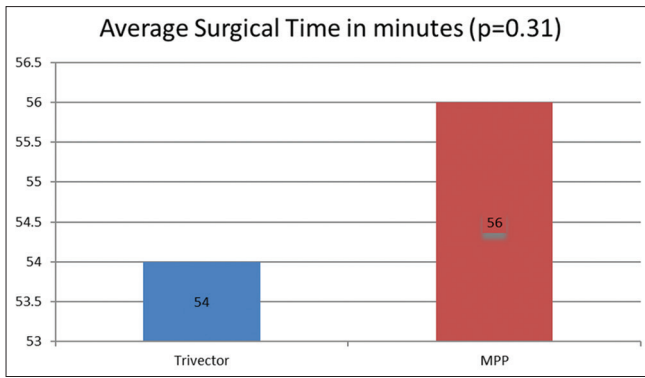
Both the groups consisted of 28 patients each. The types of postoperative analgesia and rehabilitation protocol were the same in both the groups. We looked at operative times, the time taken to perform SLR, and range of movement achieved before discharge. We also looked at the length of the hospital stay.

The range of movements was quantified using a goniometer. The physiotherapists who worked with these patients were blinded to the type of approach the patients had undergone. We also looked at how many sessions of physiotherapy patients needed after they were discharged from the hospital.

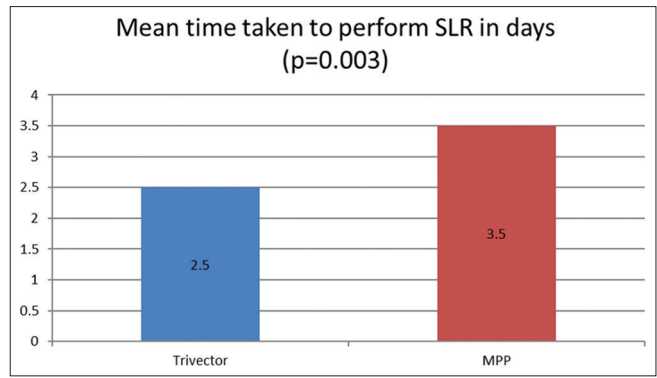
Results

The average age of the patients was 70 years (range 62–80 years). Sixty-seven percent (67%) of the patients were female and 33% were male patients.

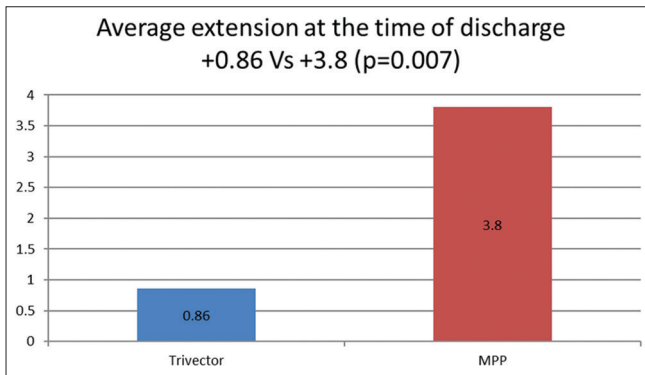
The mean surgical time taken for performing TKA through the MPP approach was 56 min, and for the trivector approach, it was 54 min ($P = 0.31$) [Graph 1]. Consultant surgeons performed all the operations, and nurse practitioners assisted them. The proximal closure in the trivector approach was in two layers. The VMO here is partly tendinous in the deeper layer and muscular in



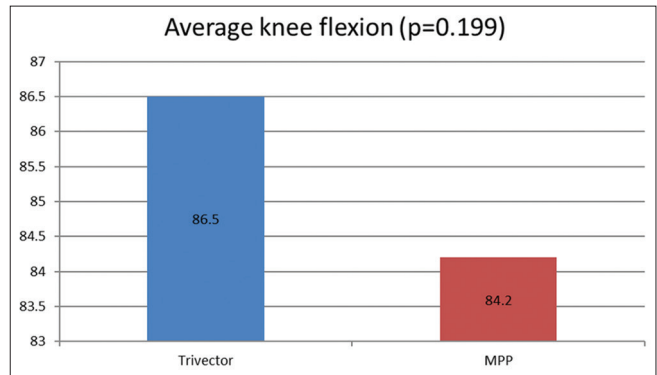
Graph 1: Surgical time



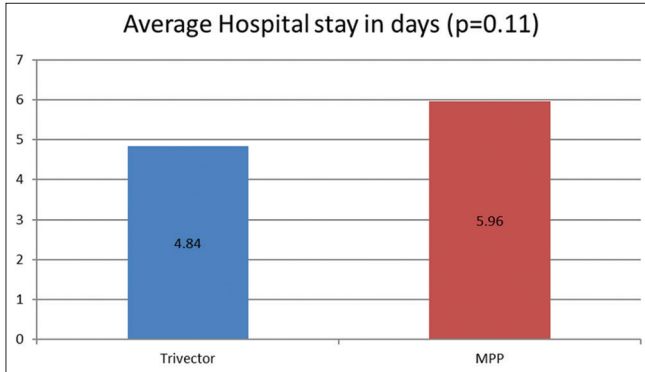
Graph 2: Mean time taken to perform SLR



Graph 3: Average knee extension in degrees



Graph 4: Average knee flexion in degrees



Graph 5: Average hospital stay

the superficial layer. It is recommended to close these in two separate layers. Once the lower tendinous layer was closed, the muscular layer was closed by suturing the fascia. Despite this, the trivector approach took slightly less time compared to the MPP approach, but this was not statistically significant.

The mean time taken to perform SLR in MPP approach group was 3.5 days, whereas in the trivector group, it was 2.5 days ($P = 0.003$) [Graph 2]. Thus, the patients who underwent trivector approach performed the SLR a day earlier, which enabled relatively quicker rehabilitation, and their nursing needs were considerably lower than the MPP group of patients.

The average knee extension at the time of discharge in the MPP group was 3.8°, and in the trivector group, it was 0.86° ($P = 0.007$) [Graph 3]. The better knee extension enabled trivector group of patients to recreate better the normal gait pattern with the knee going into better extension after heel strike, thus making it energy efficient.

The average knee flexion at the time of discharge in the MPP group was 84.2°, whereas in the trivector group, it was 86.5° ($P = 0.199$) [Graph 4]. Thus, the knee flexion was also slightly better in the trivector group, but this was not statistically significant.

The average hospital stay in the MPP group was 5.96 days, whereas in the trivector group, it was 4.84 days ($P = 0.11$) [Graph 5]. Although the result was not statistically significant, the patients in the trivector group were able to go home 1 day earlier which is clinically significant. The 1-day difference in terms of hospital stay is potentially a huge cost saving, especially to busy centers like our teaching hospital where around 500 total knee replacements are performed per year.

After the discharge from the hospital, patients were followed up in the physiotherapy outpatient department to oversee the knee joint range of movements. The patients in trivector group needed one-third less follow-up physiotherapy appointments compared to the MPP group before being discharged from the physiotherapy outpatient

clinic. The follow-up in the outpatient physiotherapy is also another potential area of cost savings in the patients undergoing trivector approach for total knee joint arthroplasty.

Discussion

Patellofemoral joint problems pose a significant challenge following TKA. In the literature, the reported incidence of patellofemoral problems has ranged from 5% to 30% after TKAs.^[8] These complications include abnormal tracking of the patella, patellar subluxation, and dislocation and increased wear of patella due to abnormal dynamics resulting in anterior knee pain. These complications mostly become apparent during the early postoperative period, thus implicating that at least in part they may be due to the surgical approach used during the knee replacement and subsequent extensor function.^[3] The trivector approach has the advantage of retaining all the vectors of the extensor mechanism, and the resultant medially directed patellar force helps the patella to sit in the trochlear groove and thus normal patellar tracking.

Fisher *et al.*^[14] compared the clinical results of the trivector approach to the MPP approach in primary TKA. They reported patients undergoing the trivector approach achieved active SLR 2 days sooner than patients undergoing the MPP arthroplasty. Moreover, at 6 months postoperatively, the concentric quadriceps strength was 15% more in trivector approach group.

Bramlett *et al.*^[15] in their case series concluded that the trivector approach had reduced the need for lateral patellar retinacular releases and other procedures designed to reduce postoperative patellar instability.

Although there are several case series in the literature showing excellent clinical outcomes with the use of trivector approach,^[16,17] and also most knee arthroplasty reference books describe the advantages of this approach, there are not many clinical studies comparing the trivector approach with the other knee approaches to provide clinical evidence for this. There are studies seen comparing midvastus, subvastus, and MPP approaches but not trivector approach. Liu *et al.*^[18] in their meta-analysis compared the MPP approach with the midvastus and subvastus approaches and showed better outcomes in pain and knee range of motion at postoperative 1–2 weeks with midvastus approach; the subvastus approach showed better outcomes in knee range of motion at postoperative 1 week, SLR, and lateral retinacular release. However, the subvastus and midvastus approaches have got their limitations as they are not extensile and thus cannot be used in every patient, whereas the trivector approach can be performed even in very obese patient and is extensile when required.

Our study is the first study comparing the MPP and trivector approaches which focuses on the early postoperative

period and looked into the clinical outcomes and health economics; thus, it adds to the clinical evidence behind the advantages of using the trivector approach.

Conclusions

The trivector approach has got biomechanical advantages compared to a MPP approach. The approach involves the preservation of all the vectors and is thus patellafemoral joint-friendly. Our study showed that it has got many clinical advantages in the early postoperative period. The trivector approach patients took significantly less time to do SLR and achieved a better range of extension before discharge from hospital compared to MPP approach patients. The trivector approach enabled the patients to regain independence sooner, and even after discharge, these patients needed less outpatient physiotherapy. Furthermore, the patients with trivector approach were discharged 1 day earlier which in addition to clinical benefits can result in huge savings in high-volume arthroplasty centers.

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Conflicts of interest

There are no conflicts of interest.

References

1. National Joint Registry for England, Northern Ireland and the Isle of Man. NJR 15th Annual Report 2018. Wales: National Joint Registry for England; 2018. Available from: <http://www.njrreports.org.uk/Portals/0/PDFdownloads/NJR%2015th%20Annual%20Report%202018.pdf>. [Last accessed on 2019 May 02].
2. Vaishya R, Vijay V, Demesugh DM, Agarwal AK. Surgical approaches for total knee arthroplasty. *J Clin Orthop Trauma* 2016;7:71-9.
3. Brick GW, Scott RD. The patellofemoral component of total knee arthroplasty. *Clin Orthop Relat Res* 1988;231:163-78.
4. Murray DG. Total knee arthroplasty. *Clin Orthop Relat Res* 1985;192:59-68.
5. Webster DA, Murray DG. Complications of variable axis total knee arthroplasty. *Clin Orthop Relat Res* 1985;193:160-7.
6. Insall JN, Binazzi R, Soudry M, Mestriner LA. Total knee arthroplasty. *Clin Orthop Relat Res* 1985;192:13-22.
7. Leblanc JM. Patellar complications in total knee arthroplasty. A literature review. *Orthop Rev* 1989;18:296-304.
8. Merkow RL, Soudry M, Insall JN. Patellar dislocation following total knee replacement. *J Bone Joint Surg Am* 1985;67:1321-7.
9. Roffman M, Hirsh DM, Mendes DG. Fracture of the resurfaced patella in total knee replacement. *Clin Orthop Relat Res* 1980;148:112-6.
10. Scott RD, Turoff N, Ewald FC. Stress fracture of the patella following duopatellar total knee arthroplasty with patellar resurfacing. *Clin Orthop Relat Res* 1982;170:147-51.

11. Terry GC. The anatomy of the extensor mechanism. *Clin Sports Med* 1989;8:163-77.
12. Grace JN, Rand JA. Patellar instability after total knee arthroplasty. *Clin Orthop Relat Res* 1988;237:184-9.
13. Benazzo F, Rossi SM. The trivector approach for minimally invasive total knee arthroplasty: A technical note. *J Orthop Traumatol* 2012;13:159-62.
14. Fisher DA, Trimble SM, Breedlove K. The medial tri-vector approach in total knee arthroplasty. *Orthopedics* 1998;21:53-6.
15. Bramlett KW, Haller WN, Krauss WD. The trivector-retaining arthrotomy. In: Scuderi GR, Tria AJ, editors. *Surgical Techniques in Total Knee Arthroplasty*. New York: Springer; 2002.
16. Bloch BV, Palan J, Shahid M, James PJ. A new total knee arthroplasty design has significantly better early implant survivorship than a previous gold-standard design-A retrospective analysis of 1,000 cases. *J Knee Surg* 2019. doi: 10.1055/s-0038-1676770. [Epub ahead of print].
17. Benazzo F, Rossi SM, Danesino G, Klersy C, Perelli S, Ghiara M, *et al.* Computed tomography evaluation of total knee arthroplasty implants position after two different surgical methods of implantation. *Int Orthop* 2019;43:139-49.
18. 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.