



Review

Total knee replacement: A comparison of the subvastus and medial parapatellar approaches

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ABSTRACT

Objective: The goal of this study is to compare the subvastus method to the usual medial parapatellar technique for total knee replacement in patients with osteoarthritis who present to a tertiary care centre, based on quadriceps function recovery in days after surgery.

Materials and methods: We retrospectively reviewed case notes of 76 patients with osteoarthritis who had total knee replacements in a tertiary care hospital over the course of a year from August 2019 to August 2020. We divided them into two groups: group A received TKR via the subvastus approach, and group B received TKR via the medial parapatellar approach. Preoperative quadriceps strength, BMI, and baseline demographics were all recorded from their initial pre-operative workup case notes. Starting on the first postoperative day, patients recorded first unassisted straight leg raise (SLR) was kept as the main determinant for muscle function. The data were evaluated to determine the quadriceps muscle function post TKR.

Results: When compared to the medial parapatellar approach, the quadriceps muscle function returns sooner with the subvastus technique. Patients in their sixties showed the highest improvement. Preoperative quadriceps strength has a major impact on muscle recovery after surgery.

Conclusion: The subvastus method to total knee replacement is linked to a faster recovery of quadriceps muscle strength, resulting in a shorter hospital stay and postoperative therapy.

1. Introduction

Knee osteoarthritis (OA) is a major public health concern and a primary cause of functional disability and reduced quality of life in the elderly [1]. It is the most common chronic condition in the United States, afflicting 59% of those aged 65 and up. Women, on average, have a higher prevalence of OA than men [2]. The diagnosis of OA of the hip or knee is the same for both men and women. Significant joint pain, unpleasant and limited ambulation, the discomfort that is exacerbated by weight-bearing activities, and noticeable joint space narrowing and osteophyte growth are common symptoms in patients with severe hip or knee OA.

Total knee arthroplasty [3] is a successful operation for treating knee joint deterioration. Over the last three decades, this procedure has grown in popularity. In the United States, the age and gender-adjusted incidence per 100,000 people per year climbed from twenty-nine in 1971–1975 to 157 in 2000–2003, showing a >400% rise in total knee arthroplasty. From 51% of total knee arthroplasties in 1971–1975 to 92% in 2000–2003, the proportion of total knee arthroplasties performed for the treatment of osteoarthritis has increased significantly. The number of primary total knee arthroplasties in the United States is expected to rise from 450,400 in 2008 to 3.48 million by 2030 [4].

An anterior midline incision with medial parapatellar arthrotomy is the most common skin incision for primary total knee arthroplasty. To

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gain access to the knee joint with patellar subluxation, a portion of the quadriceps tendon is incorporated in the arthrotomy.

Alternative ways of exposure have been described to prevent patellofemoral problems and speed up the restoration of quadriceps function after surgery. In terms of subluxing the extensor mechanism laterally for knee exposure, the subvastus ("Southern") technique varies from the medial parapatellar technique [5]. Leave the extensor mechanism intact, according to proponents, results in faster restoration of quadriceps strength, retains greater vascularity in the patella, increases patient satisfaction while reducing postoperative pain, and reduces the need for lateral release. The exposure may be reduced compared to the medial parapatellar approach, especially in obese individuals and those who have had previous knee procedures.

Other approaches have been documented in the literature, with the majority, if not all, aiming to retain the quadriceps mechanism in order to have fast postoperative recovery and quadriceps function.

The midvastus technique, which varies from the subvastus technique in that the vastus medialis muscle is split in line with its fibres rather than being subluxated laterally in its whole [6], is another strategy to access the joint. The quadriceps tendon and the superior genicular artery to the patella are preserved with this technique.

The goal of this study is to compare the subvastus technique to the usual medial parapatellar technique for total knee replacement in patients with osteoarthritis who present to a tertiary care centre based on quadriceps function recovery in days.

2. Operational definitions

2.1. Quadriceps function

The first unassisted straight leg raise (SLR) was assessed objectively with time in days following total knee replacement and indicated that the muscle had recovered.

2.2. Straight leg raise (SLR)

Quadriceps muscle function is recovered when the hip joint is flexed and the knee joint is extended above ground level.

3. Materials and methods

This is a retrospective study carried out in a UK tertiary care institution registered under Zaud no 12216. Data from patients who had complete knee replacements from August 2019 to August 2020 was collected after clearance from the clinical governance department and registration as a quality improvement initiative. The study comprised patients of either gender between the ages of 50 and 70, with a BMI between 18.5 and 40 [measured as weight (kg)/height² (m²)], who were diagnosed with osteoarthritis and required a total knee replacement as a result. Patients with ischemic heart disease with an ejection fraction of <30% were excluded from the study. The sample size after applying the necessary criteria was down to a comparison of 76 patients keeping an equal number of patients for each approach. After collection, the patients were divided into 2 groups based on the approach for surgery. Group A consisted of patients with subvastus approach and Group B included patients with medial parapatellar approach.

The SPSS 16.0 statistical programme was used to analyse the data. The results were provided as mean sd for straight leg raise in days and gender frequency/%. Using the *t*-test to compare means, a statistical comparison of quadriceps function in days will be done between the two groups. A P-value of less than 0.05 was considered significant. Stratification would be done in regards to age, gender, quadriceps strength and BMI to see the effect of these on outcomes.

4. Results

A total of 76 patients' data were examined. The subvastus route was used in 38 individuals, whereas the medial parapatellar route was used in 38 patients. The majority of the patients in our research were women (78%) (Table 1). The average BMI was 31.98 (± 8.858). The preoperative quadriceps was rated as MRC 4 and 5 on the Medical and Research Council (MRC) scale with only a small fraction of the studies patients (29%) having an MRC of 4 and the majority (71%) having an MRC 5 (Table 1). Out of the studied patients (72%) had no co-morbidities (Table 1).

The data clearly show that patients in group A (subvastus approach) had faster recovery of SLR, indicating that the surgery spared the quadriceps. Those in Group A recovered 0.45 days faster in SLR than patients in Group B. With a p-value of 0.008, this difference was likewise statistically significant. (Table 2). BMI did not affect the post-operative recovery of patients' quadriceps strength, and no significant difference ($p = 0.104$) was detected between patients with a BMI of >30 and those with a BMI of 30 (Table 3). Side of surgery again did not show significant relevance ($p = 0.833$) to the mean number of days for the first post-operative SLR (Table 4). Gender of the studied patients didn't show any statistical importance ($p = 0.182$) on SLR in our analysis of collected patient data (Table 5) (see Table 6).

In contrast to the above-mentioned results in Table 4 and Table 5, when the preoperative quadriceps strength of two groups was compared, it was discovered that there is a statistically significant relationship ($p = 0.000$) between preoperative quadriceps strength and postoperative muscle function recovery, with patients with preoperative MRC V strength recovering faster than those with MRC IV strength.

It's worth noting that there was a statistically significant association between the ages of the two groups. When the mean age of patients in the medial parapatellar group was 62.74 (5.598) and the mean age of patients in the subvastus group was 58.55 (4.919), we discovered a significant result with $p = 0.001$. Further investigation of the data revealed that patients in their sixth decade had a statistically significant difference in postoperative SLR between the two groups, as indicated in Table 7.

5. Discussion

TKA procedures that are less invasive are rapidly becoming available. For uni-compartmental knee arthroplasty, small knee capsular incisions were originally documented [7]. The need for a faster recovery and less time in the hospital following TKA has led to the development of minimal-incision TKA procedures. To present, the literature on minimally invasive procedures for TKA is restricted to anecdotal reports based on one surgeon's experience, with only a few prospective, single-cohort or matched-control comparative studies available [8–11].

A previous observer blinded study done on 120 patients evaluated

Table 1
Demographics.

Age	60.64 (± 5.642)
Gender	
Male	17 (22.3%)
Female	59 (77.6%)
Body Mass Index (BMI)	31.98 (± 8.858)
Side of surgery	
Right	44 (57.8%)
Left	32 (42.1%)
Preoperative quadriceps strength	
MRC 4	22 (29%)
MRC 5	54 (71%)
Comorbidities	
None	55 (72%)
IHD	03 (4%)
HTN	18 (24%)

Table 2
Straight Leg Raise (SLR) in two approaches.

Approach	N	Mean (days)	Standard deviation	P value
Medial parapatellar	38	3.03	0.677	0.008
Subvastus	38	2.58	0.758	

Table 3
Affect of BMI on straight leg raise.

BMI	N	Mean days to SLR	Std. Deviation	Std. Error Mean	P value
> 30	37	2.95	0.780	0.128	0.104
< 30	39	2.67	0.701	0.112	

Table 4
Data stratification according to side of surgery.

side	N	Mean days of SLR	Std. Deviation	Std. Error Mean	P value
right	44	2.8182	0.81477	0.12283	0.833
left	32	2.7813	0.65915	0.11652	

Table 5
Stratification according to gender.

sex	N	Mean days of SLR	Std. Deviation	Std. Error Mean	P value
male	17	2.5882	0.71229	0.17276	0.182
female	59	2.8644	0.75333	0.09808	

two nonrandomized groups of TKAs performed using either the usual medial parapatellar approach or a minimally invasive method using a mini-subvastus incision and followed up to 90 days [8]. When compared to the traditional technique, the minimally invasive method exhibited certain advantages in terms of functional recovery and postoperative pain. These benefits came at the cost of a heightened risk of problems. However, this was my first time, and there is a learning curve. Their findings matched those of a previous retrospective study done on 58 patients and followed up for 3 months that used minimally invasive techniques like the mini-midvastus or the “quadriceps-sparing” approach [10]. A similar study done by the same authors on a 100 patients followed for 2 years gave similar conclusions [12].

Only recently has the subvastus technique to the knee acquired prominence in knee arthroplasty [13–16]. A randomized blinded trial done on 89 patients showed that the subvastus technique offered early advantages in gaining mobility for patients postop [13].

This method offers several anatomic advantages that may help with knee arthroplasty function and survival. The supreme (descending) geniculate, superomedial and inferomedial geniculate, superolateral and inferolateral geniculate, and anterior tibial recurrent arteries all feed a parapatellar extraosseous ring of vessels that supplies blood to the patella [17].

The supreme, superomedial, and inferomedial geniculate arteries' contributions to the perivascular ring are severed in the medial parapatellar approach. The subvastus primarily preserves the contribution of the medial patellar blood flow, which may reduce the risk of patellar avascular necrosis in theory.

A comparison study of 20 patients undergoing one-stage bilateral knee arthroplasty found that patients prefer the subvastus method to the parapatellar technique. One knee was exposed using the parapatellar

technique, while the second knee was exposed using the subvastus technique [17]. The objective and functional outcomes measured by the knee society rating scales did not differ substantially between the two groups in the same trial; however, the medial parapatellar approach group's higher incidence of patellar maltracking may have a late significant effect on knee function.

Another study [18] discovered that subvastus appeared to provide an early benefit to knee arthroplasty patients in the postoperative period, as seen by significantly reduced pain medication dosages utilised in the subvastus approach group during the first 48 h. SLR might be completed in substantially less time by the Subvastus group. Patients who had the subvastus technique required 40% less postoperative pain medications and could straight leg lift on average 2.6–4 days sooner than those who had the traditional medial parapatellar technique, according to other research [13,14].

Up to one month after surgery, the same patient who had the subvastus technique showed considerable improvement in quadriceps strength. However, by the third month after surgery, this early function advantage had faded and did not appear to confer any long-term benefit. These findings are consistent with other reports that patients with total knee arthroplasty usually regained quadriceps strength with little difference between the medial parapatellar approach and the subvastus approach, and that patients with total knee arthroplasty usually regained quadriceps strength with little difference between the medial parapatellar approach and the subvastus approach [13,14,16].

In line with prior studies [13,14], their findings revealed no significant changes in the postoperative range of knee motions offered by the subvastus approach at any time period, as well as no significant differences in operating time or postoperative blood loss.

A review by Bonutti et al. found that the least invasive and standard groups had equal mean Knee Society scores [19]. A randomized multi centre study done by Kolisek et al. on 80 knees found that at the three-month follow-up, these two approaches had identical scores [20]. Seon et al. in their study found that patients who had been randomised to minimally invasive surgery had significantly better scores on a 10-point visual analogue pain scale on postoperative day 3 than patients who had a standard approach, but the scores obtained at two weeks indicated equivalence between the cohorts [21]. Some writers have taken a firm stance against the use of minimally invasive procedures, citing the lack of a demonstrated advantage in other similar studies [20].

In this study, we looked at patients' quadriceps muscular strength recovery after surgery, as well as their probable implications on the outcome and early postoperative rehabilitation, which led to early discharges. In terms of faster recovery of straight leg raise (SLR) in the subvastus group, our findings are comparable with those found in the literature. It's also worth noting that this faster recovery was especially noticeable in people between the ages of 60 and 70. Preoperative quadriceps strength has a substantial impact on early postoperative SLR attainment. The current study, however, showed no evidence of a

Table 7
Stratification according to age.

		Approach		P value
		Medial parapatellar	Subvastus	
Age in years	50–59	13	19	0.511
	60–69	21	18	0.008
	70–79	4	1	0.35

Table 6
Stratification according to preoperative quadriceps strength.

MRCscale	Medial Parapatellar	Subvastus	N	Mean days SLR	Std. Deviation	Std. Error Mean	P value
IV	12	10	22	3.4545	0.67098	0.14305	0.000
V	26	28	54	2.5370	0.60541	0.08239	

significant effect of gender or surgical side.

There are a few limitations to our study. Our study was a retrospective one and we had to work of data recorded earlier. Sample size for the study was a small one and we don't have long term follow up to see how patients in each group progressed on 3 and 6 month follow up. We plan on following up this study with a randomized control trial with a bigger cohort and following them up for at least a year to see how long term follow up in both approaches can be seen.

6. Conclusion

In conclusion, complete knee replacement can be performed successfully using either of the above techniques; but, based on our findings, we may conclude that patients who underwent surgery using the subvastus approach have faster recovery of quadriceps strength. This supports our hypothesis that the subvastus technique is better anatomic and facilitates faster postoperative recovery.

Provenance and peer review

Not commissioned, externally peer reviewed.

Declaration of competing interest

Nil.

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Ethical approval

Retrospective study looking at patient notes so no ethical approval needed.

Consent

All data anonymised.

Author contributions

Mr Mohammad Noah H Khan: lead author idea and write up.
Mr Kashif Abbas: data analysis and collection.
Dr Pervaiz Mehmood Hashmi: proof reading.
Mr Ahmad Faraz: data analysis.
Mr Hassan Shafiq: proof reading and corrections of statistics.
Mr Waqas Ilyas: write up.
Dr Muhammad Hamzah Jamshed: data collection.

Trial registry number

1. Name of the registry:

2. Unique Identifying number or registration ID:
3. Hyperlink to your specific registration (must be publicly accessible and will be checked):

Guarantor

Mohammad Noah H Khan corresponding author.

References

- [1] J.M. Hootman, J.E. Sniezek, C.G. Helmick, Women and arthritis: burden, impact and prevention programs, *J. Womens Health Gend. Based Med.* 11 (5) (2002) 407–416.
- [2] R.W. Moskowitz, D.S. Howell, V.M. Goldberg (Eds.), *Osteoarthritis: Diagnosis and Medical/surgical Management*, second ed., W.B. Saunders, Philadelphia, 1992, pp. 15–37.
- [3] O. Ethgen, O. Bruyere, F. Richy, C. Dardennes, J.Y. Reginster, Health-related quality of life in total hip and total knee arthroplasty. A qualitative and systematic review of the literature, *J. Bone Joint Surg.* 86 (5) (2004) 963.
- [4] C.A. Deirmengian, J.H. Lonner, What's new in adult reconstructive knee surgery, *J. Bone Joint Surg.* 91 (12) (2009) 3008.
- [5] A.A. Hofmann, R.L. Plaster, L.E. Murdock, Subvastus (Southern) approach for primary total knee arthroplasty, *Clin. Orthop. Relat. Res.* 269 (1991) 70.
- [6] G.A. Engh, B.T. Holt, N.L. Parks, A midvastus muscle-splitting approach for total knee arthroplasty, *J. Arthroplasty* 12 (3) (1997) 322–331.
- [7] J.A. Repicci, R.W. Eberle, Minimally invasive surgical technique for unicompartmental knee arthroplasty, *J. South Orthop. Assoc.* 8 (1999) 20–27.
- [8] T.O. Boerger, P. Aglietti, N. Mondanelli, L. Sensi, Mini-subvastus versus medial parapatellar approach in total knee arthroplasty, *Clin. Orthop. Relat. Res.* 440 (2005) 82–87.
- [9] P.M. Bonutti, M.A. Mont, M.A. Kester, Minimally invasive total knee arthroplasty: a 10-feature evolutionary approach, *Orthop. Clin. N. Am.* 35 (2003) 217–226.
- [10] R.S. Laskin, B. Beksac, A. Phongjunakorn, K. Pittors, J.R.N. Davis, J.C. Shim, Minimally invasive total knee replacement through a mini-midvastus incision: an outcome study, *Clin. Orthop. Relat. Res.* 428 (2004) 74–81.
- [11] M. Tenholder, H.D. Clarke, G.R. Scuderi, Minimal-incision total knee arthroplasty: the early clinical experience, *Clin. Orthop. Relat. Res.* 440 (2005) 67–76.
- [12] R.S. Laskin, Minimally invasive total knee arthroplasty: the results justify its use, *Clin. Orthop. Relat. Res.* 440 (2005) 54–59.
- [13] G.S. Roysam, M.J. Oakley, Subvastus approach for total knee arthroplasty: a prospective, randomized, and observer-blinded trial, *J. Arthroplasty* 16 (2001) 454.
- [14] Z. Marie, The standard versus the subvastus approach for total knee arthroplasty: a randomized prospective study, *Orthop. Trans.* 15 (1991) 43.
- [15] M. Matsueda, R.B. Gustilo, Subvastus and medial parapatellar approaches in total knee arthroplasty, *Clin. Orthop.* 371 (2000) 161–168.
- [16] E. Cila, V. Guzel, M. Ozalay, J. Tan, A.S. Simsek, U. Kanath, et al., Subvastus versus medial parapatellar approach in total knee arthroplasty, *Arch. Orthop. Trauma Surg.* 122 (2002) 65–68.
- [17] B.T. Faure, J.B. Benjamin, B. Lindsey, R.G. Volz, D. Schutte, Comparison of the subvastus and paramedian surgical approaches in bilateral knee arthroplasty, *J. Arthroplasty* 8 (1993) 511–516.
- [18] Mohammad A. Hafiz, The subvastus approach for primary total knee replacement: does it affect the early results? 6 Pan Arab Orthopedic association, July 2002.
- [19] P.M. Bonutti, M.A. Mont, M. McMahon, et al., Minimally invasive total knee arthroplasty, *J. Bone Joint Surg. Am.* 86 (Suppl 2) (2004) 26–32.
- [20] F.R. Kolisek, P.M. Bonutti, W.J. Hozack, J. Purtill, P.F. Sharkey, S.B. Zelicof, 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* 22 (2007) 8–13.
- [21] J.K. Seon, E.K. Song, Navigation-assisted less invasive total knee arthroplasty compared with conventional total knee arthroplasty: a randomized prospective trial, *J. Arthroplasty* 21 (2006) 777–782.