

Comparison of subvastus and medial parapatellar approaches in primary total knee arthroplasty in term of clinical outcome

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Abstract

Background & objectives: The purpose of this study was to determine differences in clinical outcome between subvastus and medial parapatellar approach in primary total knee arthroplasty.

Methods: This is a prospective randomized study; we compared the clinical results of primary total knee arthroplasty using Subvastus and medial Parapatellar approaches in 34 patients. The standard medial Parapatellar approach used in 19 patients and Subvastus approach used in 15 patients. Clinical outcome assessed using knee society score, time to return quadriceps function and visual analogue scale for pain.

Results: The mean follow-up time was 3 months. Pain improved significantly overtime in both groups. However, when comparing groups together, patients in subvastus group had better numerical visual analogue scale score at 3rd day postoperatively, nevertheless, no significant differences found at other follow up times (8.11, 6.05, 4.26, 2.32, 1.47 for medial parapatellar group and 8.20, 4.47, 4.0, 1.67, 1.07 for subvastus group at preoperative, 3rd day, 2, 6 and 12 weeks postoperative respectively for both groups). Subvastus group had earlier return of quadriceps function by 1.9 days which was significant statistically. Knee society score improved significantly overtime without any significant differences when comparing both groups together at any time of the follow up periods (, 66.42, 105.21, 137.63, 155.53 for medial parapatellar group and, 62.53, 107.53, 137.6, 155.81 for subvastus group at preoperative, 2, 6 and 12 weeks postoperative respectively for both groups).

Conclusions: Subvastus approach allowed earlier return of quadriceps function and less pain in the early postoperative day. In term of physical and functional outcome, none of two surgical approaches showed advantage over the other.

Keywords: Total knee arthroplasty; Surgical approach, Knee society score, Replacement.

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Introduction

Subvastus (SV) and medial parapatellar (MPP) approaches are two commonly performed surgical exposures in primary total knee arthroplasty (TKA). The MPP approach is considered the standard technique with good surgical exposure. It allows incision to medial side of patella through quadriceps tendon. With MPP approach, there is concern about vascularity of patella which may lead to subsequent patellar necrosis that can cause anterior knee pain and patellar fracture¹⁻³. Subvastus approach is a “quadriceps-sparing” technique, in which extensor mechanism left intact. It may allow earlier return of knee function and decrease disruption of patellar vascularity. However, the limitation of this

approach includes inadequate surgical exposure that can cause technical difficulty, especially in obese patients^{1, 4-7}. Previously, many studies had compared short and long term outcomes of each surgical approach with conflicting results. It has been shown that the SV approach has quicker rehabilitation due to preserving quadriceps tendon, however, the ultimate long term outcomes were similar between two approaches^{6, 8-11}. The goal of this prospective study was to compare two consecutive groups of patients undergoing primary TKA in term of clinical results. The first group with a medial parapatellar approach and the second group with a subvastus approach.

Patients and methods

This prospective randomized comparative study was conducted in Sulaimani teaching Hospital and Shar teaching Hospital on patients who underwent primary TKA surgery with two different surgical approaches, medial subvastus and medial parapatellar for advanced knee osteoarthritis. Thirty four patients were involved in the current study between the periods October 1st 2018 to September 1st 2019. This study was approved by the

institutional ethics committee of Kurdistan Board for Medical Specialties (KBMS) and written informed consent was obtained from each participant. The established inclusion criteria included osteoarthritis with severe pain and functional disability with documented failure of conservative management. The exclusion criteria comprised patients with revision TKA, previous ipsilateral knee surgery (e.g. patellectomy, osteotomies around knee and

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open meniscus procedure), Varus deformity greater than 20 degrees, fixed flexion deformity more than 25 degrees, age over 80 years, cognitive impairment, body mass index more than 35 kg/m², rheumatoid arthritis, neuromuscular conditions, and ligamentous deficiency that need constrained knee prosthesis. Patients were randomly divided in to two groups, the standard MPP approach was used in 19 patients undergoing primary TKA and medial SV approach was performed in 15 additional patients. All patients underwent primary TKA by two surgeons who had been in practice for over 10 years. A research investigator collected all data prospectively. In order to assess the functional outcome of the knee after TKA, the following measurements were taken just prior to surgery and postoperatively at 2, 6 and 12 weeks. The Knee Society Score¹² (KSS) consisted of knee score (severity of pain, range of motion, flexion contracture and stability of the knee) and function score (functional capacity during walking and climbing stairs with or without walking aid) were used to assess clinical outcome of the knee. Also, Visual analogue scale (VAS) score was used to rate pain¹³. Lastly, patients were tested for returning of quadriceps function by their ability to do

active straight leg raise test (SLRT). All patients received a general or spinal anesthesia, cemented cruciate-substituting design (DePuy Synthes, Zimmer Biomet) were used in all cases without patellar replacement. Midline skin incision centered on patella followed by either medial parapatellar arthrotomy as described by Campbell¹⁴ or medial subvastus arthrotomy as described by Hoffmann¹⁵. An intramedullary guide system on femoral side and an extramedullary guide on the tibial side were used. Proper soft tissue balance checked with trial implants. After confirming knee stability with equal gaps, definitive implants were cemented in position and wound closed in multiple layers without using drain. Postoperative follow up included the same protocol for pain control and early physiotherapy that started 24 hours after operation with passive and active exercises. Data were entered into Microsoft excel program in which data coding and clearance taked place, then transferred to SPSS program version 22 (statistical package of social science), here two approaches were used for statistical analysis: Descriptive approach “for calculation of frequencies, percentages, mean and standard deviation, constructing tables and diagrams”

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Analytical approach “for finding associations between variables by finding P-value using chi square test, t-test, ANOVA

table and fissure exact test”. A p-value equal to and less than 0.05 regarded as statistical significant.

Results

The study included 34 patients randomized to undergo primary total knee arthroplasty with use one of the two techniques. All

patients were available throughout the entire testing period. Preoperative demographic characteristics are presented in Table (1).

Table (1): Demographic characteristics

Demographic characteristics	MPP group	SV group
Age (mean)	67.57	67.4
BMI (mean)	29.36	29.87
Sex	2M/17F	4M/11F
No. of patients	19	15

Knee society score for Knee score were significantly improved at all different follow-up periods (2, 6 and 12 weeks) in comparison to baseline preoperative score in

the same group. Nevertheless, no statistically significant differences observed when comparing both groups together at any time of the follow up periods table (2).

Table (2): knee society score-knee score.

Knee society score-knee score	Comparison of pre-op with post-op scores at 2, 6, 12 week in MPP group	Comparison of pre-op score with post-op score at 2, 6, 12 weeks in SV group	Comparison of score improvement between MPP &SV.
<u>Pre-op</u> Mean Std. deviation	42.74 11.35	32.20 12.45	-----
<u>2 weeks post-op</u> Mean Std. deviation Comparison with pre-op.	64.16 7.13 P=0.001	59.20 6.38 p=0.001	p=0.067
<u>6 weeks post-op</u> Mean Std. deviation Comparison with pre-op.	73.42 7.15 p=0.001	67.60 6.70 p= 0.001	p=0.059

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<u>12 weeks post-op</u> Mean Std. deviation Comparison with pre-op.	80.0 5.84 p=0.001	75.08 5.28 p=0.001	p=0.092
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Knee society score for function was improved significantly with time in the same group when compared to the baseline score. On the other hand, Comparison between both groups revealed no significant differences at any time of follow-up periods, Table (3).

Table (3): knee society score for function.

Knee society score- knee function	Comparison of pre-op with post-op scores at 2, 6, 12 week in MPP group	Comparison of pre-op score with post-op score at 2, 6, 12 weeks in SV group	Comparison of score improvement between MPP &SV.
<u>Pre-op</u> Mean Std.deviation	23.68 15.62	30.33 13.94	-----
<u>2 weeks post-op</u> Mean Std. deviation Comparison with pre-op.	41.05 14.10 p=0.001	48.33 15.43 p=0.001	p=0.788
<u>6 weeks post-op</u> Mean Std. deviation Comparison with pre-op.	64.21 8.37 p=0.001	70.0 11.01 p= 0.001	p=0.836
<u>12 weeks post-op</u> Mean Std. deviation Comparison with pre-op.	75.53 7.61 p=0.001	80.73 8.20 p=0.001	p=0.724

Time to return quadriceps function (TRQF) was assessed by ability of patients to actively raise straight leg (MPP: 4.80±0.83 days vs. SV: 2.90±0.57days, p=0.001). SV group had earlier return of quadriceps function by 1.9 days which was significant statistically. The VAS to rate pain

preoperatively was 8.11 for MPP group and 8.20 for SV group. Pain improved significantly at all different follow-up times when compared to the preoperative rate of pain in the same group (6.05, 4.26, 2.32, 1.47 for MPP group and

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4.47, 4.0, 1.67, 1.07 for SV group at 3rd day, 2, 6 and 12 weeks postoperative respectively). When comparing both groups together, no statistically significant differences found at 2, 6, and 12 weeks. However, differences were significant at postoperative day three of the follow up period, in favor of SV group ($p= 0.001$). Two patients in MPP group had partial patellar tendon avulsion and one patient in SV group had partial injury of patellar tendon. Statistical analysis demonstrated no significant difference between both surgical

Discussion

Subvastus and MPP are the main surgical approaches used for primary TKA with many arguments on which approach results in better functional outcome in last 2 decades. This has stimulated us to conduct a study to compare functional outcome of 2 approaches. One of the measures to evaluate clinical outcome was knee society score which consists of the Knee score and functional score. Comparison of improvement in knee score between both groups displayed slightly better score in favor of SV group, nonetheless, this differences was not significant statistically at any periods of the follow up. Similar observations found in other studies^{10, 16-18} In contrast, meta-analysis of 9 randomized control trial by Peng et al⁶ found better

approaches. One patient in Subvastus group needed manipulation under anesthesia for limited knee flexion which was 83 degrees. Moreover, one patient in medial parapatellar group recorded to have fallen on ground which caused a mild trauma to operated knee at 2 weeks post-operation. In this particular case knee was swollen and the patient was unable to perform SLRT. Later she was treated by opening the joint and repairing avulsion of quadriceps medially at suturing site.

KSS in SV approach at 3 months and 2 years but no differences at 4-6 weeks. Similarly, they found better ROM at 1 week and 1 year, on the other hand, they found better VAS score at 1 week and 6 months follow up in Subvastus group. These decreases in postoperative pain and increases in ROM had resulted in better knee score in their study. In our study we found no differences in pain and ROM at 2, 6 and 12 weeks. Hence, no differences in KSS could be found in our patients. Moreover, we followed patients for 12 weeks only and we need more follow up time to evaluate long term result. The knee function score which assessed overall

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function of the knee demonstrated no statistically significant differences when two groups compared together at any time of follow-up. These findings correlate with the observations of other studies¹⁹⁻²¹, whom failed to show significant differences between two approaches in function score.

In contrast, Teng et al²² in a meta-analysis of 9 studies showed that SV provided better function score at 1 month follow up. They correlate this finding via reducing the skin incision, preserving the vastus medialis insertion, and avoiding patellar eversion in Subvastus group. In our study, vastus medialis preservation resulted in less pain in early postoperative days and quicker return of quadriceps function. However differences in pain were temporary and disappeared within 2 weeks and have not affected the knee function. Returning quadriceps function delayed in MPP group by 1.9 days, at 2 weeks follow up, all patients were able to do active straight leg raise test in both groups. Hence, it was not affected knee function. Time to return quadriceps function (TRQF) performed by ability of patients to do active straight leg raise test (SLRT). We found shorter time to return quadriceps function in SV group by 1.9 days (MPP: 4.80 ± 0.83 vs. SV: 2.90 ± 0.57 , $p = 0.001$). This observation shows a well relationship with other studies^{10,17,18, 23},

whom showed earlier return of quadriceps function that were significant statistically. This earlier return of SLR explained by preservation of vastus medialis as a part of quadriceps mechanism or may be related to pain that limit quadriceps function, because patients in MPP have more pain than SV at 3rd postoperative day as shown by VAS. Despite these differences, earlier SLR did not result in significantly better outcomes on the KSS because pain was less only at 3rd postoperative day of the follow up and we took KSS at 2, 6 and 12 weeks but not at 3rd postoperative day. Subvastus group had less pain at 3rd postoperative day which was significant statistically. No statistically significant differences found between two groups at 2, 6 and 12 weeks follow-up periods. Similar results founded in other studies^{17, 24}. Similarly, Yuan et al²⁵ in a meta-analysis found SV approach to have less pain at 1st postoperative day with no significant differences after that (3rd day, 4 and 8 weeks). Our result may be due to the fact that less cut of extensor mechanism in SV approach may lead to less pain early postoperatively. Thereafter, no differences in pain can be found when soft tissue has healed. In contrast, no differences in pain were found between two groups according to some other studies^{20, 22- 23}. Their results

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could be related to increased intake of analgesia. Two patients in MPP group (10.5%) had partial avulsion of patellar tendon at tibial tuberosity which is required repair in 1 patient using suture anchor. One patient in SV group (6.66%) had partial patellar tendon injury to the substance of distal half of patellar tendon by the saw during preparing tibia, which was mild and no need repair. Avulsion of patellar tendon in MPP group can be explained by that, when we are retracting quadriceps mechanism laterally, stress of retraction will be on both patellar tendon insertions inferiorly and vastus medialis insertion medially in SV group, on the other hand, in MPP, stress of retraction will be only on patellar tendon insertion as we have divided

Conclusions

Subvastus group had earlier return of quadriceps function but it was not affecting functional outcome. Patients in SV group had less pain in 3rd postoperative day but identical in other occasions. In our study, we found no evidence to support using one surgical approach over the other in term of

Conflict of interests

The authors recorded no conflict of interests.

vastus medialis. This greater retraction put stress on patellar tendon insertion in MPP that may be responsible for increased risk of avulsion. Injury to substance of patellar tendon by electrical saw was thought to be due to inadequate surgical exposure in SV group. Limitations in our study include small sample size in each treatment group. In addition most patients were female. In term of preoperative variables, groups already differ in many parameters and therefore postoperative results may be affected. Furthermore, two surgeons were performing operations. Finally short follow up time may affect our result and longer follow up time may be required to give more information about outcome of the 2 surgical approaches.

clinical outcome. Both surgical approaches yield good clinical results with proper surgical techniques. With respect to our result, we think that, Overall function of the knee is determined by well balanced, properly aligned and stable implants rather than type of surgical approaches.

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