Mini-midvastus versus medial parapatellar approach in total knee arthroplasty: difference in patient-reported outcomes measured with the Forgotten Joint Score

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Research article

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Abstract

Background: Low knee awareness after minimally invasive total knee arthroplasty (TKA) has become the ultimate target of a natural feeling knee that meet patient expectations. The objective of this research was to compare the clinical outcomes of TKA via the mini-midvastus (MMV) approach or medial parapatellar (MPP) approach and expound which approach can acquire better quality of life after surgery.

Methods: From January 2015 to December 2016, a retrospective cohort study was conducted in 330 patients who underwent TKA via mini-midvastus (MMV) approach were included in MMV group. In this period, we selected 330 patients who underwent TKA via medial parapatellar (MPP) approach (MPP group) for comparison. Clinical results were assessed with visual analogue score for pain (VAS), range of motion (ROM), Knee Society Score (KSS). The forgotten joint score (FJS) was used to analyze the ability to forget the joint.

Results: There were significant differences with regard to VAS, ROM and KSS score until six months after surgery between the MMV and MPP group ($p < 0.05$), but the differences were not found at 12 months, 24 months and 36 months after surgery. However, there were significant differences with regard to FJS score between the groups during the follow up time ($p < 0.05$).

Conclusion: When forgetting the artificial joint after TKA is the ultimate target, better quality of life can be acquired by performing TKA via the MMV approach. In addition, compared with MPP approach, the MMV approach could offer less pain and faster recovery.

Introduction

Total knee arthroplasty (TKA) is the best choice for the treatment of end-stage osteoarthritis, which can remarkably restore knee function, relieve pain and improve quality of life (QOL), with 95% of patients have achieved good prosthesis survival rate [1,2]. There are several surgical approaches for primary TKA, but it is still controversial which approach can achieve the best postoperative results.

Although the medial parapatellar (MPP) approach furnishes well surgical vision [3], it injures the quadriceps tendon and may cause weakened extensor function, so the functional outcome is still unsatisfactory [4]. On the contrary, the mini-midvastus (MMV) approach not only reduces the injury of quadriceps, but also improves the postoperative outcomes [5]. Simultaneously, the MMV approach has also been popularized, and compared with the TKA via the standard approach, it has achieved earlier postoperative flexion and higher Knee Society scores (KSS) [6, 7, 8].

The traditional evaluation system often focuses on the objective evaluation of surgeons when evaluating the postoperative results of TKA. However, the concerns of patients after TKA are not always consistent with the surgeon's assessment [9,10]. Therefore, there is a growing tendency to use patient-reported outcomes (PRO) tools to evaluate patient-centered outcomes [11].

The “Forgotten Joint Score (FJS)” is such a PRO tool designed to assess patients' ability to forget joint awareness and artificial joints [12]. The ability of forgetting artificial joint has been seen as the ultimate goal of joint replacement and can well reflect patient satisfaction [12,13]. So far, few studies have evaluated the change of joint awareness after TKA via different approaches. It is important to clearly understand the actual changes in joint awareness after TKA via different approaches.

The objective of this research was to conduct a retrospective cohort study to investigate the functional outcomes of TKA via MMV or MPP approach using FJS score, and expound which approach can acquire better QOL after surgery.

Materials And Methods

Approved by the Institutional Review Committee, we performed a retrospective cohort study from January 2015 to December 2016. 330 patients who underwent primary TKA via MMV approach were included in MMV group. To improve the reliability of this research, matching in a 1:1 ratio in regard to age, gender, body mass index (BMI) and follow-up time, we selected 330 patients who underwent primary TKA via MPP approach (MPP group) for comparison.

Our eligibility criteria were (1) unilateral knee osteoarthritis; (2) a primary cruciate-retaining TKA; (3) flexion-contracture deformity < 15°; (4) varus deformity < 20°. Patients who had knee instability, valgus or stiff knee were excluded.

Surgical procedures

All patients received the same anesthesia method and all surgeries were accomplished in our center by the same senior orthopaedic surgeon. In both groups, as described by Liu H et al [18], all surgeries were performed through the midline skin incision. Using standard surgical instruments, extramedullary alignment for the tibial component and intramedullary alignment for the femoral component. In MMV group, dissecting the vastus medialis obliquus at a distance of no more than 3cm from the superior pole of the patella. In MPP group, superiorly extension into quadriceps tendon at a distance of no more than 3cm. The patella was subluxated to the lateral without eversion, and the soft tissue balance was achieved in a standard method. All patients used the same knee prosthesis (cruciate-retaining, LINK, Germany, Gemini MK II). After the total knee prosthesis was implanted, the wound was closed in layers.

Postoperative Treatment

All patients received the same postoperative pain control and rehabilitation programs [14]. After surgery, the patients were asked to walk with load-bearing as soon as possible, functional exercise and physical therapy were best started on the first day, active and passive extension and flexion exercises of the knee were performed at least 3 months.

Outcome measures

Assessments were performed by a senior orthopaedic surgeon who did not attend the treatments. Parameters including operation time, tourniquet time, skin incision length and time to straight leg raise for all patients were recorded after surgery.

The visual analogue score for pain (VAS), range of motion (ROM) and Knee Society Scores (KSS) [15] were assessed. For comparing the postoperative status of the patients who received TKA via the two differ approaches, we used the forgotten joint score (FJS; a 12-item questionnaire with a maximum of 100) to analyze the ability to forget the joint [12]. Higher scores represented better results. All data were assessed at 1 month, 6 months, 12 months, 24 months, 36 months after surgery.

Standard anteroposterior and lateral radiographs were used for all preoperative and postoperative radiologic evaluation. Component and overall alignment of neutral ± 3° was rated as correct.

Statistical Analysis

Normality of continuous variables were checked with Shapiro-Wilks test. If the data were normally distributed, the variables were checked with student t-test; instead, a non-parametric test was selected. Categorical variables were checked with Fisher's exact test or chi-square test. The correlation between the FJS score and surgery approach (MMV vs. MPP), sex, gender and BMI were analyzed by multiple linear regression. The data were analyzed with SPSS 23.0 (Chicago, Illinois, USA). $p < 0.05$ was considered statistically significant.

Results

All patients were followed up for at least 3 years. No significant differences were found for demographic parameters between the MMV group and MPP group (Table 1). We found dramatic differences in skin incision length between the two groups (Table 2).

The VAS, ROM and KSS score in MMV group were better than those in MPP group within 6 months, but no significant differences were found at 12 months, 24 months and 36 months after surgery (Table 3,4). However, during follow-up, the FJS score in MMV group was higher than that in MPP group (Table 5). The multiple linear regression showed that higher FJS score was correlated with the MMV approach (Table 6).

According to the radiographic evaluation, there was no improper implant position in the two groups. Until the last follow-up, no significant postoperative complications were found in all patients.

Discussion

The most important finding in our research is that when forgetting the artificial joint after TKA is the ultimate target, better QOL can be acquired by performing TKA via MMV approach. In addition, compared with MPP approach, the MMV approach could offer less pain and faster recovery.

Several authors attempted to compare MMV approach and MPP approach with conventional scores such as the VAS, HSS (Hospital for Special Surgery) score and KSS, and found only differences in short-term outcomes, but this early clinical advantage seemed to disappear over time [5-7]. Some authors even found no differences in clinical outcomes during follow-up period [16-19]. A more responsive joint specific score, such as FJS, can provide a clearer assessment of patients' postoperative satisfaction and it observed differences for the first time between the two approaches during the follow-up for at least 3 years. This shows that FJS is an appropriate tool to evaluate patients' satisfaction, which can reflect patients' satisfaction well not only in the early postoperative period but also in the medium-term postoperative period when KSS can not detect the differences.

The FJS is a highly evaluated scoring method in last few years, which is often used to measure the ability of patients to forget joint awareness or joint arthroplasty [12]. Even if the patient's knee function is improved and no pain is felt, the FJS score will be lower if the patient is “aware of ” the presence of artificial joints in daily life. As a result, minor complaints that are not identified by specific issues (such as “Can you do sports?”) are called “aware” joints, which may more sensitively reflect postoperative patient satisfaction and reduce the ceiling effect [12,20].

Hiyama Y et al. found that quadriceps strength and pain were the main factors affecting joint awareness after TKA [21]. Quadriceps weakness is the main obstacle to patients' functional recovery after TKA, and pain is usually one of the main criteria for success or failure after TKA. Quadriceps weakness and pain are closely related to disability [22], patients' satisfaction [23] and QOL [24,25].

One of the greatest advantages of TKA via MMV approach is that it retains the extensor mechanism as much as possible during the operation. Therefore, it can reduce the perioperative pain and help the patients recover quickly. However, it has been pointed out that the standard MPP approach may decreased the strength of quadriceps measured by isokinetic as much as 30.7% in two years after TKA, and excessive damage to the extensor mechanism may be permanent [26]. This was the main reason why MMV approach enabled patients to achieve faster functional recovery and higher satisfaction [8, 27]. Our study add to these findings by investigating the effects of quadriceps weakness and pain on joint awareness after TKA.

In our study, no significant correlation was found in regard to age, gender and BMI with the FJS. However, the MMV approach were positively correlated with the good outcome of FJS. This demonstrated that the FJS is optimally adapted to compensate for age, gender and obesity covariates [28].

Some studies indicated that the performance of postoperative straight leg raise reflects the recovery of quadriceps muscle strength [29, 30]. Schroer and Nestor measured the pre and postoperative muscle strengths of their patients who underwent TKA via MMV approach and reported that patients had gained their preoperative quadriceps muscle strength in a short period and even exceeded those levels by 30% in 3 to 6 months [31,32]. The similar results were found in our research. This difference in quadriceps muscle strength is essential for patients to resume daily activities. As reported in previous studies [33, 34], we also found that MMV approach can shorten the length of skin incision compared with traditional MPP

approach. In addition, shorter skin incision could produce better aesthetic effect, which could improve patients' satisfaction.

It has been pointed out that during the operation, complex manipulation and poor exposure would lead to the malalignment of the components [31, 35], which might lead to the failure of TKA [36]. However, in our study, no significant postoperative complications were found in all patients until the last follow-up. Consequently, the MMV approach which protected the extensor mechanism might be a good choice to perform TKA.

The limitation is that this research was a retrospective mid-term follow-up design, which has its potential weaknesses. A prospective and long term research should be established to confirm these findings.

Conclusion

When forgetting the artificial joint after TKA is the ultimate target, better quality of life can be acquired by performing TKA via the MMV approach. In addition, compared with MPP approach, the MMV approach could offer less pain and faster recovery.

Abbreviations

TKA: total knee arthroplasty; MMV, mini-midvastus; MPP, medial parapatellar; PRO, patient-reported outcome; QOL, quality of life; ROM: range of motion; KSS: knee society score; FJS: forgotten joint score; BMI: body mass index.

Declarations

Ethics approval

This study was approved by the Third Hospital of Hebei Medical University and followed the Declaration of Helsinki. Informed consent was received from all patients.

Consent for publication

Not applicable.

Availability of data and materials

The detailed data and materials of this study were available from the corresponding author through emails on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Not applicable.

Authors' contributions

FW designed the study. WL, JHN, and YKD performed the experimental work. GMY, ML, WL evaluated the data. WL wrote the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1 Patients demographics between the two groups

Demographics	MMV Group	MPP Group	*p*-Value
Total patients	330	330	-
Age (years)	65.2 ± 7.7	66 ± 8.1	0.08
BMI (kg/m^2)	26.2 ± 3.9	25.6 ± 3.7	0.46
Gender			0.58
Male	82 (24.8 %)	76 (23 %)	-
Female	248 (75.2 %)	254 (77 %)	-
Follow-up time	3.5 ± 0.4	3.6 ± 0.3	0.51

MMV, mini-midvastus; MPP, medial parapatellar; BMI, body mass index; mean±standard deviation.

Table 2 Postoperative clinical results between the two groups

Results	MMV Group	MPP Group	*p*-Value
Operation time (min)	83.1 ± 8.4	81.8 ± 7.2	0.382
Tourniquet time (min)	41.1 ± 4.2	39.2 ± 3.4	0.421
skin incision length (cm)	9.4 ± 3.2	12.8 ± 2.6	0.032
straight leg raise (day)	1.3 ± 0.7	2.8 ± 0.6	0.026

MMV, mini-midvastus; MPP, medial parapatellar; mean±standard deviation.

Table 3 The VAS, ROM between the two groups

	MMV Group	MPP Group	*p*-Value
VAS			
Preop	5.1 ± 0.7	5.3 ± 0.8	0.421
Postop 1 month	3.4 ± 0.7	4.5 ± 1.1	0.032
Postop 6 months	3.1 ± 0.8	4.1 ± 0.9	0.043
Postop 12 months	2.8 ± 1.2	2.9 ± 1.1	0.072
Postop 24 months	2.3 ± 0.8	2.4 ± 0.7	0.771
Postop 36 months	2.1 ± .7	2.2 ± 1.1	0.881
ROM			
preop	97.8 ± 8.9	97.1 ± 6.7	0.615
Postop 1 month	103.9 ± 7.4	98.6 ± 7.3	0.034
Postop 6 months	105.1 ± 5.4	100.8 ± 7.7	0.041
Postop 12 months	106.3 ± 7.8	104.1 ± 8.2	0.064
Postop 24 months	109.9 ± 6.8	108.6 ± 7.3	0.525
Postop 36 months	112.9 ± 7.8	110.2 ± 7.2	0.846

MMV, mini-midvastus; MPP, medial parapatellar; VAS, visual analogue score for pain; ROM, range of motion; Preop, Preoperation; Postop, Postoperation; mean±standard deviation.

Table 4 The KSS score between the two groups

	MMV Group	MPP Group	*p*-Value
Clinical score			
preop	36.5 ± 4.8	36.7 ± 5.4	0.681
Postop 1 month	71.6 ± 5.7	68.2 ± 6.5	0.032
Postop 6 months	76.3± 4.9	73.6 ± 6.2	0.037
Postop 12 months	81.6 ± 5.9	80.4 ± 5.7	0.087
Postop 24 months	89.6 ± 3.2	88.4 ± 3.9	0.661
Postop 36 months	93.3 ± 4.1	92.2 ± 4.8	0.783
Functional score			
preop	38.4 ± 3.9	37.2 ± 5.4	0.783
Postop 1 month	65.1 ± 5.9	61.2 ± 6.1	0.022
Postop 6 months	71.4 ± 4.8	67.1 ± 5.2	0.033
Postop 12 months	74.1 ± 3.1	73.4 ± 4.7	0.061
Postop 24 months	82.2 ± 3.6	81.6 ± 3.3	0.511
Postop 36 months	85.1 ± 3.7	84.1 ± 3.2	0.685

MMV, mini-midvastus; MPP, medial parapatellar; KSS, Knee Society Score; Preop, Preoperation; Postop, Postoperation; mean±standard deviation.

Table 5 The FJS score between the two groups

	MMV Group	MPP Group	*p*-Value
Postop 1 month	57.6 ± 6.9	50.4 ± 5.4	0.027
Postop 6 months	62.4 ± 7.1	55.6 ± 5.5	0.022
Postop 12 months	71.6 ± 5.1	65.3 ± 4.8	0.041
Postop 24 months	78.6 ± 6.3	70.4 ± 6.1	0.037
Postop 36 months	81.1 ± 4.1	78.2 ± 4.4	0.046

MMV, mini-midvastus; MPP, medial parapatellar; FJS, Forgotten Joint Score; Preop, Preoperation; Postop, Postoperation; mean±standard deviation.

Table 6. Multiple linear regression analysis

	Coefficient	95 % CI	*p*-value
MMV approach	42.3	28.4 to 72.5	0.037
MPP approach	32.5	20.4 to 53.6	0.463
Age	0.903	0.128 to 1.431	0.537
BMI	-0.701	-1.814 to -0.831	0.974
Gender	0.857	-1.934 to 4.547	0.541

MMV, mini-midvastus; MPP, medial parapatellar; BMI, body mass index; CI, confidence interval.