Comparative Analysis of Functional Outcome of Conventional Midline Parapatellar to Minimally Invasive Subvastus Approach in Total Knee Replacement

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Abstract

Background: Minimally invasive subvastus total knee replacement (TKR) has gained popularity over the past few years. Early results of this minimal invasive TKR have shown no clear advantage over conventional longer midline parapatellar approach in relation to the functional outcome and recovery. Hence we analyzed and compared the functional outcome of conventional midline longer parapatellar approach with minimal invasive subvastus approach in TKR surgery.

Material and methods: All cases operated for TKR by two approach minimally invasive subvastus approach or conventional midline parapatellar approach were compared for length of incision, amount of blood loss (drain in first 24-hrs), tourniquet time, visual analogue pain score, range of motion, straight leg raising (SLR), length of hospital stay, knee functional & objective society scores.

Results: 40 patients with mean age 65.3 years (range 59 to 72 years) of osteoarthritis knee who underwent TKR by conventional midline parapatellar approach or minimal invasive subvastus approach were included in the study. 27 were female and 13 were male. The mean incision length, mean tourniquet time and mean total blood loss in conventional midline parapatellar approach group was 18.85 cm (range 17 to 19 cm), 65.5 min (range 60 to 70 min) and 347.6 ml (range 240 to 460 ml) respectively. The mean incision length, mean tourniquet time and mean total blood loss in minimal invasive subvastus approach group was 10.30 cm (range 9 to 11 cm), 85 min (range 80 to 90 ml) and 293.35 ml (range 175 to 409 ml). The mean length of hospital stay was same in both the groups 6.8 days (range 5 to 9).

Conclusion: TKR by conventional midline parapatellar approach demonstrated better functional outcome, reduced operative time, reduced tissue trauma (lesser pressure by retractors), shorter learning curve, easier availability of implant and instrument sets and precise implant placement due to a good visualization of the surgical field in comparison to minimal invasive subvastus approach. Hence conventional midline parapatellar approach method which is tried and time tested, still holds important corner stone in TKR surgery and should be given due consideration.

Keywords: TKR, Midline parapatellar approach, Minimally invasive subvastus approach

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Introduction

Joint replacement (arthroplasty) is a well-established definitive treatment option for end stage arthritis, which is a chronic degenerative disorder of multi-factorial aetiology and is associated by the loss of articular cartilage, hypertrophy of bone at the margins, subchondral sclerosis, and biochemical and morphological alterations at the synovial

membrane as well as the joint capsule [1-5]. With huge population, more than 1.2 billion people in Indian had significant knee arthritis, requiring replacement. Replacement of such a large population will create enormous economic pressures on the healthcare system in terms of longer hospital stay, post-operative visits and rehabilitation [6,7].

Minimal invasive total knee replacement (TKR), done with a smaller skin incision and a smaller arthrotomy can decrease morbidity, hospital stay and promote early rehabilitation but at the cost of limited exposure and increased surgical time [8-10]. Whereas conventional midline longer surgical incision provides better visualization of the surgical field, reduced tissue trauma due to avoidance of excessive tissue compression by retractors, reduced surgical time and shorter learning curve for surgeons, but at cost of blood loss and morbidity [11-12]. There are no clear common guidelines dictating the length of incision needed for primary TKR, where some are in favour of minimal invasive TKR while others promoting conventional midline parapatellar approach. Hence, we conducted this study to compare the functional outcome of conventional midline long parapatellar approach to minimal invasive subvastus approach in total knee replacement.

Material and method

40 patients of primary osteoarthritis (OA) of knee operated for total knee replacement at our institute were included in the study. The study protocol was approved by the institutional ethical review committee and was conducted as per the good clinical practice guidelines and the principles laid down in the Declaration of Helsinki. Well written informed consent was obtained prior to the study from all the participants.

All patients with either sex and any age of primary osteoarthritis knee undergoing total knee replacement were included in the study. No exclusions based on body mass index (BMI) or pre-operative deformities were done. All enrolled patients were randomized to either surgery by conventional midline parapatellar approach TKR (n=20) or minimally invasive subvastus TKR (n=20) in a ratio of 1:1. All procedures were performed by surgeons with similar level of training and expertise. Age, sex, weight, BMI, height, preoperative deformity, range of motion, preoperative knee functional and objective score were recorded.

All patients were operated under spinal or epidural anaesthesia in supine position under tourniquet.

a. In the conventional midline parapatellar approach group – Anterior midline incision from tibial tuberosity to tendinous portion of quadriceps was made and median para-patellar approach was used. Patella was everted with knee flexion to expose knee.
b. In the minimally invasive subvastus group – Anterior midline incision from 2 cm distal to joint line from the tibial tuberosity to 2 cm above the superior pole of patella was made and sub-vastus approach was used by developing a medial sub-fascial flap by dividing the exposed vastus medialis obliqus (VMO) muscle. The patella was displaced laterally but was not everted (subluxation).

For both groups, femoral cuts were performed using intramedullary guiding system via anterior referencing technique and placing cutting jigs with femoral component in 5° valgus as referenced to the femoral intramedullary axis in the coronal plane and at 180° as referenced to the femoral intramedullary axis in the lateral plane. An extra-medullary guide was used for placement of the tibial resection guide to resect the tibia at 90° to its anatomical axis in the coronal plane, and with a 3° down slope in the lateral plane. All femoral and tibial components were fixed in place using cement after confirming the size by using trials and checking for equal flexion and extension gap. The osteophytes around the patella were nibbled and the inferior surface of patella was refreshed and patellar tracking was tested.

Post operatively a negative pressure drain was fixed for 48 hours. Deep vein thrombosis prophylaxis was given to all patients in form of low molecular weight heparin (clexane 0.4/0.6 post op after 3 hours and 6 hours after which 14 days of Xeralto (rivaroxaban) and 3 months

of ecosprin 75 mg). Mobilization was started from day two with full weight bearing with a knee immobilizer for support and a walker for balance. Active and passive and assisted ROM exercises were started simultaneously. No continuous passive motion machine was used. Post-operative pain was managed by epidural spinal catheter (tramadol /buprenorphine/fentanyl) kept for 48 hours post operatively.

Postoperatively, patients in both the groups were compared for length of incision, amount of blood loss (drain in first 24-hrs), tourniquet time, visual analogue pain score, range of motion, straight leg raising (SLR), length of hospital stay, and knee functional and objective society scores. Statistical analysis was done using windows-based program SPSS (Statistical Package for the Social Sciences) version 17. The age and other measurements (blood loss, surgery duration and incision length) were compared between the two groups using independent sample t-test, whereas the scores for the HSS subscales and total scores were compared between the two groups using Mann-Whitney 'U' test (non-parametric). Discrete data for the patients in categories of HSS subscales are analyzed using chi-square test. All analyses were done using two-sided tests at alpha 0.05 (95% confidence level).

Results

40 patients of OA knee with mean age of 65.3 years (range 59 to 72 years) who underwent TKR were included in the study. 27 were female and 13 were male. 20 cases of TKR were included in conventional midline parapatellar approach group and 20 cases in minimal invasive subvastus group.

The mean incision length, mean tourniquet time and mean total blood loss in conventional midline parapatellar approach group was 18.85 cm (range 17 to 19 cm), 65.5 min (range 60 to 70 min) and 347.6 ml (range 240 to 460 ml) respectively. The mean incision length, mean tourniquet time and mean total blood loss in minimal invasive subvastus group was 10.30 cm (range 9 to 11 cm), 85 min (range 80 to 90 ml) and 293.35 ml (range 175 to 409 ml). The mean length of hospital stay was same in both the groups i.e. 6.8 days (range 5 to 9).

Active straight leg raise was achieved significantly quicker in the conventional midline parapatellar approach group as compared to the minimally invasive subvastus group due to greater confidence in the implant placement. The post-operative pain on day one was lower in minimally invasive subvastus group as compared to the conventional midline parapatellar approach group, but the amount of narcotics consumed in the first 72 hours was same in both the groups. Furthermore, on the third post-operative day the flexion was better in the conventional midline parapatellar approach group as compared to the minimally invasive subvastus group. Conventional midline parapatellar approach group patients had a better ROM at 6 months follow up also. Since range of motion was better in conventional midline parapatellar approach group, the KSS score was also higher in this conventional midline parapatellar approach group as compared to minimally invasive subvastus group ($p=0.0618$). No major complications were noted in either of the groups.

Discussion

Various surgical approaches are used for total knee arthroplasty ranging from midline parapatellar, midvastus, subvastus to quadriceps sniff etc. Among these midline parapatellar and subvastus approach are the two most commonly used surgical approaches [7-14].

First described by Von Langenbeck in 1879, conventional midline parapatellar approach is standard approach in majority of knee joint replacement, with advantage of good joint exposure but at cost of impairing the extensor mechanism of knee joint, interfering patellar vascularity, patellofemoral instability and maltracking [15]. Subvastus (quadriceps sparing) approach introduced by Hoffman in 1991, is less invasive approach, provides better postoperative knee range of movements and less impairment of patellar vascularity but it is a technically demanding [16].

The available literature shows no clear advantage of short incision (minimal invasive subvastus approach) over longer incision (conventional midline parapatellar approach), hence we decided to analyze and compare the functional outcome of long incision total knee replacement (conventional midline parapatellar approach) to short incision total knee replacement (minimal invasive subvastus approach) in 40 total knee replacement patients with mean age of 65.3 years and found that subvastus approach had shorter mean incision length and lesser mean blood loss but higher mean tourniquet time as compared to the conventional midline parapatellar approach. In our study the pain score was higher initially in the conventional midline parapatellar group, but in the follow-up period the pain score was same in both the groups. Roysam et al, Dutka et al and Bridgman et al also found similar results as ours [17-19], but Weinhardt et al, Van Hemert et al and Teng et al did not found such results [20-22]. There was no significant difference between the complications in both the groups, which was in accordance with other studies [17-22].

The mean hospital stay in both the groups was almost the same in our series but Tenget al and Bourke et al found shorter hospital stay in subvastus group due to reduced post-operative pain and early mobilization due to preservation of quadriceps musculature [22,23]. In our limited 40 patient study group, conventional midline parapatellar approach total knee replacement provided a better functional outcome as compared to a minimally invasive subvastus approach.

Minimal incision subvastus total knee replacement approach has same skin incision as of conventional parapatellar approach, but is smaller in size and it approaches the knee joint with less soft tissue dissection as joint is exposed via medial to vastus medialis muscle thus sparing quadriceps and without patellar eversion. The limited visibility as seen in subvastus approach, can lead to mal-alignment of the components and hence all these beneficial effects would be underweighted if the minimal subvastus approach resulted in implant mal-positioning. On the other hand, the conventional midline parapatellar approach used for more than 50 years provide excellent visibility required for placement of components in proper position, but at the cost of disruption of the quadriceps mechanism, eversion of the patella, dislocation of tibio-femoral joint and interruption of suprapatellar pouch. But all the complications are within the acceptable range by this conventional approach and the approach is time tested with excellent results and 10-year survival of more than 90% [24,25]. Out study is limited by lesser number of patients and lesser follow-up.

Conclusion

Our study showed that total knee replacement by conventional midline parapatellar approach showed better functional outcome, reduced operative time, reduced tissue trauma (lesser pressure by retractors), shorter learning curve, easier availability of implant and instrument sets and precise implant placement due to a good visualization of the surgical field in comparison to minimal invasive subvastus approach, hence conventional parapatellar approach method which is tried and time tested, still holds important corner stone in knee replacement surgery and should always be given due consideration.

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