Retraction: “Comparison of the Mini-Midvastus With the Mini-Medial Parapatellar Approach in Primary TKA”

This article has been retracted at the request of the authors.

We write to retract the article, “Comparison of the Mini-Midvastus With the Mini-Medial Parapatellar Approach in Primary TKA,” (volume 33, number 10, pp. 723-730, doi: 10.3928/01477447-20100826-04) published in the October 2010 issue of Orthopedics. Although the majority of clinical data were accurate for the patients undergoing the 2 minimally invasive procedures in our study, not all patients received the Genesis II prosthesis, as reported in the article; some received the LPS-Flex prosthesis. Total knee arthroplasties through different minimally invasive approaches had been prospectively studied by a research team in our department, which included Junying Sun, MD. Total knee arthroplasties using the Genesis II knee prosthesis in this series were mainly performed by Dr Sun. However, all patients were prospectively followed by the co-authors. We submitted our article without communication with Dr Sun, which resulted in the errors reported in the article. Considering these inaccurate data, we withdraw our article from the literature.

Xi-gong Li, PhD, MD; Tian-si Tang, MD; Zhong-lai Qian, PhD, MD; Li-xin Huang, PhD, MD; Wen-ming Pan, PhD, MD; Ruo-fu Zhu, PhD, MD
First Affiliated Hospital of Suzhou University
Suzhou, China

doi: 10.3928/01477447-20101221-01
RETRACTED: Comparison of the Mini-Midvastus With the Mini-Medial Parapatellar Approach in Primary TKA

XI-GONG LI, PhD, MD; TIAN-SI TANG, MD; ZHONG-LAI QIAN, PhD, MD; LI-XIN HUANG, PhD, MD; WEN-MING PAN, PhD, MD; RUO-FU ZHU, PhD, MD

abstract

Full article available online at OrthoSuperSite.com/view.aspx?rID=70287

A prospective randomized study was performed to compare the clinical and radiological results of primary total knee arthroplasties (TKAs) using a mini-midvastus approach or a mini-medial parapatellar approach in 134 patients. The mini-midvastus approach was used on 68 patients (group A) and the mini-medial parapatellar approach on 66 patients (group B). All knees were implanted with the same posterior-stabilized prosthesis by the same surgeon (T.-S.T.) with the same set of downsized instruments. Mean follow-up in both groups was 30.5 months (range, 24-48 months). Patients in group A achieved an active straight-leg raise and 90° of flexion significantly earlier (P<.017 and P<.025, respectively). However, no significant difference was detected between the groups with respect to range of movement and Knee Society scores at all the postoperative visits and at final follow-up (all, P>.05). In contrast, the tourniquet time was significantly longer in group A (P=.015), with a higher incidence of medialized tibial component (P=.031). We believe the early clinical results are similar between the mini-midvastus and mini-medial parapatellar approach. The mini-medial parapatellar approach is easier to initially apply and provides better visualization for TKA.

---

Drs Li, Tang, Qian, Huang, Pan, and Zhu are from the Department of Orthopedic Surgery, First Affiliated Hospital of Suzhou University, Suzhou, China.

Drs Li, Tang, Qian, Huang, and Pan, and Zhu have no relevant financial relationships to disclose.

The study was approved by our institutional review board and all patients gave informed consent.

Correspondence should be addressed to: Tian-si Tang, MD, Department of Orthopedic Surgery, First Affiliated Hospital of Suzhou University, Shizi St 188, Suzhou, Jiangsu Province, China, 215006 (tiansihang@yahoo.cn).

doi: 10.3928/01477447-20100826-04

723
Total knee arthroplasty (TKA) has been a successful treatment for end-stage arthritis of the knee. However, traditional approaches have resulted in postoperative pain and lengthy rehabilitation periods, which may contribute to patient dissatisfaction or knee stiffness.

Reports of unicompartmental knee arthroplasty through a smaller arthrotomy with no patellar eversion have achieved better early results and a faster recovery. The success of minimally invasive surgery for unicompartmental knee arthroplasty has sparked interest in applying a similar method to TKA.

Minimally-invasive TKA technique can be initially accomplished through miniature versions of traditional approaches, including mini-medial parapatellar, mini-midvastus, and mini-subvastus approaches. All these approaches can be viewed as the transition from traditional exposures to quadriceps-sparing techniques.

Scuderi et al and Tenholder et al modified the standard medial parapatellar approach, developing a minimally-invasive medial parapatellar approach and found their patients required less transfusion and achieved better flexion. Alternatively, Haas et al and Laskin et al performed minimally-invasive TKA using a mini-midvastus approach. These studies showed that the mini-midvastus TKA resulted in increased range of movement and a higher Knee Society score than the standard procedure.

To our knowledge, no one compared clinical and radiological parameters associated with the 2 minimally invasive approaches in primary TKA, which were more familiar to surgeons and easier to initially apply.

The purpose of this study was to use a prospective randomized controlled design to determine the 2- to 4-year clinical and radiological results of primary TKA, performed with either a mini-midvastus or a mini-medial parapatellar approach.

MATERIALS AND METHODS

Between January 2006 and November 2007, 149 patients with osteoarthritis of the knee undergoing primary unilateral TKA were included in the study (Figure 1). The criteria for inclusion were varus or valgus deformity, flexion deformity, range of movement, and body mass index (BMI) <30.

Exclusion criteria were rheumatoid arthritis, a previously operated on joint, compromise of soft tissue envelope, and knees requiring a complex reconstruction with a bone graft and/or a prosthetic augmentation. The median duration of follow-up was 30.5 months (range, 24 to 48 months). All operations were performed by the senior author (T.-S.T.) who had performed 30 TKAs using a mini-midvastus approach and 25 using a mini-medial parapatellar approach prior to this study.

A mini-midvastus surgical approach as described by Laskin et al was used in patients from group A. A straight skin incision was made, which began in the tibial tubercle level, crossed the medial one-third of the patella, and extended for 2 cm proximal to the superior pole of the patella. The median parapatellar retinaculum was then incised from the tibial tubercle level and extended around the medial border of the patella. The suprapatellar pouch was not opened.

For the control group, a mini-medial parapatellar approach as described by...
Scuderi et al ⁹ and Tenholder et al ¹⁰ was used. The surgical approach consisted of a straight anterior midline skin incision extending from the superior aspect of the tibial tubercle to the superior border of the patella. A limited medial parapatellar arthroscopy was used with 2 cm division of the quadriceps tendon above the superior pole of the patella, and extended around the medial border of the patella and distally to the tibial tubercle level.

In both groups, using differential force, the limited arthroscopy could be moved as a mobile window from medial to lateral and from superior to inferior as necessary, and the patella was subluxated laterally but not everted. Intraoperatively, soft tissue balancing was done in a standard manner, and the bone resection was performed using the Genesis II MIS instruments (Genesis II, Smith and Nephew, Memphis, Tennessee), with intramedullary referencing on the femoral side and extramedullary on the tibial side. All patients in each group received the same cemented posterior-stabilized prosthesis (Genesis II), and the patella was not replaced. Instead, the patellar aponeurosis at a distance of 5 mm all around the patella was released with electrocautery, and the patellofemoral osteophytes were removed. Before layered closure, intra-operative parietal analgesia with multimodal drugs was administered.²⁶

All patients received epidural anesthesia and followed an identical postoperative pain protocol. This included a patient-controlled epidural analgesia for 48 hours and oral medications. A drain remained in situ for 24 hours. Low-molecular-weight heparin sodium was used for prophylaxis against deep vein thrombosis beginning on the day of surgery and continuing during the inpatient stay. Continuous passive motion was started immediately in the recovery room. Twice-daily physical therapy assisted by 2 physical therapists began 1 day postoperatively. All patients were discharged on the seventh postoperative day and transferred to the rehabilitation center affiliated with our hospital.

Clinical outcomes were assessed commencing preoperatively and continuing postoperatively at 3 and 6 weeks, 3 months, 1 year, and annually thereafter. Knee function was rated according to the Knee Society clinical rating system (knee score and function score).²⁷ Knee pain was evaluated by visual analogue scale, with 0 points indicating no pain and 10 points indicating the worst pain. The first active straight-leg raise and complications were also recorded during the postoperative recovery period. Intraoperative evaluation included data collected concerning closed skin incision length measured in 90° of flexion, blood loss, lateral retinaculum release, and tourniquet time.

For radiological evaluation, standard anteroposterior (AP), lateral, and Merchantview radiographs were taken and analyzed preoperatively, postoperatively and at each follow-up. Alignment of the knee, the position of components, and the presence and location of radiolucencies at the cement–bone interface were evaluated according to the Knee Society radiological rating system.²⁸ The clinical and radiographic assessments were undertaken by 2 of the authors (W.M.P. and R.F.Z.) who were blinded to the surgical approach used.

Statistical tests used in comparisons were chosen based on the type of variable being compared. Descriptive statistics were calculated for all variables with SPSS 13.0 (SPSS Inc, Chicago, Illinois). The student t test was used for analysis of the continuous variables. The analysis for dichotomous variables was completed using the likelihood ratio chi-squared test. Statistical significance was set at P<.05.

**RESULTS**

Demographic characteristics of the patients, including age, gender, BMI, diagnosis, and preoperative knee deformity, were similar for the 2 groups (Table 1). The mean length of the closed skin incision in 90° of flexion was 11 cm (range, 10-12 cm) in group A and 10.5 cm (range, 9-12 cm) in group B (Table 2). This difference was not significant (P=.585, Ta-
ble 2). All the procedures in both groups could be completed without extending the incision, but 3 knees (4.41%) in group A and 1 knee (1.52%) in group B had partial laceration of the patellar ligament into the tibial tubercle because of excessive retraction to achieve adequate exposure. These lacerations did not affect the postoperative management. Estimated total blood loss was measured by calculating the sum of recorded intraoperative loss and loss from drains during the first 24 hours. With the numbers available, no difference in estimated total blood loss was observed between the 2 groups (P = .672, Table 2). Four (5.88%) lateral retinacular releases were required in the mini-midvastus group (Group A) and 6 (9.09%) in the mini-medial parapatellar group (Group B) (P = .528, Table 2); the rule of no thumb test was used to assess patellar tracking.

Preoperative and final follow-up results, and differences between and within groups for the knee score, function score, and range of movement are shown in Table 3. Both the preoperative knee score and function score were not statistically different between the 2 groups (Table 3) and neither were the postoperative scores at each time interval (Figures 2, 3) and at final follow-up (Table 3). Significant improvement in the knee score and function score at the latest follow-up occurred in the 2 groups based on preoperative scores (Table 3). The range of movement parameter of the knee score was measured with a goniometer in the supine position. No significant difference in range of movement could be observed between the 2 groups preoperatively (Table 2), at all time intervals, (Figure 4) and at final follow-up (Table 3), but the time when the patients attained 90° knee flexion was significantly earlier in group A than group B (P = .025, Table 2). Patients in group A also achieved active straight-leg raising significantly rapidly when compared with those in group B (P = .017, Table 2).

The average postoperative knee pain, as recorded on the visual analog scale, was comparable for both groups during the inpatient stay (Figure 5). At final follow-up, the pain parameter of the knee score in the 2 groups did not differ, with 40 patients (58.82%) in group A and 38 patients (57.58%) in group B having no pain, 25 patients (36.77%) in group A and 26 patients (39.39%) in group B experiencing mild occasional pain, and 3 patients (4.41%) in group A and 2 (3.03%) in group B with moderate, occasional pain.

There were no infections or neurovascular complications in either group. There was no clinical evidence of deep venous thrombosis (DVT) or pulmonary embolus.
in the perioperative period, although no radiographic or Doppler testing was done. Five patients (7.35%) in group A and 3 patients (4.55%) in group B had partial skin necrosis delaying the healing process, but the clinical parameters of these cases was not influenced by the delayed healing. At follow-up, no patients had stiffness needing manipulation or extra physiotherapy sessions and no one in either group required revision.

A radiographic outlier in the coronal view was defined as any knee alignment $>3^\circ$ outside the ideal or any component medialization or lateralization $>3$ mm. The ideal coronal alignment was considered to be $6^\circ$, with the femoral component in $6^\circ$ valgus and the tibial component in neutral. The shift length was defined by the distance between the midpoint of the components and the midpoint of both condyles. Femoral notchings $>2$ mm in the sagittal view were also considered as outliers. The ideal flexion of the femoral component was $0^\circ$. Radiographic analysis revealed correct knee alignment in all patients in both groups. There were no significant differences between the 2 groups with regard to alignment of the knee and the alignment of the femoral and tibial components in the coronal and sagittal planes. The assessment of shift length of the components revealed there were 9 knees (13.24%) in group A where the tibial component showed a medial shift of $>3$ mm compared with 2 (4.55%) in group B ($P<.031$). No evidence of patella subluxation or dislocation was found on Merchant view radiographs. At final follow-up, there was no evidence of radioluent lines around any component or aseptic loosening of any component in either group.

**Discussion**

The quest for quicker postoperative rehabilitation and shorter hospitalization has led to the development of minimally invasive surgical techniques and instruments for TKA. Currently, there is no agreement about the clear definition of a minimally invasive approach for TKA in the orthopedic community. Most surgeons have described incisions that are smaller than those used with the standard techniques in an attempt to limit softtissue dissection as being minimally invasive. In the present study, a minimally invasive approach was defined as an approach that ranged from quadriceps-sparing arthrotomy to one in which a $\leq$2 cm extension was made into the quadriceps, with incision lengths of 10 to 14 cm. Avoiding eversion of the patella and tibial dislocation, the use of modified instruments, and the softtissue mobile window concept were also important components of minimally invasive knee surgery. Theoretically, all these procedures resulted in less trauma to the extensor mechanism than with traditional approaches.

However, the contemporary literature does not support the widespread use of minimally invasive TKA technique. Critics have raised questions about the implant malalignment and the length of the learning curve. Since 2005, the minimally invasive TKA technique has been cautiously used in our department. The medial parapatellar and the midvastus approach have
been the most commonly used surgical approaches in our standard TKAs. We therefore introduced miniature versions of the 2 approaches into our practices. Despite the confidence gained after initial minimally invasive TKAs were successfully performed, to date, it is unknown whether there are differences in terms of the early clinical and radiological results between the 2 minimally invasive approaches for TKA, which led to our establishment of this prospective, randomized study. The follow-up period in the study was 2 to 4 years, because our major aim was to assess functional recovery and complications rather than the longevity of the prosthesis. As functional improvement following TKA had been shown to continue up to the second postoperative year,\(^\text{35,36}\) and the majority of complications occurred during the first 2 years,\(^\text{2,3}\) the data collected at this time were sufficient for an analysis of this end point.

Several studies had demonstrated TKA through a mini-midvastus approach resulting in more rapid functional recovery compared with a traditional TKA using a medial parapatellar exposure.\(^\text{11-13,15}\) Similarly, the current study evaluated the differences between the mini-midvastus and the mini-medial parapatellar technique in terms of short-term outcomes. In our study of 134 patients who were divided into 2 groups, we found that patients in the mini-midvastus group (A) reached 90° of flexion around 1.5 days earlier and an active straight-leg raise 1.2 days earlier than those in the mini-medial parapatellar group (B). However we doubt that the difference, which diminished with time, had any clinical significance for our patients.

The range of movement and the Knee Society score between the 2 groups were not notably different at 3 and 6 weeks, 3 and 6 months, 1 year postoperatively, and at final follow-up. These findings demonstrated that a mini-medial parapatellar approach may have the same benefits of less resection of the extensor mechanism and earlier return to function with the mini-midvastus approach. Our results mirrored the outcome of 1 previous report where the mini-medial parapatellar technique had better early improvement in knee flexion than the standard procedure.\(^\text{10}\) In addition, no significant differences were identified between the 2 groups in terms of pain scale and blood loss. But a multicenter trial with increased numbers of patients may be required to detect any subtle difference.

Although a good alignment was obtained in all the cases, exposures in these 2 minimally invasive approaches were found to be more difficult than traditional approaches. Few cases from both groups had superficial wound healing problems and partial laceration of patellar ligament, due to the increased complexity of performing these operations through limited visualization. These minor complications did not significantly affect the postoperative clinical outcomes, but surgeons should attach importance to the issues yet. Maintaining the basic principles of the minimally-invasive TKA, including appropriate patient selection, adopting the mobile window technique, and application of specially-designed instruments,
is believed to contribute to a decrease in the incidence of complications. Moreover, when required, the minimally invasive approach should be progressive extended or converted in a corresponding traditional approach to prevent severe damage to the patellar tendon or other soft tissues. Additionally, the mini-midvastus approach, compared with the mini-medial parapatellar approach, is a more technically demanding surgical procedure with some difficulty in visibility of the entire joint, particularly in the posterolateral tibia. Consequently, the tourniquet time was significantly longer by an average of 15 minutes. There was also a significant increase in medial shift of the tibial component in the mini-midvastus group (A).

Numerous authors noted a learning curve of minimally invasive TKA technique associated with longer operative time and increased complication rate. Our results indicated that the mini-medial parapatellar approach could allow for a more incremental, safer learning curve and was easier to initially apply.

No significant difference was observed in early clinical outcomes between the mini-midvastus and mini-medial parapatellar approach. Minimally invasive TKA can be performed successfully through both approaches in selected patient groups. Based on our preliminary experience, the mini-medial parapatellar approach is easier to initially apply and provides better visualization for TKA.

REFERENCES


