Minimal invasive subvastal approach versus standard medial parapatellar approach in total knee replacement

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Background
Although the long-term results of knee arthroplasty have proven to be excellent, the rehabilitation period often is long and painful. To improve the patient's well-being during the immediate postoperative period, other less traumatic exposures have been introduced, including the mini-subvastus approach. The purpose of this study was to evaluate the short-term functional results of minimal invasive subvastal-total knee arthroplasty (MIS-TKA) (mini-subvastus approach) compared with a traditional total knee arthroplasty (TKA) using a medial parapatellar exposure.

Patients and methods
The study population was divided into two groups of patients who underwent surgery with the same surgeons during 2010–2011: 16 MIS-TKA and 18 medial parapatellar total knee arthroplasty, following the same arthroplasty model (Nexgen) and similar preoperative and postoperative procedures.

Results
In the immediate postoperative results, the subvastus group showed significant decrease in blood loss, significant decrease in hospital stay, significantly shorter length of incision, and significant increase in duration of surgery. After 1-year follow-up, Knee Society Scores were 173.2 ± 7.0 for the minimal invasive subvastal group and 173.4 ± 5.9 for the standard technique group. This difference was not statistically significant.

Conclusion
Our study allows us to assert that the minimal invasive subvastal technique does offer some advantages for the immediate postoperative period, including a lesser blood loss and a shorter hospital stay. However, results at 1 year after surgery are similar, both in functional assessment and in the quality of life for the patient.

Keywords:
medial parapatellar approach, subvastal approach, total knee replacement

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Introduction

Total knee arthroplasty (TKA) is a very successful procedure in the treatment of end-stage arthritis of the knee. Long-term results for pain relief and functional improvement have been excellent. The procedure, however, traditionally requires an extensile approach. The medial parapatellar arthrotomy is the most common method used to expose the knee. This exposure involves patella eversion and generally is performed through large incisions of ~20–30 cm. Although the long-term results of knee arthroplasty have proven to be excellent, the rehabilitation period often is long and painful [1]. To improve the patient's well-being during the immediate postoperative period, other less traumatic exposures [minimal invasive subvastal-total knee arthroplasty (MIS-TKA)] have been introduced, including the subvastus, midvastus, and lateral arthrotomy. The mini-subvastus approach extends from the tibial tubercle to the superior patella and then to the muscle of the vastus medialis, and the muscle fibers are not cut [2]. Although recommendations for the use of this technique are not precisely defined, the exclusion criteria for patients to receive the MIS-TKA were rheumatoid arthritis, obesity, severe osteoporosis, valgus-varus deformity greater than 10°, previous arthrotomy on the knee, and preoperative knee flexion less than 100°. These techniques aim for a faster recovery of mobility, a shorter postoperative period, a reduction in blood loss, less pain throughout the postoperative period, a lessened aesthetic impact, and to reduce the amount of health resources required by resorting to a smaller incision and a less aggressive technique for soft tissues; they will not, however, impair the good results this procedure achieves [3].

Objectives

The purpose of this study was to evaluate the short-term functional and health-related quality of life results of MIS-TKA (mini-subvastus approach) compared with a traditional TKA using a medial parapatellar exposure. In addition, this study examines the effect of MIS-TKA on operative time, blood loss, size of

incision, duration of hospital stay, and postoperative well-being.

Patients and methods

This was a prospective, comparative, and randomized study. Data were collected before surgery, at immediate follow-up, and at 1 year of follow-up. All patients suffered from knee osteoarthritis, which had not improved with medical treatment and which presented a less than 10° deformity in the coronal and sagittal radiographic projections. Patients who already had undergone through previous knee surgery other than arthroscopy were excluded. The study population was divided into two groups of patients who underwent surgery with the same surgeons during 2010–2011: 16 MIS-TKA and 18 medial parapatellar TKA, following the same arthroplasty model (Nexgen: Zimmer, Inc., P.O. Box 708, 1800 West Center Street, Warsaw, IN, 46581–0708) and similar preoperative and postoperative procedures. Using a table of random numbers, patients would be allocated to either the minimally invasive group (MIS-TKA) (group A) or the standard group (group B) before surgery. We explained to the patient the type of surgery in the moment of random assignment. Written informed consent was obtained from all patients. Demographic, clinical, and radiographic data were collected and measured by the authors. Preoperative data were similar in both groups (Table1). All knee prosthesis were Nexgen mobile bearing as primary surgery. All the implants used in this study were cemented, and all patients had patella debridement. A third-generation cephalosphorins antibiotic prophylaxis was used during perioperative care, and low-molecular-weight subcutaneous heparins were administered as antithrombotic treatment for 3 weeks after surgery.

A specific questionnaire was filled in, and the Knee Society Score (KSS) scale was filled in at 1 year after the intervention. Data were processed with Microsoft Excel 2007 (1 Microsoft Way, Redmond, WA 98052–6399). The Mann–Whitney *U*-test was used to measure significance of variables and significant *P*-value (two tailed) was at less than 0.01. A computerized SPSS program was used for data statistical analysis and graphs formulation.

Table 1 Preoperative data

Number of TKAs	MIS-TKA	Standard
Number	16	18
Women/men	11/5	13/5
Age (years)	66.7 (SD, 5.4)	65.6 (SD, 5.8)
BMI (mean)	31.1 (SD, 4.3)	30.8 (SD, 3.6)
Previous arthroscopy (%)	12.5	16.6
Extension (deg.)	3 (range, 0–10)	4 (range, 0–11)
Flexion (deg.)	99 (range, 83–126)	102 (range, 79–128)
KSS (points)	44	46

KSS, Knee Society Score; MIS, minimal invasive subvastal; TKA, total knee arthroplasty.

Data collected

(1) Surgery duration (min).
(2) Size of incision (cm).
(3) Length of postoperative hospital stay (days).
(4) Portovac draining (ml).
(5) Complications.

Approach and technique

Standard medial parapatellar approach

The prosthesis will be inserted through a midline skin incision beginning over the medial portion of the quadriceps tendon, 4 inches above the upper border of the patella. The incision will continue in a gentle curve following the medial margin of the quadriceps tendon, patella, and patella tendon. It will then cross the upper end of the tibia and end inferior to the tubercle of the tibia. A straight incision will be made through the three layers of fascia over the quadriceps and the patella tendons. The synovia and deep aponeurosis will be divided medial to the patella and the quadriceps tendon will be separated in the line of its fibers just lateral to the insertion of the vastus medialis. The patella tendon will be freed along its medial border to the level of the tibial tubercle, exposing the infrapatellar bursa. The patella will be dislocated laterally [4–7].

Subvastus approach

The skin incision in the mini-subvastus group was made along the medial aspect of the patella and from 0.5–1 cm proximal to the superior pole of the patella to ~2–4 cm beyond the medial extent of the tibial tubercle. The distal insertion of the vastus medialis obliqus (VMO) on the patella is exposed. The fascia overlying the VMO is released sharply, taking care not to injure any underlying muscle fibers. The fascia is released posteriorly toward the attachment of the VMO on the medial intermuscular septum. This exposes the entire distal extent of the VMO. Using blunt dissection, a finger can be placed underneath the VMO at its inferior border. The VMO is then retracted proximally and laterally while maintaining its attachment to the patella. A Z-retractor is inserted anterior to the distal femur and deep to the muscle to maintain retraction. Distally, the medial parapatellar retinaculum was incised and the incision was continued medial to the patellar tendon to the tibia ~5 mm medial to the tubercle. The knee was flexed and the patella was subluxed, but not everted, and the technique 'mobile windows' was carried out so as to better visualize the femorotibial compartments. The femoral and tibial incisions are performed with the specific equipment. In the standard group, intramedullary guides were used

for the distal femoral cut, with a target alignment of 5° of valgus with 3° of flexion. The proximal tibia was cut using extramedullary guides at right angles in the coronal plane and at 3° of posterior slope. After these cuts were made, all remaining posterior osteophytes and meniscal remnants were removed. Ligament balancing was accomplished using either spacer blocks or a tension/balancer. Final preparation was performed with a 4-in-1 cutting block. The wound was closed routinely with one drain. A tourniquet was used in all cases and deflated routinely before the wound closes [1,8].

Assessment of outcome

The primary outcome measure for this study will be the KSS [9] at 1 year postoperative and will be carried out by a trained independent assessor (physiotherapist) who will be blinded to the surgical approach taken.

Secondary outcomes are patient based:

(1) Operative duration.
(2) Operative incision.
(3) Postoperative blood loss.
(4) Duration of hospital stay.

Results

Surgery

Figure 1 shows that the mean duration of the surgery for group B was 99.4 min (SD 4.46), whereas the mean time for group A was 114.9 min (SD 6.2). This means that applying the minimal invasive subvastal (MIS) technique required more time ($P < 0.0001$).

Figure 2 shows that the mean size of the length of the cutaneous incision was 12.3 cm (11–14) for the MIS-TKA group and 18.2 cm (16–21) for the group using the traditional method.

Immediate postoperative period

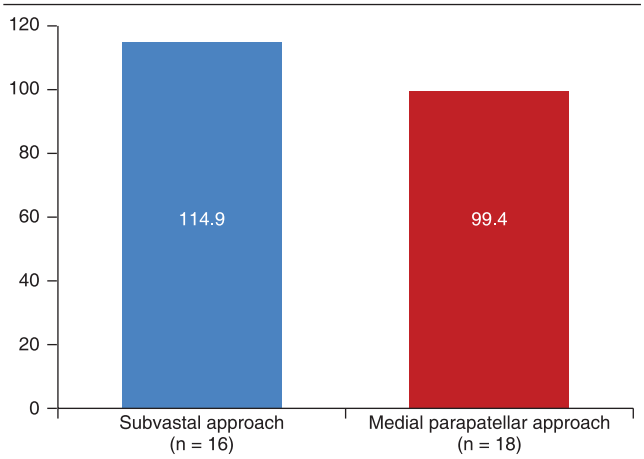
Figure 3 shows that the hospital stay duration was noticeably shorter ($P = 0.0014$) for the MIS group patients (mean: 7 ± 0.73) than for the standard group (mean: 7.9 ± 0.76).

Figure 4 shows that the drainage volume collected after surgery for group A had a mean of 537.5 ± 80.6 ml, whereas the figure for the traditional technique was significantly higher ($P < 0.0001$), with a mean of 763.9 ± 44.7 ml.

Evaluation at 1 year

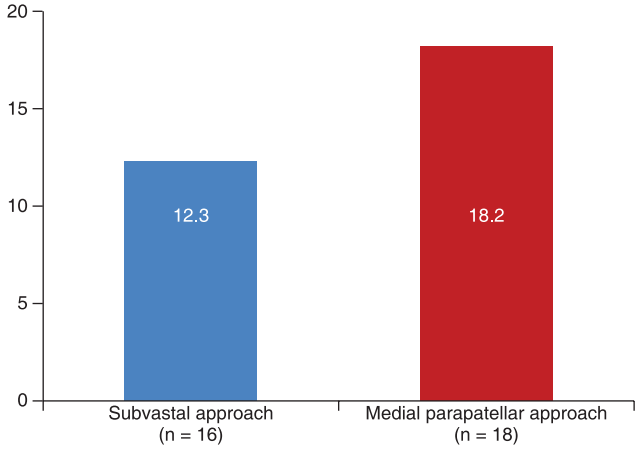
Regarding the observed mobility at 1 year after surgery, no significant differences were observed between both groups. Extension in the MIS group was −0.5° (SD 2.23) and −0.6° (SD 2.14) in the standard group. The mean flexion for the MIS group was 107.4° (SD 9.45),

Figure 1



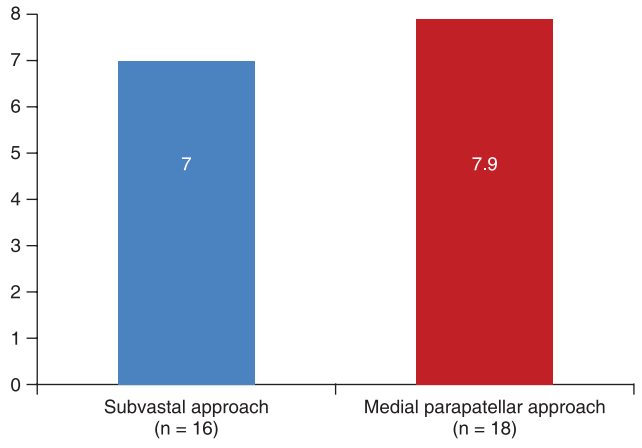
The duration of operation (min).

Figure 2



The mean size of the length of the cutaneous incision.

Figure 3



The hospital stays duration.

whereas it was 105.23° (SD 10.3) in the standard group. There were no severe complications that might have altered the clinical or radiographic results.

KSSs were 86.6 ± 7.0 for the MIS group and 86.7 ± 5.9 for the standard technique group. This difference was not statistically significant as shown in Fig. 5.

An example of radiographic findings preoperative and postoperative is shown in Fig. 6.

Discussion

There are many studies that have determined the effectiveness of TKA in reducing pain and deformity and improving function. Standard TKA has led to consistent, reproducible, and enduring results. Long-term success at 10 years or more encompasses survivorship of greater than 90% for many studies, and more than 80% of patients were satisfied [5–7]. For many years, clinicians relied exclusively on objective and physical measures of disability to assess orthopedic surgical outcomes [10,11]. Most have assessed outcomes using standardized knee scoring systems such as KSS.

Few studies exist that have compared prospectively two groups of patients [2–4], one with MIS and one with the standard technique, and compared both groups through functional scales, which is important to assess a technique proposed to enhance patient's satisfaction and cosmetic benefits. Furthermore, it is a prospective, randomized study in which the same type of arthroplasty was implanted by the same surgeons [11,12].

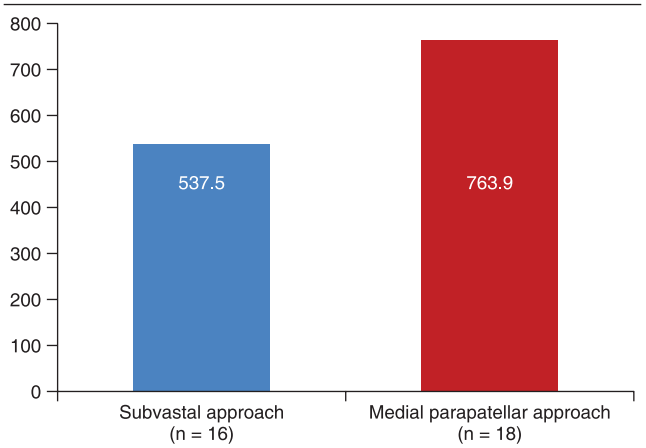
The mean operative duration was significantly longer in group MIS-TKA; this was already referred to in other studies on MIS [13,14].

Hospital stay for patients in group A was significantly less than that of patients who underwent the traditional technique. Bridgman *et al.* [14], which helps to make good use of health resources. Blood loss was significantly lower in the MIS group. These data are also in agreement with other studies [2–4] and are supposedly related to the less aggressive surgery. In any case, none of our patients needed a blood transfusion.

We encountered no major perioperative complications in either group. It is possible that, being more careful with the soft parts may have avoided the high number of cutaneous complications.

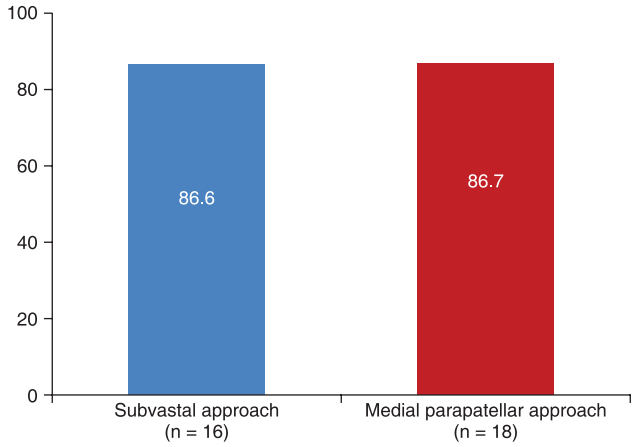
At 1 year of follow-up, results for both groups were similar, and there were no statistically significant differences in KSS. The range of motion in both groups was good at 1 year; these data are in agreement with those of other authors [2–4,14], where the minimally invasive technique positively contributes to the early restoration of quadriceps strength and a speedy return to normal functioning. In other studies, manipulation was necessary in 14% of the traditional group compared

Figure 4



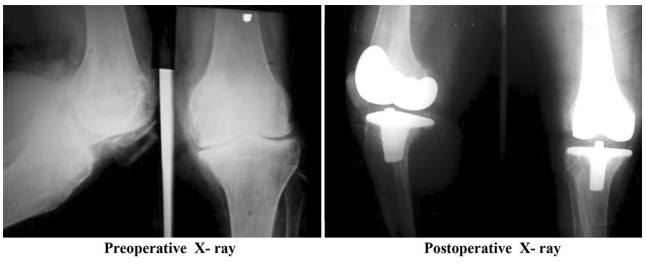
Postoperative blood loss.

Figure 5



The Knee Society Score of both groups after 1-year follow-up.

Figure 6



Preoperative and postoperative radiograph of example case of total knee replacement.

with 2% in the minimal incision group [14], but there was no significant difference in range of motion or functional outcome at 1 year after surgery, nor was there significant difference in component position or complication rates.

Both groups reported a good quality of life at 1 year. On the KSS scale, both groups achieved high scores, but there were no statistically significant differences between them.

It is usual that studies appear showing better short-term outcomes for MIS-TKA [13] regarding the patient's well-being and hospital stay. However, to properly gauge the scientific evidence on MIS techniques, it should be noted that those results have frequently been obtained from expert centers or from surgeons devoted to such techniques [14]. This fact may distort the results, as any complications and the follow-up of TKAs implanted through MIS in general hospitals or nonspecialized centers are not analyzed. It is possible then that, presently, the MIS technique is more a personal choice of the patient or a commercial demand than a true advancement in TKA placement. The surgeon should look for the minimum size necessary for him to correctly implant a TKA and look away from showing off that he is able to implant arthroplasties with ever smaller incisions. Therefore, we recommend the use of a standard arthrotomy with the shortest possible invasion and skin incision. MIS-TKA demands an effort on the part of the surgeon [2,4]; the learning curve may be unacceptably long for a low-volume arthroplasty surgeon [13,14] and it takes more intervention length, requires longer tourniquet time, and special tools are needed to insert the implant.

Conclusion

Our study allows us to assert that the MIS technique does offer some advantages for the immediate postoperative period, including a lesser blood loss and a shorter hospital stay. However, results at 1 year after surgery are similar, both in functional assessment and in the quality of life for the patient.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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