Results of the 136 Consecutive Minimally Invasive Total Knee Arthroplasties

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The authors evaluated results of 136 consecutive minimally invasive total knee arthroplasties (MIS TKAs). The first 22 knees, performed with strict patient selection criteria, were determined as a learning experience. According to results of the next 114 knees, the average wound length was 9.2 centimeters and the average blood loss was 470 milliliters. At a mean follow-up of 14 months, the mean Knee Society score improved from 37.5 to 96 points with 96.3% of excellent results. Sixty-five knees, group A, had within 10 degrees of varus and 49 knees, group B, had more deformity. Clinical results of both groups were not statistically different in terms of operative time, blood loss, pain score, postoperative knee flexion at 2 weeks and 6 months and postoperative day of walking. However, the ability to straighten the knee was significantly delayed in knees with more deformity (group B). After gaining learning curve, surgeons could extend performing MIS TKA in patients with more knee deformity.

Keywords: *Minimally invasive, Total knee arthroplasty, Technique, Knee deformity*

J Med Assoc Thai 2005; 88(Suppl 4): S74-8
Full text. e-Journal: *http://www.medassocthai.org/journal*

Total knee arthroplasty (TKA) has been the standard of treatment for debilitating arthritis of the knee since the introduction of the first total knee in 1974[1,2]. The techniques of balancing the ligaments, equalizing the flexion-extension gaps, and adjusting the overall alignment have been perfected so that the long term results are very satisfactory and are now approaching 20 years for the follow up studies[3-8]. Minimally invasive surgery (MIS) for knee arthroplasty began in the late 1990's. Repicci's work with unicondylar knee arthroplasty (UKA) encouraged further interest in both the limited surgical approach and in partial knee arthroplasty[9,10]. In the year 2001, Tria and Coon[11] demonstrated that with concepts of MIS UKA approach, TKA could be performed successfully. Following principle of surgical technique as classically described by Insall et al[1,2] and the concepts to work inside the mobile skin window, they could accomplished successful results[11]. Later on, the MIS TKA technique, which minimizes extensor mechanism injury, has been far interested by orthopaedic surgeons all over the world. In addition, modified anesthetic and postoperative pain management for MIS arthroplasty have important roles on the early postoperative ambulation[12].

Authors performed the first MIS TKA in Thailand in October 2002 and reported the early experience on the first 22 knees with better clinical results than those underwent standard TKA in terms of wound size, blood loss, postoperative knee pain, timing of walking ambulation and length of hospital stay[13]. However, this study had limited number of cases and limited knee deformity (within 10 degrees of anatomical varus). To verify the clinical results of MIS TKA, especially after the learning curve, the next 114 knees with more knee deformity were evaluated.

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Material and Method

Between October 2002 and December 2004, we performed 136 consecutive MIS TKAs in 122 patients. The first consecutive 22 knees in 22 patients were reported in the first series of MIS TKA study and was determined as learning curve experience[13]. Another consecutive 114 knees in 100 patients were included for evaluation in terms of intraoperative data, clinical results, and radiographic study. The average age of the group was 66 years (range, 48-81 years).

Eleven were male and 89 were female. The diagnosis was osteoarthritis in 107 knees and rheumatoid arthritis in 7 knees. Patient selection criteria included; advanced knee disease with stable medical condition, more than 110 degrees of range of motion (ROM), within 10 degrees of flexion contracture, and no previous major knee operation. The average deformity was 10.1 degrees of anatomical varus (range, 11 degrees of anatomical valgus to 30 degrees of anatomical varus). The average preoperative ROM was 2.8-119.2 degrees. The average preoperative Knee Society score was 37.5, (range, 24-46).

Surgery was performed by a single surgeon (AT) with the same surgical technique and no patella eversion as previously described[13]. Capsular incision for every patient was begun with quadriceps sparing approach[11]. After removal of osteophytes, a provisional patella bone cut was performed with knee position in 30-45 degrees of flexion. Then, the patella was retracted laterally to 70-80 degrees of tilting. If there was any difficulty, a longitudinal quadriceps snip was performed with 1-centimeter increment and maximum of 3 centimeters. Rotation of femoral component was determined with following both epicondylar axis[14] and anteroposterior axis[15]. The posterior stabilized knee implant (NexGen HiFlex, Zimmer, Warsaw, IN, USA) was used in all knees (Fig. 1). Multimodal postoperative pain control (opiates or simple analgesics and nonsteriodal anti-inflammatory dreugs) was used in all knees. All patients were asked involuntarily to sit upright on postoperative day 0 (POD 0) and to stand and walk with walker on POD 1 or POD 2. Discharge criteria included; ability to flex the operated knee to 90 degrees and walking independently with walking aid. Intraoperative data, immediate postoperative data and ambulation ability, pain scores, range of motion and radiographic measurement were evaluated by independent observer (ST). There were 2 subgroups according severity of knee deformity (preoperative anatomical tibiofemoral angle on the anteroposterior view of standing radiograph). Group A, 65 knees had within 10 degrees of anatomical varus and group B, 49 knees, had more than 10 degrees of anatomical varus. Results of 2 subgroups were compared. The mean follow-up was 14 months (range, 6-17 months).

Statistical analysis

Descriptive statistics were used for all knees. To compare between 2 subgroups with different knee deformity, unpaired t-test was used to evaluate the operative time, collected blood in the drain, patient numeric pain scores at 24 hours, 48 hours, 2 weeks, 6 weeks and 12 weeks as well as postoperative day of ambulation and postoperative degrees of knee flexion. The p values < 0.05 were considered significant.

Results

The average wound size was 9.2 centimeters (range, 6.5-12 centimeters). The average tourniquet time and operative time was 110.3 minutes (range, 90-140 minutes). The average blood collected in the drain was 470 milliliters (range, 170-980 milliliters). At the final follow-up, the mean Knee Society score improved to 96 points. Ninety-six percent had an excellent clinical result and 4% had good result.

The average preoperative ROMs of subgroup A and subgroup B were not statistically different (2-121 degrees vs 1-117 degrees, p=0.179). Comparing

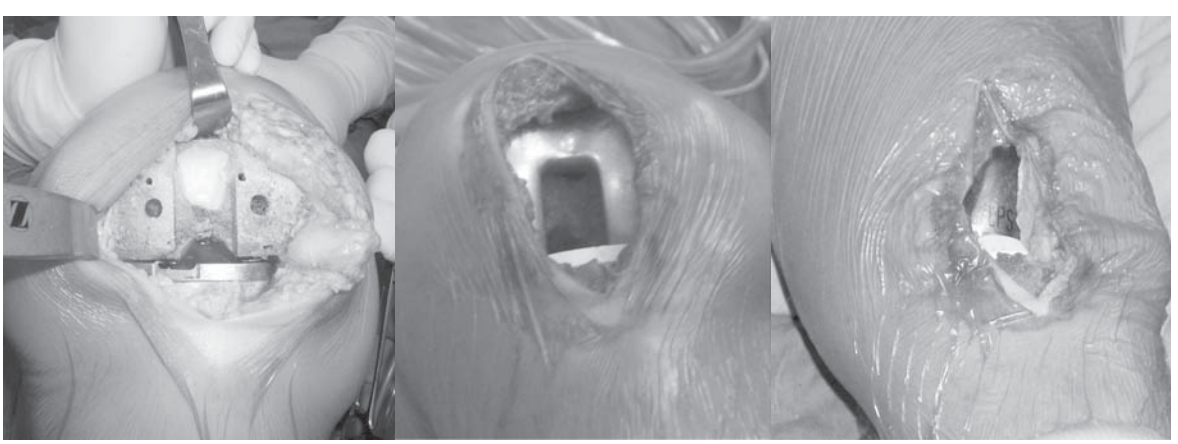

Fig. 1 Pictures demonstrated visualization during MIS TKA (left), after components insertion with knee flexion (middle) and extension (right)

Table 1. Comparison of results of MIS TKA between Group A and B

Parameters	Group A		Group B		p value
Average and range: op time (min)	111.4	90-140	108.8	90-140	0.326
Blood loss (ml)	450.8	140-980	496.3	160-780	0.190
Average and range: pain score					
24 hours postop	3.8	1 to 8	3.8	1 to 8	0.919
48 hours postop	3.3	1 to 8	2.9	1 to 6	0.211
2 weeks postop	1.9	0 to 9	2	1 to 5	0.722
6 weeks postop	1.3	0 to 5	1.3	0 to 4	0.893
Average and range: knee flexion (deg)					
2 weeks postop	110.1	100-130	109.9	80-125	0.907
6 weeks postop	123.9	110-135	119.8	100-130	0.000***
12 weeks postop	130.5	110-140	128.4	115-140	0.046***
6 months postop	131.1	110-140	128.8	110-140	0.057
Average and range: recovery (POD)					
Ability to straighten knee	1.2	1 to 3	1.5	1 to 3	0.001***
Ability to stand and walk	1	1 to 4	2	1 to 3	0.276
Length of stay after surgery	5	1 to 10	4	2 to 9	0.280

Note POD; post operative day ***; statistical significant

of the average operative time, blood loss, pain score at 24 hrs, 48 hrs, 2 weeks, 6 week, and degrees of knee flexion at different postoperative period between both subgroups were shown in Table 1. There were no significant differences of the POD which patient had ability to stand and walk and the average length of stay; however, there was statistical difference of both subgroups on POD that patients were able to straighten the operated knee (Fig. 2) and ROMs at 6 weeks and 12 weeks, postoperatively (Fig. 3).

Complications included 10 knees with prolonged wound drainage more than 5 days. All were treated by limitation of activity without any further complication. One knee had unaccepted malalignment (2 degrees of anatomical varus). This complication was

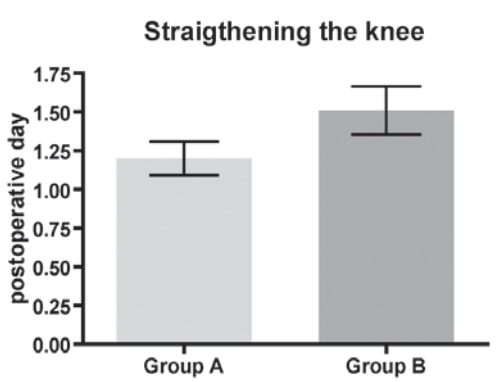

Fig. 2 Graph comparing postoperative day (POD) which patient can strengthen the operated knee between group A and group B with significant difference

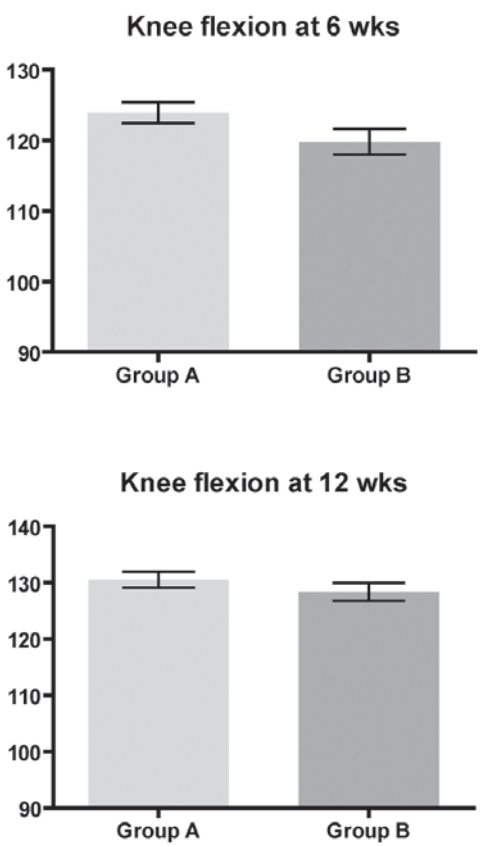

Fig. 3 Graphs demonstrated significant difference of postoperative degrees of knee flexion at 6 weeks and 12 weeks between group A and group B. Authors believed that better ROM of group A related to more limited quadriceps tendon division

due to technical error and the patient has been under closed observation. There was no skin problem, no early failure or early revision.

Radiographic evaluation of the tibiofemoral angle on standing film was averaged 5.1 degrees of anatomical valgus (range, 3-7 degrees). The position of the femoral component with respect to femoral anatomical axis was averaged 6 degrees of valgus (range, 5-7 degrees) and 0 degree of flexion (range, 0-1 degree). The position of tibial component with respect to tibial anatomical axis was averaged 1.4 degrees of varus (range, 1 degree of valgus-3 degrees to varus) and 5 degrees of posterior slope (range, 2-10 degrees).

Discussion

As authors were surgeons who have performed the first MIS TKA in Thailand since 2002, we are responsible for reporting results of this procedure in a large series. Our previous results of 22 MIS TKAs[13], being compared to results of 22 standard TKAs, demonstrated better results in terms of early ambulation, postoperative knee pain, range of motion, blood loss and patient satisfaction. However, the average operative time of the MIS TKA group was longer than the standard group. The extended operative time was due to the early experience and careful surgical steps during surgery. The present study focused mainly on the rest of 114 consecutive knees which had the same satisfactory clinical results as those reported in the first series, but it had less average operative time, with good consistency. Prolonged operative time in some certain cases was closely related to the too small wound size for adequate access of instruments and implant placement. In addition, patient anatomical profiles, such as patellar baja, large bone in mediolateral projection and patients with obesity and firm subcutaneous fat caused difficulty for MIS TKA procedure.

According to Tria and Coon series[11], limited patient selection criteria were proposed, especially within 10-degree knee deformity in mediolateral plane. The current study demonstrated satisfactory results of MIS TKA in patients with limited knee deformity (group A). Regarding those with more knee deformity (group B), significant delay of ability to straightening and less knee flexion at 6 weeks and 12 weeks postoperatively were found. This was related to the extension of quadriceps tendon incision which caused more injury to the quadriceps tendon and possibly, more postoperative knee stiffness. However, with the MIS surgical principle to handle the soft tissue, pain score at different postoperative period, ability to walk and length of stay were not different between groups.

Conclusion

Results of MIS TKA in 136 consecutive knees were very satisfied. These results suggest after gaining learning experience, MIS-TKA can be reproducible with consistent operative time and can be extended to perform in patients with preoperative deformity more than 10 degrees of anatomical varus.

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รายงานการผ่าตัดเปลี่ยนข้อเข่าเทียมด้วยวิธีเนื้อเยื่อบาดเจ็บน้อย 136 เข่า

อารี ตนาวลี, สาธิต เที่ยงวิทยาพร, พิบูลย์ อิทธิระวิวงศ์

คณะผู้วิจัยศึกษาผลของการผ่าตัดเปลี่ยนข้อเข่าเทียมด้วยวิธีเนื้อเยื่อบาดเจ็บน้อยใน 136 เข่า โดยรายงานผู้ป่วย 22 เข่าแรกเป็นประสบการณ์ระยะแรก ผลของการผ่าตัด 114 เข่าถัดมา มีค่าเฉลี่ยของความยาวของแผล 9.2 ซม. และเสียเลือด 470 มล. ที่ค่าเฉลี่ยการติดตามผู้ป่วย 14 เดือน ค่าเฉลี่ย Knee Society score เพิ่มจาก 37.5 คะแนน เป็น 96 คะแนน โดยร้อยละ 96.3 อยู่ในเกณฑ์ดีมาก ข้อเข่า 65 ข้อ (กลุ่ม A) มีเข่าโก่งไม่เกิน 10 องศา และ 49 ข้อ (กลุ่ม B) มีเข่าโก่งมากกว่า 10 องศา ทั้ง 2 กลุ่มไม่แตกต่างกันในเรื่องค่าเฉลี่ยของ เวลาผ่าตัด, การเสียเลือด, ความเจ็บปวด, การงอข้อเข่าที่ 2 สัปดาห์, ที่ 6 เดือน, การเริ่มเดิน และจำนวนวันนอนโรงพยาบาล แต่การงอข้อเข่าที่ 6, ที่ 12 สัปดาห์ และการเหยียดขา แตกต่างกันอย่างมีนัยสำคัญ การศึกษานี้พบว่าเมื่อแพทย์มีประสบการณ์ผ่าตัด MIS TKA เพียงพอ สามารถขยายข้อบ่งชี้การผ่าตัดไปยังข้อเข่าที่ผิดรูปมากขึ้นได้