Comparison Outcomes of Opening-Wedge High Tibial Osteotomy without Bone Graft and Unicondylar Knee Replacement at 5-year Follow up

Pawaris Sungkhun, MD

Department of Orthopedic Surgery, Somdejprasangkharach XVII Hospital, Suphan Buri, Thailand

Purpose: *The purpose of this study is to compare midterm outcomes of opening-wedge high tibial osteotomy (HTO) without bone graft and unicompartmental arthroplasty (UKA) in advance medial compartment arthritis.*
Materials and Methods: *Fifty patients were divided into the HTO (n=20) and UKA (n=30) groups. Clinically, we evaluated range of motion, the Oxford knee scoring scale, and Knee Society Score at the five years follow-up postoperatively.*
Results: *All clinical outcomes gradually improved in both groups from the postoperative period to the final follow-up. At the final follow-up, all clinical outcomes were slightly better in the HTO group than in the UKA group; however, differences were not statistically significant.*
Conclusions: *HTO is comparable to UKA in terms of clinical outcomes. Thus, the results of this study suggest that HTO might be a good alternative treatment to UKA for medial unicompartmental arthritis.*

Keywords: *Knee, Osteoarthritis, Osteotomy, Arthroplasty, Unicompartment*

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Introduction

Both unicompartmental knee arthroplasty (UKA) and high tibial osteotomy (HTO) have been used to treat unicompartmental knee osteoarthritis (OA). Looking at the trends of both treatments, the number of UKA performed in the United States between 2007 and 2011 had remained the same; whilst that of HTO had slightly declined[1]. However, the characteristics of candidates for the mentioned treatments and the outcomes of them are controversial.

UKA was firstly described in the 1970s[2]. It is the partial surface replacement of knee. Several factors were indicated to consider UKA, for example: unicompartmental osteoarthritis or femoral condyle avascular necrosis, age of 60 or above, non-obesity, range of motion (ROM) over 90 degrees, and axial malalignment less than 10 degrees[1,3]. According to the Finnish Arthroplasty Register, the 15-year survival rate of UKA was 60%[4].

Unlike UKA, HTO was introduced to correct angular deformity in 1960s[3,5]. The major benefit of HTO is that it preserves the natural knee without affecting the physical loading[6]. The age of patients underwent HTO is younger and active; the ideal demographic is less than 60 years old[1,3]. The patients may have a good flexion of knee, which is higher than 120 degrees, without any laxity or instability[3]. The survivorship of HTO at 15 years was reported as high as 90.4%[7].

Although there are several studies show the ideal indications and the survivorships of both procedures, the studies that report the functional outcomes of UKA in comparison with those of HTO are limited. Therefore, this study aims to retrospectively review the outcomes of patients underwent either UKA or HTO at a single institute.

Correspondence to: Sungkhun P. Department of Orthopedic Surgery, Somdejprasangkharach XVII Hospital, Suphan Buri, Thailand
E-mail: pae_pawaris@hotmail.com

Materials and Methods

Patient Selection

This study was approved by the Institutional Review Board of our hospital. From January 2014 to April 2019, all patients who were treated with HTO or UKA and had medial compartmental arthritis. Of 65 patients in total, seven patients whose follow-up were <5 years, three who had lateral meniscus lesions or lateral compartment arthritis, three who had insufficiencies in the anterior or posterior cruciate ligaments, and two who had severe patellofemoral OA were excluded. No patient who had a deformity or history of trauma in any limb was included to evaluate the accurate alignment of the lower limbs. Ultimately, 50 patients were divided into the HTO group (n=20) and UKA group (n=30) for a comparative analysis. Age, sex, and mean follow-up period were not statistically significantly different; however, body mass index (BMI) showed a statistically significant difference between the two groups (p=0.020). The patients underwent either HTO or UKA after a discussion with the surgeon about the prognosis,

rehabilitation program, and their expectation of the level of physical activity after surgery. Based on the evaluation of the patient's compliance, their ability to reduce weight, and hygiene, we finally decide proper treatment. HTO was recommended for patients with severe labor, such as farming, and UKA was recommended for sedentary patients in urban areas.

Surgical Techniques

Unicompartment Knee Arthroplasty: The surgery was indicated for patients with medial compartment pain and limited mobility without any inflammatory knee joint disease if the anterior and posterior cruciate ligaments were functionally intact and varus deformity and flexion contracture was ≤15° and ROM was ≥110°. UKA was performed on patients with radiographic evidence of osteophyte formation without narrowing of the lateral joint space and patellofemoral joint space and those without patellofemoral joint pain in the presence of degenerative osteoarthritis. The exclusion criteria included pre-operative findings of anterior/posterior instability, degenerative changes such as joint space narrowing in the lateral compartment, and anterior knee pain during level-ground walking or stair climbing in patients with patellofemoral joint osteoarthritis.

The surgery was performed at a single institution in all cases by one surgeon using a minimally invasive surgical technique. The sigma fix bearing uni-knee prosthesis (Johnson & Johnson, Depuy, USA) was implanted in all knees (Fig 1). A short skin incision was made on the medial side of the patella from the superior border of the patella to inferior to the joint line. The joint was exposed via a medial parapatellar capsulotomy, and after checking the structures inside the joint, osteophyte removal was performed. Using an extramedullary tibial resection guide, proximal tibial resection was performed. The posterior condyle of the femur was resected using a femoral drill guide and a femoral cut-ting block. After flexion and extension gaps were measured using a feeler gauges, they were equalized by milling of the distal femoral condyle. The tibial and femoral components were fixed with bone cement, and a fix bearing polyethylene bearing was inserted between them. Full (contact) weight-bearing was authorized on postoperative day 1.

Open Wedge High Tibial Osteotomy without Bone Graft: The patient was positioned supine, with a tourniquet at the root of the limb. A 6 cm longitudinal incision was made halfway between the anterior tibial tuberlosity and the medial collateral ligament, 1 cm from the joint. The sartorius fascia was incised, and the hamstring tendons were released subperiosteally toward the posterior region. A Hohmann retractor was used to retract the posterior neurovascular elements. Two K-wires were positioned under fluoroscopic control, from medial to lateral up to the fibular head. Osteotomy, using an oscillating saw, was performed along the K-wires, respecting the lateral cortex. A second osteotomy was performed on the anterior tibial tuberosity, obliquely, in the coronal plane parallel to the anterior tibial cortex. Opening was progressive, until the desired correction was achieved, using the manufacturer's instrumentation. Finally, a TomoFix™ locking plate (Depuy Synthes, Saint Priest, France) was fitted, with at least 3 locking screws on either side of the osteotomy (Fig 2). The target correction angle was measured at the point where the mechanical axis of the lower limb passed through the Fujisawa point, which was 62.5% from the medial tibial articular margin[8] and created medial gap less than 12.5 mm.[9]. Partial (contact) weight-bearing was authorized on postoperative day 1, and full weight-bearing as of 6 weeks.

Assessment of outcomes

There were two kinds of outcome assessments collected in this study. The first one was the range of motion before and 5-year after surgery. The second assessment was the Oxford Knee Scores and the third assessment was Knee Society Score (KSS) and KSS functional scores.

Statistical Analysis

Descriptive statistics are presented as means with standard deviation for continuous variables and frequencies with percentages for categorical variables. The Student's unpaired t-test was used to compare quantitative variables of the cohorts. Categorical data, such as the gender and the Oxford knee scores, was analyzed using either Fisher's exact test or chi-squared test. Statistical analyses were performed using SPSS Statistics version 23 (SPSS, Inc., Chicago, IL, USA) at a level of significance of 0.05.

Fig. 1 Radiography taken before and after undergoing unicompartmental arthroplasty.

Fig. 2 Radiography taken before and after undergoing HTO without bone graft.

Results

Thirty patients who underwent UKA and 20 patients who underwent HTO were included in this study as they had met the recruiting criteria. The mean age in UKA and HTO groups at the surgery were 59.77 ± 10.07 and 52.65 ± 4.88, respectively. There was significant difference among the mean age of the studied groups (p = 0.05). 90% of patients in each group were female which were not significantly different between the groups. The mean follow-up duration was 5.23 ± 0.47 years in the UKA group, and it was 5.05±0.43 in the HTO group (Table 1).

In comparison among the groups, the pre- and post-operative Oxford Knee Scores were significantly different (p = 0.002). Whilst the difference of Oxford Knee Scores among two groups were not statistically significant (p = 0.198). The mean difference between pre- and post-operative Oxford Knee Scores of the UKA groups was 18.30 ± 4.33, and that of the HTO group was 15.85 ± 2.68 (Table 2).

In the UKA group, the pre-, and post-operative ROM were 99.17 ± 12.99 and 115.57 ± 13.22, respectively. The difference of ROM between before and after surgery in the UKA group was 16.40 ± 7.65. In the comparison among the groups, the pre- and post-operative KSS Knee Scores and KSS functional score were significantly different (p = 0.002). Whilst the difference of KSS Knee Scores and KSS functional scores among two groups were not statistically significant (p = 0.092, p = 0.686). (Table 2).

There was no complication or failure found in any groups. The survivorship of each group remained full performance. None of the revision was conducted due to any reasons.

Table 1 Characteristics of patients.

Description	**UKA (n = 30)**	**HTO (n = 20)**	***p*-value**
Mean Age (y)	59.77±10.07	52.65±4.88	0.05*
Gender			
Female (n, %)	27 (90%)	18 (90%)	0.674
BMI (kg/m2)	22.23±2.36	20.02±2.50	0.74
Affected side			
Left	9	10	0.51
Right	14	10	
Bilateral	7	0	
Follow-up duration (y)	5.23±0.47	5.05±0.43	0.72

Table 2 Comparison of the outcomes between two groups.

Description	**UKA (n = 30)**	**HTO (n = 20)**	***p*-value**
Pre-op Oxford Knee Scores	18.67±6.54	20.85±3.47	0.768
Post-op Oxford Knee Scores	36.97±5.52	36.70±2.16	0.094
Pre-op KSS Knee score	30.3±20.2	35.8±20.0	0.092
Post-op KSS Functional score	52.2±18.4	53.2±20.2	0.686
Pre-op ROM	99.17±12.99	100.59±11.22	0.62
Post-op ROM	115.57±13.22	120.57±11.08	0.54
Difference of ROM	16.40±7.65	20.02±0.12	0.84

Discussion

In this study, the retrospective review of patient data was conducted. The functional outcomes were evaluated in terms of the Oxford Knee Scores, Knee Society Scores and the ROM at pre-operation and post-operative follow-up. According to the results, it had been found that the development of functional scores and ROM were similar in both groups ($p = 0.198$ and $p = 0.84$, respectively).

In contrast with this study, the previous studies had shown that UKA performed better results than HTO in terms of functional outcomes and survivorship[10,11]. While a few studies reported that HTO resulted good or excellent outcomes[12,13]. The clinical outcomes of this study were insignificantly observed which was similar to the finding reported by Yim et al.[14]

The literatures mentioned that HTO had the higher complication rate when compared with the UKA[14-17]. According to the study of Yim el al. (2013) the overall complication rate was approximately 6%[14]. Moreover, it was known that performing open-wedge HTO over the tibial tubercle may cause a complication regarding patellofemoral articulation[18,19]. However, none of the complication was found in the present study.

However, there are numerous patients to which knee arthroplasty can be hardly applied owing to the risk of infection and the difficulty in management. Although there was no major complication in the UKA group in our study, if complications occur, such as component loosening or infection, it is disastrous for young patients as revision operations are more difficult. Extended life expectancy has made patients more unwilling to undergo knee revision arthroplasty, and a long-term follow-up has found that UKA is not effective in every case[7,20,21]. In our study, there was no statistically significant difference in terms of all clinical outcomes in the UKA group compared with the HTO group. Therefore, we suggest that HTO might be a good alternative treatment for medial unicompartmental arthritis young, borderline patients considering the risk of arthroplasty.

There were a few limitations of this study. First, this study was a retrospective study which may have several confounds. Second, the mean age of two groups were significantly different. The baseline functions, which are the pre-operative Oxford Knee Scores and the pre-operative ROM, among these two groups were not significantly difference. As a result, the difference between pre- and post-operative were evaluated. Third, this study was conducted at the mid-term follow-up. A longer study shall be taken into consideration to assess the survivorships of the surgical techniques.

Conclusion, HTO was comparable to UKA in terms of clinical outcomes and complications in unicompartmental arthritis in relatively young, borderline patients. Thus, the results of this study suggest that HTO and UKA for medial unicompartmental arthritis were safe and effective for treating patients with OA knee. However, this study did not find any difference between the UKA and the HTO groups in terms of the functional outcomes.

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ผลลัพธ์การเปรียบเทียบการรักษาข้อเข่าเสื่อมด้านเดียวโดยวิธีการผ่าตัดด้วยวิธีเปลี่ยนแนวกระดูก โดยไม่ต้องปลูกถ่ายกระดูก (HTO without bone graft) และการเปลี่ยนข้อเข่าแบบ Unicondylar arthroplasty ในการติดตามผล 5 ปี

ปวริศ สังขันธ์, พบ

วัตถุประสงค์: *การศึกษานี้มีวัตถุประสงค์เพื่อเปรียบเทียบผลของการผ่าตัดเปลี่ยนแนวกระดูกข้อเข่าให้ตรงโดยไม่ใช้วัสดุเสริมกระดูกกับการผ่าตัดเปลี่ยนผิวข้อเข่าเทียมบางส่วนในโรคข้อเข่าเสื่อมด้านเดียว*

วิธีการศึกษา: *ข้อมูลของผู้ป่วยจำนวน 50 ราย แบ่งเป็นผู้ป่วยที่เข้ารับการผ่าตัดเปลี่ยนแนวกระดูกข้อเข่าให้ตรงโดยไม่ใช้วัสดุเสริมกระดูก จำนวน 20 ราย และผู้ป่วยที่เข้ารับการผ่าตัดเปลี่ยนผิวข้อเข่าเทียมบางส่วน จำนวน 30 ราย ถูกประเมินในด้านของคะแนน Oxford Knee Score และ Knee Society Score หลังจากที่ได้รับการผ่าตัดไปแล้ว 5 ปี*

ผลการศึกษา: *จากการศึกษาพบว่าผู้ป่วยที่เข้ารับการผ่าตัดเปลี่ยนแนวกระดูกข้อเข่าให้ตรงโดยไม่ใช้วัสดุเสริมกระดูกมีผลที่ดีกว่าเล็กน้อย แต่ไม่แตกต่างกันอย่างมีนัยสำคัญ*

สรุป: *การผ่าตัดเปลี่ยนแนวกระดูกข้อเข่าให้ตรงโดยไม่ใช้วัสดุเสริมกระดูกกับการผ่าตัดเปลี่ยนผิวข้อเข่าเทียมบางส่วนสามารถเปรียบเทียบกันได้ โดยการผ่าตัดเปลี่ยนแนวกระดูกข้อเข่าให้ตรงอาจเป็นอีกทางเลือกหนึ่งในการรักษาโรคข้อข้อเข่าเสื่อมด้านเดียว*