The Effects of Patellar Resurfacing in Total Knee Arthroplasty on Position Sense: A Prospective Randomized Study

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Abstract

To find out the improvement of joint position sense after total knee arthroplasty with patellar resurfacing compared to total knee arthoplasty without patellar resurfacing, the study was carried out as a randomised parallel trial in patients who had stage III and IV primary osteoarthrosis of only 1 side of the knee with a 2 year follow-up. Twenty-one patients underwent patellar resurfacing and 26 patients had no patellar resurfacing. Joint position sense was evaluated by the average absolute different angle of the operated knees from the non operated knees which was the asymptomatic knee and acted as the reference knee. Position sense was improved significantly in both groups. However, the patients without patellar resurfacing had better im provement. The patients with patellar resurfacing had better results in terms of anterior knee pain and tenderness. Patellar resurfacing should be used in severe articular cartilage damage, not as a routine operation.

Key word : Joint Position Sense, Knee Arthroplasty

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Resurfacing of the patella at the time of a total knee arthoplasty remains controversial(1). Most of the reports have revealed no significant difference in clinical evaluation between total knee arthroplasty with and without patellar resurfacing (2-16). All of the previous studies globally evaluated and compared knee function and knee score of the patients who underwent total knee arthroplasty with and without patellar resurfacing but no study had evaluated joint position sense.

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Position sense of the synovial joint depends on the function of mechanoreceptors in the skin, muscles, tendons, ligaments, joint capsules and the subchondral bones[17,18]. Total knee arthoplasty which usually needs rather extensive soft tissue and bone dissection and removal may lead to a further decrease in the sensation[19,20]. On the other hand, improvement of knee position sense after total knee arthroplasty with good soft tissue balance has been reported[21]. Furthermore, posterior cruciate ligament retaining prosthesis has also been found to confirm a greater improvement in joint position sense than a posterior cruciated sacrificing design [22]. Mechanoreceptors within the cruciate ligament can be preserved in the cruciate retained knee arthroplasty[18]. This finding supports the concept of conservative surgery in which preservation of the normal structures should be carried out when possible. Most of the reports were carried out as a cross-section study and there was no information of changes of the joint position sense during the post-operative period.

It was our interest to compare the position sense of the knee after total knee arthroplasty with and without patellar resurfacing during the post operative period for at least 2 years.

MATERIAL AND METHOD

The study was performed as a parallel clinical trial with at least 2 years follow-up. The inclusion criteria of the patients were 1) primary osteoarthrosis of the knee stage III or IV on the operated side with asymptomatic or osteoarthrosis stage I to II which needed no surgery during the follow-up on the other side, 2) adequate soft tissue balance was performed, 3) no evidence of systemic neurological disorders and spinal problems, 4) no underlying disease which compromised neural functions, 5) the ability to walk with or without walking aids before surgery, and 6) active movement of the knee from 0 to 90 degrees or more on both knees. The exclusion criteria were 1) patients who had had knee surgery or injury before the trial, 2) inability to walk before the trial, 3) patients under 60 years old, 4) technical error during total knee replacement, 5) incomplete follow-up and 6) patients who needed knee surgery on the other side during the follow-up.

Patients who fulfilled the criteria were evaluated for their knee position sense by active and passive reproduction of the operated knee using the non operated knee which was the asymptomatic knee as the reference knee. In the first method, or the active reproduction method, the patient lay down on the examination bed in prone position with straight hips and knees to avoid body weight passing through the knees. The patient's eyes were closed by a special pad to prevent eye control motion. The patient's feet were placed beyond the edge of the table to allow them to hang freely. This was the zero degree of the knee. The knee which was planned to be operated on was evaluated with regard to the position sense and the other knee was used as the reference knee. A hammock was placed to support the reference knee at the ankle. A rope was fixed to the hammock and passed through a pulley on the ceiling at the point that allowed flexing of the reference knee from zero degree to 100 degrees in the saggital plane of the reference knee by the examiner pulling the rope. CIBEX EDI 320 goniometer, CIBEX International, Ronkonkoma, New York, USA, was fixed to the calf of each leg by velco straps (Fig. 1). The patient was asked to relax both lower limbs and the goniometer was set to zero degree. Then, the examiner pulled the rope to flex the reference knee and stopped at a random position between 0 to 90 degrees. The flexion angle was recorded on the goniometer. Then, the patient was asked to flex the other knee actively to the same position. When the patient stopped moving the knee, the flexion angle was recorded. The absolute different angle between the reference and the evaluating knee was calculated and recorded. Six positions, 3 positions below 45 degrees of knee flexion and 3 positions above 45 degrees of knee flexion were used to evaluate the active positioning.

In the second method, the patient was placed in the same position as the previous examination. A short leg airsplint was applied on the ankle of the knee which was planned to be operated on. A rope was fixed to the airsplint at the heel with a special hook. The rope was passed through the first pulley on the ceiling at the point allowing passive flexion of the evaluation knee from 0 to 90 degrees in the saggital plane by the examiner pulling the rope. (Fig. 2). The other knee was used as the reference knee. A hammock was placed to support the ankle of the reference knee. A rope was fixed to the hammock and was passed through the second pulley which was fixed on the ceiling at the point allowing passive flexion of the reference knee from

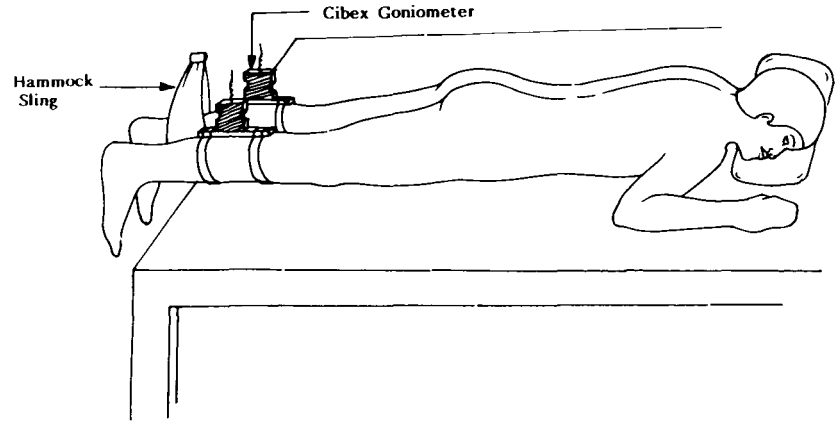

Fig. 1. Schematic picture of the patient undergoing active knee positioning evaluation.

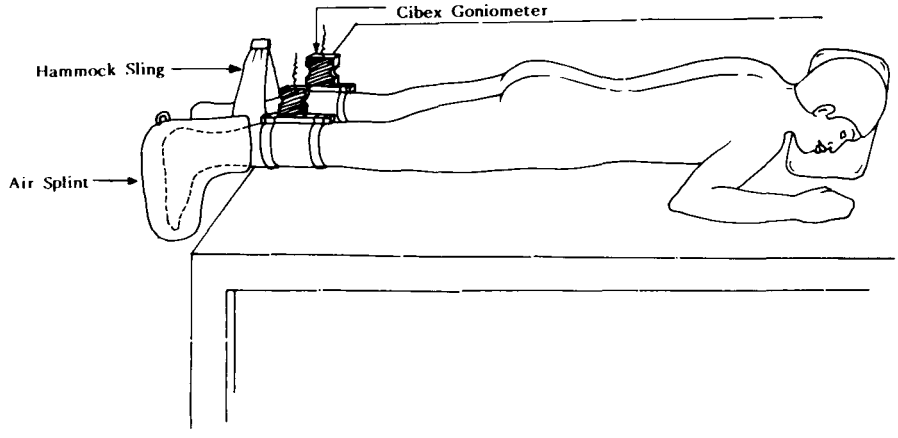

Fig. 2. Schematic picture of the patient undergoing passive knee positioning evaluation.

0 to 90 degrees in the saggital plane. CIBEX EDI 320 gomiometer was fixed to the calf of each knee with velco straps. The patient was asked to relax and the goniometers were set to zero. Then, the examiner pulled the second rope to flex the reference knee and stopped at 6 random positions between 0 to 90 degrees, 3 positions below 45 degree knee flexion and 3 positions above 45 degree knee flexion. When the reference knee was stopped at a particular position, the flexion angle was recorded on the goniometer. Then, the first rope was pulled by the examiner to flex the evaluating knee slowly, about 10 degrees/second[20]. The patient was asked to ring a bell when he felt that the evaluating knee was flexed to the same position as the reference knee or felt that both knees were at the same position. The absolute different angle between the reference knee and the evaluating knee was recorded. All patients who passed the position sense evaluation were allocated into 2 groups randomly by their hospital number. All were prepared for total knee replacement by conventional method and were told clearly about the purpose and procedure of the study.

In group 1, patients underwent total knee arthroplasty with Insall-Burstein II prosthesis with patellar resurfacing. The conventional steps and techniques were used[9]. All osteophytes around the patella were removed. The articular cartilage of the patella was examined and staged before resur-

facing was performed[12]. After the operation, closed drainage system was used. Perioperative antibiotic administration with cefazolin and amikacin was used in every patient. Pressure dressing with posterior slap was used to temporarily immobilize the knee in full extension. The drain was removed 48 hours after the operation. All dressings and slaps were removed on the 7th post operative day. Then, active and passive continuous knee motion exercises were applied to every patient. Partial weight bearing with walking aids and knee brace were used for another 2 months. Quadriceps exercise and position sense training with eye control were used in every patient. Knee position sense evaluation was repeated at 3, 6, 9, 12, 18 and 24 months after the operation in every patient. Patello-femoral pain and tenderness were also evaluated periodically.

In group 2, the same procedure of total knee arthroplasty and the prosthesis were used except that patellar resurfacing was not performed. Post operative management and evaluation was carried out as in group 1. The examiner did not know which group the patients were in. Knee function of the patients was evaluated by the Hospital for Special Surgery Knee Score[24]. Global evaluation was also evaluated by the patients. The discrete data were analysed by Fisher exact test and Chi-square test and the continuous data were evaluated by analysis of varience.

RESULTS

There were 21 patients in group 1 and 26 patients in group 2. The basic biographic data and clinical status of the patients' knees of the 2 groups were similar (Table 1). The average absolute dif-

Table 1. Biographic data of the patients, group 1 total knee arthroplasty with patellar resurfacing and group 2 total knee arthroplasty without patellar resurfacing.

		Group 1 (n=21)	Group 2 (n=26)	P-value
Sex:	Male	8	10	P=0.2365
	Female	13	16	
Age:	Average	72.75±8.77	71.75±9.25	P=0.3501
	Range	60 to 80	60 to 82	
Weight:	Average	66.0±9.6	67.6±6.26	P=0.2018
	Range	55 to 80	58 to 75	
Operated knee				
:	Dominant	15	18	P=0.2481
	Non dominant	6	8	
Non operated knee				
:	Asymptomatic	8	12	P=0.2013
	Osteoarthrosis I to II	13	14	
Staging of the cartilage of the operated patella intraoperation		-	-	x^2=0.128
:	Normal	8	9	P>0.05
	Mild damage	9	11	
	Moderate damage	4	6	
	Severe damage			
Patello-femoral pain at preoperation				
:	Mild	2	3	x^2=0.052
	Moderate	15	18	P>0.05
	Severe	4	5	

Table 2. The average absolute different angles of the operated knees from the reference knees which were evaluated by active reproduction positioning.

	Average absolute different angle (degrees)						
	Preoperation	3 months	6 months	9 months	12 months	18 months	24 months
Group 1	18.16±6.5	13.0±3.6	11.4±4.1	11.0±3.5	9.16±4.3	9.26±4.8	8.16±3.2
Group 2	19.33±5.9	10.8±3.4	9.6±3.5	9.2±3.5	9.33±4.4	9.16±3.9	7.69±3.1
P-value	0.16	0.01	0.03	0.03	0.29	0.5	0.12

Table 3. The average absolute different angles of the operated knees from the reference knees which were evaluated by passive reproductive positioning.

	Average absolute different angle (degrees)						
	Preoperation	3 months	6 months	9 months	12 months	18 months	24 months
Group 1	20.71±5.6	13.71±3.25	12.71±4.9	11.01±3.0	10.21±3.02	10.42±5.4	9.28±2.8
Group 2	21.28±5.5	12.28±3.7	10.14±3.0	10.85±3.3	8.85±3.3	8.14±3.20	8.25±2.6
P-value	0.24	0.01	0.02	0.01	0.03	0.12	0.02

Table 4. Changes of the knee rating scale during post operative period.

	Average point score						
	Preoperation	3 months	6 months	9 months	12 months	18 months	24 months
Group 1	44.2±4.9	43.0±2.9	59.2±5.7	71.2±3.0	75.4±3.6	76.2±3.0	76.6±2.5
Group 2	41.8±3.4	48.6±4.5	66.0±4.1	71.6±2.4	76.2±2.8	77.0±3.2	77.2±2.6
P-value	0.16	<0.001	<0.001	0.36	0.15	0.14	0.16

ferent angles of the operated knee and the reference knee at preoperative evaluation of the 2 groups were comparable both in active and passive evaluation (Table 2 and 3). Active reproduction of positioning resulted in smaller average absolute different angle compared to the passive reproduction evaluation. After the operation, both groups had improvement in positioning sense as the average absolute different angles were smaller (Table 2 and 3). However, group 2, with total knee arthroplasty without patellar resurfacing had better improvement especially in the first year after the operation, as evaluated by active and passive reproduction of position. Knee rating scale in both groups changed by time and correlated well to the changes of position sense with the correlation coefficient of -0.82 to -0.93 (Table 2, 3 and 4). Group 2 had slightly better position sense and knee score 3 to 6 months after the operation (Table 3).

After the operation, all patients in both groups had much improvement in patellofemoral pain. Group 1 had less pain and tenderness at the 1 and 2 year follow-up (Table 5). At the 1 year follow-up, two patients in group 2 had mild pain at the patella with tenderness in 1 patient. Both felt dissatisfied with the result. These 2 patients had severe articular cartilage damage. At the 2 year follow-up 3 patients in group 2 and 1 patient in group 1 had mild anterior knee pain. No patient in group 1 had clinical and radiographic signs of patellar loosening during follow-up.

DISCUSSION

Resurfacing of the patella in total knee arthroplasty remains controversial because most reports have been of open studies. All of the researchers who performed prospective control trial paid attention only to functions, range of motion,

Table 5. The number of the patients who had patellofemoral pain and tenderness while compressing and griding the patella.

	At 1 year follow-up			At 2 year follow-up		
	Mild pain	Mild pain + Tenderness	Total	Mild pain	Mild pain + Tenderness	Total
Group 1 n=21	1 (4.7%)	-	1 (4.7%)	1 (4.7%)	-	1 (4.7%)
Group 2 n=26	1 (3.8%)	1 (3.8%)	2 (7.6%)	2 (7.6%)	1 (3.8%)	3 (11.4%)

anterior knee pain and functional knee scoring but no studies were made of the position sense[2,4,12].

In total knee arthroplasty without patellar resurfacing, the pressure sensitive receptor in the subchondral bone might contribute to the joint position sense. However, restoration of the patella height by resurfacing and retensioning the quadriceps retinacular fibres also affected the joint position sense. Warren et al found that mean proprioceptive inaccuracy was found to be slightly better in the total knee with patellar resurfacing compared to the one without patellar resurfacing, but there was no significant difference[22]. This finding was different from our study which showed better results in joint position sense in group 2, total knee arthroplasty without patellar resurfacing. Although the mechano-receptors in the quadriceps mechanism might readjust themselves with patellar resurfacing prosthesis, pressure sensitive receptors in the subchondral bone of the patella were totally destroyed after patellar resurfacing.

Knee score of the patients in both groups changed during the post operative period and there was no significant difference between the two groups at the 2 year follow-up. There was significant difference of improvement of knee score before and after the operation. Group 2 had significant better knee score and joint position sense than group 1, 3 to 16 months after the operation. These findings might reflect the function of mechanoreceptor of the patellar which was not destroyed in group 2, total knee arthroplasty without patellar resurfacing. Function of subschondral mechanoreceptor is more important than the receptors in the soft sissue.

All patients in group 2 who had mild pain and tenderness at the patellar had severe articular damage. From this finding, patellar resurfacing should be performed only in patients who have severe articular damage stage 4. Patellar resurfacing at the time of total knee arthroplasty should not be routinely performed to provide better improvement of the joint position.

SUMMARY

Total knee arthroplasty without patellar resurfacing resulted in better improvement in joint position sense and knee score 3 to 6 months after, the operation. However, there was no significant difference at the 2 year follow-up.

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อิทธิพลของ patellar resurfacing ต่อความรู้สึกของข้อในการใส่ข้อเข่าเทียม

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ศึกษาถึงอิทธิพลของ patellar resurfacing ต่อความรู้สึกของตำแหน่งของข้อในผู้ป่วยที่ได้รับการผ่าตัดเปลี่ยนข้อเข่าเทียมในผู้ป่วยที่มีข้อเสื่อมข้างเดียว และติดตามผลเป็นเวลา 2 ปี โดยศึกษาแบบ double blind trial กลุ่มที่ได้รับ patellar resurfacing มี 21 ราย ส่วนกลุ่มควบคุมมี 26 ราย ไม่ได้รับการทำ patellar resurfacing ขณะทำการเปลี่ยนข้อเข่า วัดมุมที่เบี่ยงเบนจากมุมของขาข้างปรกติ การผ่าตัดใช้ข้อเทียมชนิด IB2 ทั้งสองกลุ่ม วิธีการผ่าตัดและดูแลหลังผ่าตัดเหมือนกัน พบว่าทั้งสองกลุ่มมีความรู้สึกถึงตำแหน่งของข้อดีขึ้นกว่าก่อนผ่าตัด แต่กลุ่มที่ไม่ได้รับการทำ patellar resurfacing มีการฟื้นตัวของความรู้สึกของข้อเร็วกว่าอย่างมีนัยสำคัญในช่วง 1 ปีแรกหลังผ่าตัด

คำสำคัญ : ข้อเข่าเทียม, ความรู้สึกของข้อ

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