Recovery of Joint Position Sense After Total Knee Replacement : The Effects of Soft Tissue Dissection

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Abstract

To find out the effect of sharp dissection compared to electrocautery for soft tissue release and balancing in total knee replacement on proprioceptive sense, the study was carried out as a parellel double blind trial with 2 year follow-up. There were 52 patients in the sharp dissection group and 42 patients in the electrocautery group. Position sense of the operated knees was evaluated by the ability to reproduce the same angles as the non operative knees which acted as reference knees. The absolute different angles were used to evaluate the position sense. Before the operation, the patients in both groups had similar biographic data, pathology, and absolute different angles of knee positioning. After the operation, both groups had improvement in knee position sense; however, the sharp dissection group had more rapid improvement in the 1st post operative year. There was no significant difference at the 2 year follow-up.

Key word : Total Knee Replacement, Joint Position Sense, Proprioceptive Sense

Position sense of the joint depends on the function of mechanoreceptors and afferent nerve fibres in the muscle, tendon, skin, joint capsule and ligaments[1,2]. In large weight bearing joints such as the knee, position sense is one of the most important factors influencing its function. Decline of position sense of the knee has been reported in aging and osteoarthrosis[3-5]. Total knee replacement with good soft tissue balance can improve position sense of the knee[5-7]. However, in the process of soft tissue release, a certain amount of mechanoreceptors and nerve fibres may be destroyed. Insall et al advocated use of sharp dissection with scalpel and chisel in soft tissue balance and release[8]. Scott et al used electrocautery to minimize bleeding while releasing the soft tissue

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(9). To compare the influence of these 2 techniques in soft tissue release and balance on post operative position sense of the knee, the study was carried out as a parallel double blind trial with a 2 year follow-up.

PATIENTS AND METHOD

The inclusion criteria of the patients were 1) primary osteoarthrosis of the knee stage IV of only 1 side, and total knee replacement was performed only on this side, 2) adequate soft tissue release to balance the knee was performed, 3) no evidence of systemic neurological disorders and neural involvement from any spinal problem was observed clinically or by electrodiagnosis, 4) no underlying systemic disease, such as metabolic, autoimmune, vascular, renal and liver diseases, 5) patients who could walk with or without walking aids before surgery, and 6) patients who could move their knees actively at least from 0 to 90 degree flexion in both sides.

Exclusion criteria were 1) injured or operated knee under any condition before the trial, 2) patients who could not walk or those who had to use a wheelchair before the trial, 3) patients who had secondary osteoarthrosis, 4) patients who were younger than 60 years old, 5) the patients who could not have good alignment of the prosthesis and/ or stability of the knee after the operation due to technical error during the surgery, 6) patients who could not be followed-up and those who had poor compliance, 7) patients who had any complication which directly related to the operation, and 8) severe bilateral osteoarthrosis of the knees.

The patients who fulfilled the criteria were prepared for total knee replacement. All were evaluated with regard to their knee position sense by active and passive methods. In the active method, the patient lay down on the examination bed in prone position with straight hips and 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 about the position sense and the other knee or the normal 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 to flex the reference knee from zero degree to 100 degrees in the saggital plan of the reference knee by pulling the rope by the examiner. CIBEX EDI 320 goniometer, CIBEX International, Ronkonkoma, New York, USA, was fixed to the calf of each leg with 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

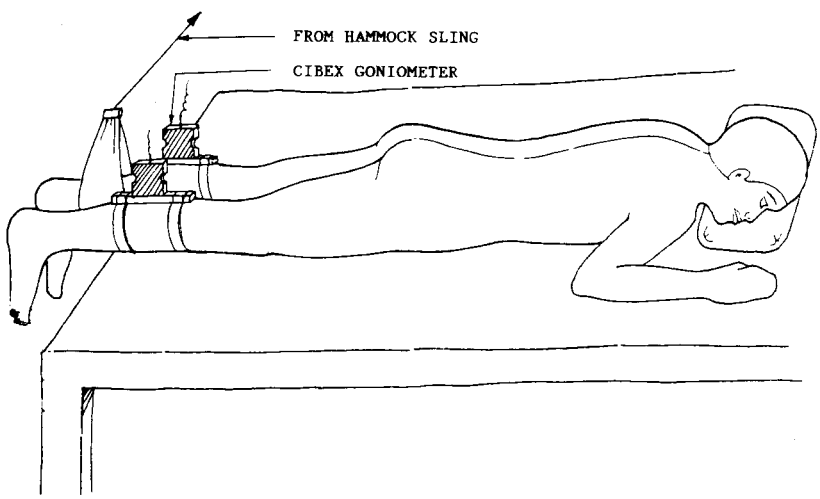

Fig. 1. Schematic picture of the patient underwent active knee positioning evaluation.

other knee, which was going to be operated on, actively to the same position. When the patient stopped moving the knee, the flexion angle was recorded. The abolute different angle between the reference and the evaluating knee was calculated and recorded. Six positions, 3 below 45 degree knee flexion and 3 above 45 degree knee flexion were used to evaluate the active position sense.

In the second method, the patient was placed in the same position as the previous examination. The patient's eyes were also closed. A short leg air-splint was applied on the ankle of the knee which was to be operated on. A rope was fixed to the air splint 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 evaluating knee in the saggital plan from 0 to 90 degrees 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 0 to 90 degrees in the saggital plan. CIBEX EDI 320 goniometers were 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 to flex the evaluating knee slowly, about 10 degrees / second[3]. 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 difference angles between the reference knee and evaluating knee were 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 all were told clearly about the procedure. Non steroidal antiinflammatory drugs were discontinued at least 2 weeks before the operation.

In group 1, the patients underwent total knee replacement with the cruciate substituting PFC modular total knee prosthesis with patellar replacement. The operation was performed under tourniquet. During soft tissue dissection and release, scalpel and sharp chisel were used. Electrocautery was used at the blood vessel only. The steps and techniques of instrumentation were carried out as described by Ranawat et al[10]. After the bones were completely shaped, the tourniquet was released and the active bleeding spots were stopped by electrocautery. Perioperative antibiotic prophylaxis with intravenous cephazolin and amikacin was used in

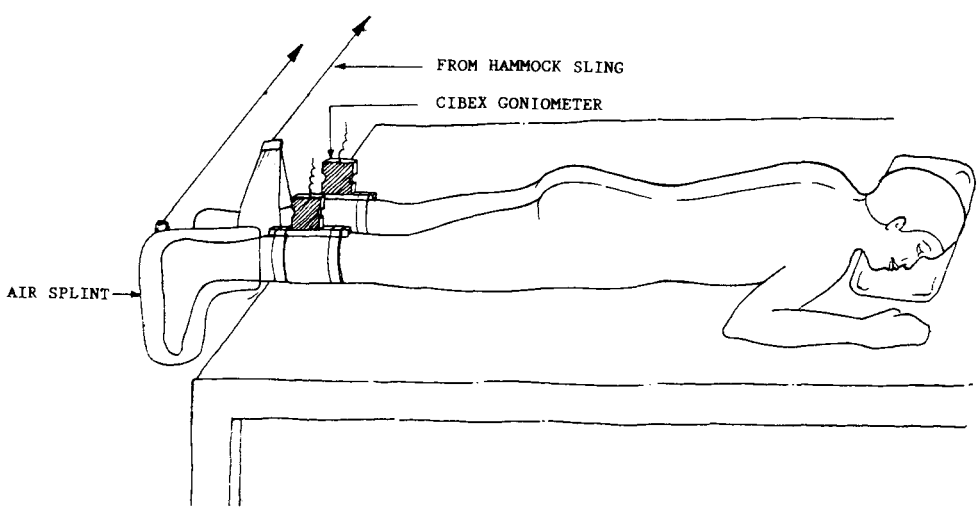

Fig. 2. Schematic picture of the patient underwent passive knee positioning evaluation.

every patient. After the operation, closed drainage system was used. Pressure dressing with posterior slap was used to immobilize the knee in full extension. The drain was removed 48 hours after the operation. All dressing and slaps were removed on the 7th post operative day. Active and passive knee motions were allowed. Patient control analgesia with intravenous morphine was used in every patient for 3 to 5 days after the operation. Partial weight bearing with walking aids and knee brace were used for another 2 months. Quadriceps exercises and position sense training with eye control motion were advocated in every patient. Knee position sense evaluation was repeated in every patient at 3, 6, 9, 12, 18 and 24 months after the operation.

In group 2, the same procedure of total knee replacement and prosthesis were used, except that electrocautery was used to dissect for knee exposition and soft tissue release. Post operative management and evaluation were carried out as in group 1. To minimize bias, the examiners did not know which group the patients were in. The discrete data were analysed by Chi-square-test and the continuous data were evaluated by analysis of variance.

RESULTS

Biographic data of the patients in both groups were similar (Table 1). There was no significant difference of the absolute different angles of the knee positioning of the operated knee from the reference knee at preoperative evaluation between the 2 groups (Table 2 and 3). However, after the operation at 3 to 9 months' evaluation, the patients in group 1 had less in the absolute different angles of the knee positioning than the patients in group 2 (Table 2 and 3). After 1 year follow-up, both groups had similar results of knee positioning evaluation. There was no significant difference in the range of motion of the operated knee between the groups. All patients had minimal post operative pain with visual analog scale less than 3. No immediate complication was found and there was no infection in

Table 1. Biographic data of the patients, group 1 soft tissue dissection with scalpel and sharp instruments and group 2 soft tissue dissection with electrocautery.

	Group 1 n=52	Group 2 n=42	P-value
Sex : Male	18	13	$x^2 = 2.39$
Female	34	29	P>0.05
Age : Average	70.33±11.06	70.66±8.50	P=0.4690
Range	60 to 82	62 to 79	
Side : Dominant	36	30	$x^2 = 2.32$
Non-dominant	16	12	P>0.05

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

	Absolute different angles (degrees)						
	Preoperation	3 months	6 months	9 months	12 months	18 months	24 months
Group 1 n=52	18.14±6.8	15.01±3.05	13.01±2.9	9.14±3.13	10.42±2.4	9.71±2.6	8.71±2.4
Group 2 n=42	18.57±6.6	17.28±4.3	15.28±3.6	13.01±3.5	9.85±2.9	9.85±3.2	9.14±2.8
P-value	0.3501	0.0009	0.0003	0.0001	0.0941	0.3511	0.1576

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

	Absolute different angles (degrees)						
	Preoperation	3 months	6 months	9 months	12 months	18 months	24 months
Group 1 n=52	19.57±8.8	15.77±3.9	11.41±3.8	9.28±3.7	9.85±4.6	9.28±3.0	8.71±3.5
Group 2 n=42	19.67±8.1	19.14±4.6	15.71±4.2	12.57±4.7	9.24±4.2	9.81±3.5	9.14±3.2
P-value	0.5100	0.0001	0.0001	0.0005	0.0581	0.0691	0.2300

Table 4. Need of blood transfusion of the patients.

Blood transfusion	Yes	No	Total
Group 1	16	36	52
Group 2	12	30	42
Total	28	66	94

$x^2 = 2.32$
$P>0.05$

any of the patients. Most of the patients in both groups could ambulate with walking aids and knee brace within 10 days. All could walk independently with a stick within 2 months after the operation.

Blood transfusion was needed in a certain number of patients in both groups. However, there was no significant difference in terms of numbers of the patients who needed blood transfusion (Table 4). In group 1, 1 to 3 units of blood were needed in 16 patients with an average of 1.5 ± 0.75 units and 1 to 2 units of blood were needed 12 patients of group 2 with an average of 1.33 ± 0.51 units. Group 2 needed slightly less blood transfusion; however, there was no significant difference from group 1, p=0.0673.

The average operative time in group 1 was 122.00 ± 27.05 minutes, ranging from 96 to 150 minutes. In group 2, the average operative time was 113.33 ± 25.16 minutes, ranging from 90 to 140 minutes. There was no significant difference in terms of operative time p=0.2310.

DISCUSSION

Proper soft tissue release gives balance to the collateral ligaments and joint capsule which results in better positioning sense after total knee replacement[5-7]. However, some mechanical receptors and nerve fibres may be injured during soft tissue release. Electrocautery can produce more tissue damage than the scalpel. Less soft tissue injury around the knee may result in better positioning of the operated knee in group 1 compared to group 2.

Using electrocautery did not result in more post operative pain as all patients had adequate pain control by intravenous morphine. The aim of using electrocautery for dissection was to minimize blood loss and lessen the operative time. Group 2 had slightly less blood transfusion and operative time. The number of patients may not be large enough to demonstrate the difference. Laser surgery may be used in knee arthroplasty in the future as it can control bleeding better than sharp dissection by scalpel and it produces less injury to soft tissue than electrocautery.

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การเปลี่ยนแปลงความรู้สึกของข้อเข่าหลังการผ่าตัดเปลี่ยนข้อเข่าเปรียบเทียบระหว่างการเจาะเนื้อเยื่อด้วยเครื่องจี้ความร้อนและใบมีด

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เปรียบเทียบผลการฟื้นตัวของประสาทรับความรู้สึกของข้อเข่า หลังการผ่าตัดเปลี่ยนข้อเข่า โดยการเจาะเนื้อเยื่อด้วยความร้อนจากเครื่องจี้กับการเจาะด้วยใบมีด ศึกษาในผู้ป่วย 2 กลุ่ม กลุ่มแรก 52 ราย การผ่าตัดใช้ใบมีดเจาะเนื้อเยื่อ กลุ่มที่สอง 42 ราย การเจาะใช้เครื่องจี้ด้วยความร้อน วัดความสามารถในการงอเข่าข้างที่ผ่าตัดให้เท่ากับการงอเข่าข้างที่ดีที่มุมต่าง ๆ ตั้งแต่ 0 ถึง 90 องศา ทั้งให้ผู้ป่วยงอข้อเข่าที่ผ่าตัดเองและผู้ตรวจดึงให้เข่างอ การวัดใช้เครื่องวัดมุม CIBEX EDI 320 พบว่ากลุ่มที่ใช้ใบมีดเจาะมีการฟื้นตัวของประสาทรับความรู้สึกถึงตำแหน่งของข้อเร็วกว่าการเจาะด้วยเครื่องจี้ความร้อนในช่วงปีแรกหลังการผ่าตัด

คำสำคัญ : ข้อเข่าเทียม, ความรู้สึกของข้อ, ข้อเข่าเสื่อม

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