

Knee stability after repair of isolated midsubstance tears of the posterior cruciate ligament

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ABSTRACT

This study was made to compare the results after operative versus non-operative management for tears in the substance of posterior cruciate ligament. The subjects were 40 patients, half of whom were managed operatively and the other half non-operatively. End-to-end suture was performed on the operated group. The procedure was followed by cast immobilization for 4 weeks. Non-operative management consisted of immobilization in a cast for 4 weeks after arthroscopy. The average follow-up periods were 6 years 7 months and 4 years 3 months. The operated knees were significantly more stable than those of the non-operated group on stress radiographs ($p < 0.0001$), but not to the extent of an age-matched control group ($p < 0.0001$). The knee rating scores did not indicate any improvement of the functional outcome in the operated group. Surgery resulted in better posterior laxity than non-operative management; the achieved stability, however, was clearly less than in controls.

Key words: *knee, posterior cruciate ligament, stress radiograph.*

INTRODUCTION

In 1944, Abbott et al.¹ reported a case of posterior cruciate ligament injury managed operatively through the mid-line approach with sectioning of the medial head of the gastrocnemius. O'Donoghue¹⁸ recommended surgical repair for posterior cruciate ligament injury through this incision in 1960, and subsequently operative management was adopted by many authors.^{5, 14, 27} The view taken was that when a knee ligament was completely torn, surgical repair should be performed as soon as possible.^{18, 30}

Follow-up studies with relatively large series of cases, however, cast doubt on the effectiveness of operative management for isolated posterior cruciate ligament injuries except in cases of avulsion fracture of the tibial attachment or tears complicated by other knee ligament injuries.²⁰ Non-operative methods thus became widely accepted for the isolated posterior cruciate ligament injury in the substance of the ligament.^{6, 19, 23} Now with long-term results available, some point to deterioration after non-operative treatment with advancing years.^{2, 9, 13} In fact, recent reports^{3, 4} concluded that primary reconstruction for isolated posterior cruciate ligament injuries was more appropriate than primary repair or non-operative

treatment in the acute phase. The appropriate treatment method for such cases is therefore still controversial.

An objective evaluation for the stability after knee ligament injury is necessary for an assessment of therapy. Stress radiography is superior to arthrometry, facilitating understanding of progression after knee ligament injury.¹⁰ There were a few reports of stress radiography after non-operative treatment²⁴, but no reports of quantitative documentation of posterior laxity after operative versus non-operative management. The present authors compared retrospectively the sagittal laxity of the joint on stress radiography between operative and non-operative cases of acute substance tearing of the posterior cruciate ligament.

MATERIALS AND METHODS

From April 1982 to June 1990, the authors treated 40 patients with acutely torn posterior cruciate ligaments. Up to 1986, a primary repair procedure on the torn ligament through the posteromedial approach was advised and performed on all patients who gave consent for surgery. A previous study by one of the authors, however, revealed that quite a number of these sutures were associated with persistent posterior instability.²⁵ We therefore reverted to non-operative methods, and no patients have undergone primary repair since 1986. We had 2 groups of patients, one with repaired posterior cruciate ligaments and the other undergoing non-operative management.

All the patients underwent arthroscopy within 2 weeks after the injury. The diagnosis of posterior cruciate ligament tears was confirmed by arthroscopy and a positive posterior drawer sign at 90° of knee flexion under anesthesia. Posterior cruciate ligament tears which were complicated by other knee ligament injuries, neurovascular injuries, and tears with avulsion fractures at the end of stump, were not included. No patient had bilateral knee involvement.

Operated group

Primary repair was performed for 20 of the 40 patients, 17 males and 3 females. The ages ranged from 13 to 49 years (mean: 26.4 ± 7.8 years). There were 12 right knee injuries and 8 left knee injuries. The injuries occurred during sporting activities in 5 cases, 14 were the result of traffic accidents and one was caused by a fall.

A 10cm-long lazy-s longitudinal incision over the medial side of the posterior aspect of the knee, a modification of Klein's posterior incision,¹⁵ was made.

The incision was deepened by blunt dissection in the plane between the semitendinosus and medial head of the gastrocnemius muscle. Then the posterior capsule was exposed and incised longitudinally at the center, and the posterior cruciate ligament rupture site was exposed.

The sites of the posterior cruciate ligament tears were divided into 3 regions in accordance with the operative findings: proximal third, 4 knees; central third, 6 knees; and distal third, 10 knees. End-to-end multiple suturing was performed on the torn posterior ligaments. The posterior capsule incision was sutured tightly after the ligament repair.

A toe-to-groin cast was applied after the operation. Isometric quadriceps exercise was encouraged immediately after the surgery, and weight bearing was permitted at the beginning of the third week in the cast. The cast was not removed for 4 weeks, and isotonic and a range of motion exercises were started after the removal. Bivalve casts were worn during ambulation until the quadriceps muscle tone difference with the contralateral thigh was reduced.

Non-operated group

Twenty patients were managed non-operatively. The group consisted of 19 men and one woman, ranging in age from 10 to 38 years (mean: 25.9 ± 7.7 years). There were 11 right knee injuries and 9 left knee injuries. The injuries occurred during sporting activities in 12 cases, 7 in traffic accidents, and one was caused by a fall.

Posterior cruciate ligament tears in the non-operated group were treated employing a knee brace or a toe-to-groin cast, as with the operated group. Isometric quadriceps exercises were encouraged immediately after arthroscopy. At the beginning of the third week, weight bearing was permitted in the cast. The cast was not removed for 4 weeks, and isotonic as well as a range of motion exercises were started after the removal. Bivalve casts were worn during ambulation until the loss of quadriceps muscle tone had been ameliorated.

All 40 patients returned to the author's clinic to be reexamined more than 2 years after their initial injury. Routine radiographs with anteroposterior, lateral and skyline views of both involved and uninvolved knees were evaluated using Fairbank's criteria (grade 0 to 4).⁷ Radiographic changes were recorded only when they were more advanced than those of the opposite normal side.

Stress views of posterior translation of the tibia were taken of the injured knees. Account was made for the radiological documentation of the posterior

drawer test with the aid of a forced translation apparatus (Telos Stress Device; Fallston, MD, USA). The knee was flexed to 90°, the thrust pad of the apparatus was placed on the proximal portion of the tibia and a backward force of 147N was added.²² The posterior translation of the tibia was measured on radiographs according with the modification of Jacobsen's method¹² described by Murase et al.¹⁷ (Mid-point displacement ratio, Fig. 1). Twenty controls who had no knee trouble also underwent the stress radiography (16 men and 4 women, ranging in age from 19 to 50 years, mean: 30.8 ± 9.3).

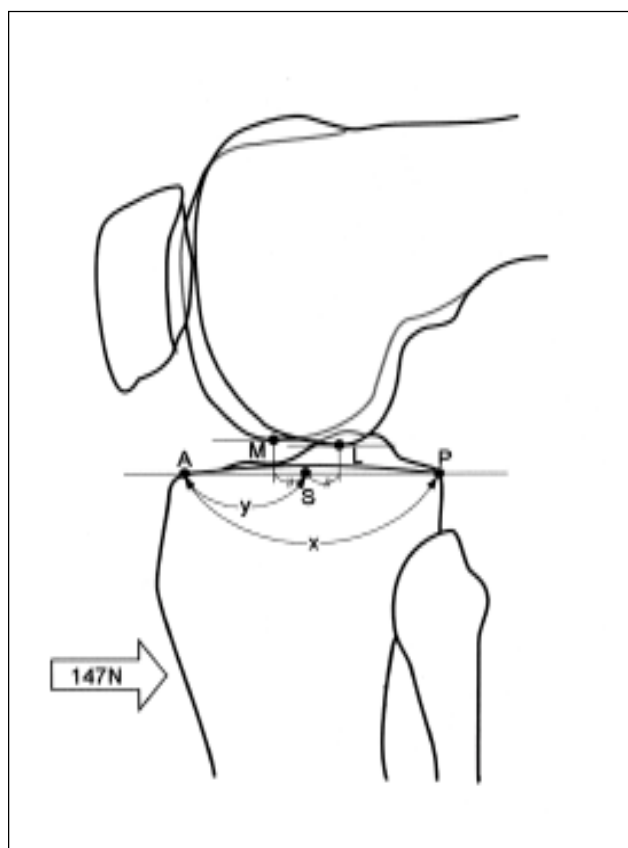


Figure 1 Technique for measurement of posterior translation of the tibia on the femur. The knee joint was flexed 90° with the 2nd metatarsal bone in the vertical plane through the tibial axis, and a lateral view was exposed at a film-focus distance of 1m during posterior traction. The baseline was drawn through the anterior (A) and posterior margins (P) of the tibial plateau on the film. The tangents to the inferior border of the medial (M) and lateral condyles (L) were drawn parallel to the baseline. A perpendicular line from the resultant nearest point of each condyle was dropped to the baseline to give an intersection, and a point for the midpoint between the intersections (S) is obtained. The displacement ratio (DMR) was calculated according the following formula: $DMR = y/x \times 100$. x: distance from A to P (mm), y: distance from A to S (mm).

The knee rating score was determined according to the scoring scale for the knee ligament injuries of the Japanese Orthopaedic Association based on a total of 100 points (Table 1).¹¹ Follow-up periods for the operated group were from 5 years 2 months to 10 years, with a mean of 6 years 7 months (78.6 ± 12.3 months). Those of the non-operated group were from 2 years to 13 years, with a mean of 4 years 3 months (51.0 ± 10.2 months).

Table 1
Criteria for evaluating ligament injuries of the knee

Items	points		
	right	left	
Giving way	never	9	9
	rarely	5	5
	often	0	0
Descending stairs or slopes unstable feeling	none	20	20
	often	8	8
	at all times	0	0
difficulty	none	14	14
	slight	7	7
	difficult or impossible	0	0
Twisting	no difficulty	9	9
	slightly difficult	3	3
	impossible	0	0
Sitting straight	no problem	14	14
	slight difficulty	7	7
	difficult or impossible	0	0
Anterior drawer test	none	10	10
	slight	5	5
	definite	0	0
Gravity test	none	10	10
	slight	5	5
	definite	0	0
Varus, valgus test	none	14	14
	slight	9	9
	definite	0	0

Total score

The differences of degenerative changes between the groups on the radiographs were analyzed by the Chi-square test. The t-test was used to analyze differences in the posterior translation of the tibia on

stress radiographs. The Kruskal-Wallis test was employed to detect a significant difference of posterior instabilities among 3 regions where the tears occurred. The Mann-Whitney test was employed to analyze differences in the knee rating scores. $P < 0.05$ was rated as significant.

RESULTS

Radiographic examinations revealed 3 of the 20 patients of the operated group and one of the 20 of the non-operated group showed a degenerative change which was thought to be caused by knee ligament injuries. This was of grade one severity in all cases, without any significant difference between the 2 groups.

The displacement ratios on the stress view for the operated group were from 43 to 59%, (mean 46.9 ± 3.7), and those of the non-operated group were from 28 to 45%, (mean 37.1 ± 4.8) at follow-up. The operated knees were more stable than those of the non-operated group. The difference was highly significant ($p < 0.0001$); the stability was, however, still significantly less than that for the control group (52 to 66%, mean 59.8 ± 3.5 , $p < 0.0001$) (Fig. 2).

The mean displacement ratio for the 21 knees injured in traffic accidents was $43.1 \pm 6.9\%$. The values

for the 17 knees injured during sports activities was $39.9 \pm 6.2\%$. No significant difference was apparent between the two causes.

Among the 20 patients in the operated group, the mean displacement ratio of 4 patients with a tear in the proximal third was $47.0 \pm 1.0\%$, that of 6 in the middle third was $48.0 \pm 5.7\%$, and that of 10 in the distal third was $46.0 \pm 2.3\%$. There was no significant difference among the 3 regions. The site of the posterior cruciate ligament rupture did not influence the sagittal laxity.

The knee rating scores for the operated and non-operated groups were from 78 to 100 points, with a mean of 92.9 ± 5.1 , and from 84 to 95 points, with a mean of 90.9 ± 2.8 , at follow-up, the difference not being significant.

DISCUSSION

The instability test for knee ligament injury is subjective, and objective measurement of the ligament stability is necessary for clinical diagnosis and assessment of therapy after ligament ruptures. Knee arthrometry at 30° of knee flexion has been adopted for the assessment for sagittal laxity by several authors.^{8,10,29} Stress radiography, however, is superior for determining posterior cruciate ligament status.¹⁰

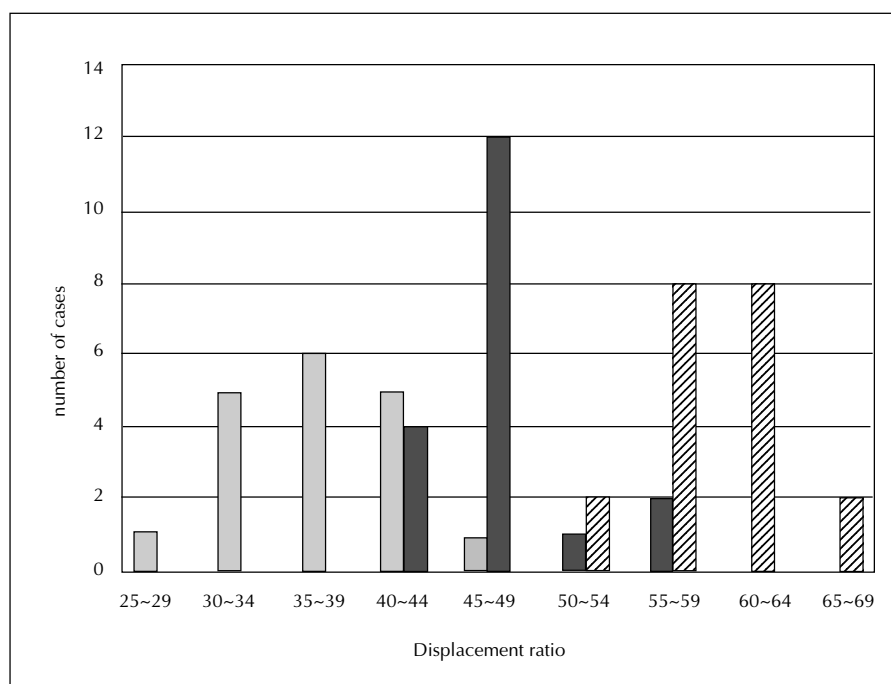


Figure 2 Distribution of displacement ratios in the 3 groups. : non-operated group, n=20; : operated group, n=20; : controls, n=20

Staubli et al.²⁸ reported the method of stress radiography at near extension of the knee. The most accurate passive means of assessment of the status of the posterior cruciate ligament is the posterior drawer test, performed at 90° of flexion of the knee.^{3, 4, 16} Radiological documentation of the posterior translation of the tibia on the femur at 90° of knee flexion is more accurate than that performed at near extension.

Skyhar et al.²⁶ proved that posterior sag of the tibia is associated with increased pressure on the articular cartilage and so is a causative factor for degeneration of cartilage in a cadaver-knee model. Long-term follow-up of posterior cruciate injuries indicated that high instability might increase degenerative changes of the joint^{2, 8, 13} and decrease the knee score.^{2, 13} While the tibial translation of the operated group was significantly lower than that of the non-operated group in the present series, it was not up to the mark of the controls. Furthermore, surgery was not associated with any improvement in the knee rating score, so that whereas primary repair had positive effects on the stabilization of the knee, effects were not of sufficient magnitude to reduce the laxity up to the normal range.

Richter et al.²¹ divided the location of posterior cruciate ligament failure into proximal, midsubstance and distal thirds. They analyzed the relationship

between the location of injury and the knee rating score, and concluded that the isolated posterior cruciate ligament injury significantly tended to have a rupture in the distal third, with a resultant significantly elevated posterior laxity. However, no difference in outcomes was seen among the locations of posterior cruciate ligament failure after operative treatment in the present study.

It has been also reported that injuries due to sporting activities are associated with better outcomes than with motor vehicle or work accident cases.^{5, 8} Traffic accidents may produce a higher degree of trauma to the knee joint than athletic accidents. However, we could not detect any difference between patients in this respect, in line with another study.²

In conclusion, surgery resulted in better posterior laxity than non-operative management; the achieved stability, however, was clearly less than in control. The clinical course should be observed for longer periods to further compare the efficacy of surgical and non-surgical treatment of posterior cruciate ligament ruptures with regard to degenerative joint changes.

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