

Staged arthroscopic reconstructive surgery for multiple ligament injuries of the knee

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ABSTRACT

Purpose. To review treatment outcome of our staged protocol for multiple ligament injuries of the knee.

Methods. 21 men who were treated for multiple ligament injuries of the knee and had completed at least one year of rehabilitation were evaluated. Patients were examined under anaesthesia and then by diagnostic arthroscopy. Arthroscopic reconstructive procedures for injured cruciate ligaments were performed after a minimum 110° flexion and full extension were regained. Collateral ligament injuries were treated first, followed by posterior cruciate ligament (PCL) and then anterior cruciate ligament (ACL) tears. Outcome was evaluated using the Lysholm knee score and International Knee Documentation Committee (IKDC) knee ligament evaluation form.

Results. 19 patients aged 24 to 55 (mean, 36) years were followed up for a mean of 22 (range, 14–33) months. The mean Lysholm score was 92. The mean scores for patients treated within and after 3 weeks were 93

and 90, respectively. The overall IKDC grading was B in 15 knees and C and D each in 2 knees. For the 2 patients with grade D, one presented 19 months after the injury and had persistent posterior sag (secondary to capsular contracture). His Lysholm score was 82. The second patient developed a deep infection and endured a flexion loss of 30° but had a satisfactory Lysholm score of 94. There was no significant difference between early and delayed treatments and between low- and high-velocity injuries in terms of the Lysholm score, the IKDC grade, the range of movement, and the functional outcome.

Conclusion. Staged management of multiple ligament injuries of the knee enabled satisfactory restoration of function, stability, and range of movement in most of our patients. By staging the procedures, the need for subsequent ACL reconstruction can be better evaluated, as ACL reconstruction is not necessary in patients not undertaking strenuous activities.

Key words: anterior cruciate ligament; knee dislocation; medial collateral ligament, knee; posterior cruciate ligament; treatment outcome

INTRODUCTION

Multiple ligament injuries of the knee joint involve at least 2 of the 4 major ligaments, with an occurrence of 0.001% to 0.013%.¹⁻³ Such knee injuries are caused by momentary dislocation that is spontaneously reduced, with no evidence of dislocation shown on radiographs.⁴ Knee dislocation should be suspected when there is gross instability of ≥ 2 ligaments following trauma, as it is a surgical emergency with severe soft tissue disruption and neurovascular compromise.^{5,6} Even when treated adequately, this injury may result in long-term morbidity of persistent pain and instability. There are controversies with regard to the timing of surgery, structures to be repaired, surgical techniques, type of graft, and rehabilitation.⁷ We reviewed treatment outcome of our staged protocol for multiple ligament injuries of the knee.

MATERIALS AND METHODS

Between 2003 and 2006, 21 men who were treated for multiple ligament injuries of the knee and had completed at least one year of rehabilitation were evaluated. Patients with associated fractures around the knee joint and neurovascular injury were excluded. The timing of the surgery were classified into acute (within 3 weeks) and chronic (after 3 weeks).^{7,8} The injury mechanism was categorised into high velocity (road traffic accidents, fall from heights)

and low velocity (twisting injuries, jumping from low heights).⁹ Grade-1 laxity was defined as a side-to-side difference of 3 to 5 mm; grade 2, 6 to 10 mm; and grade 3, >10 mm.¹⁰

According to our protocol (Fig. 1), ligament injuries were examined under anaesthesia, and then by diagnostic arthroscopy. The fluid flow for arthroscopy was gravity assisted; extravasation was monitored for patients with grade-3 collateral ligament injury with capsular tear. Arthroscopic reconstructive procedures for injured cruciate ligaments were performed after a minimum 110° flexion and full extension were regained. This decreases the risk of arthrofibrosis, which might occur after simultaneous reconstruction.

In stage 1, grade 1 or 2 injuries of collateral ligaments were treated conservatively with a hinged knee brace, whereas grade-3 injuries were primarily repaired. Peripheral meniscal tears were repaired with non-absorbable sutures, whereas middle

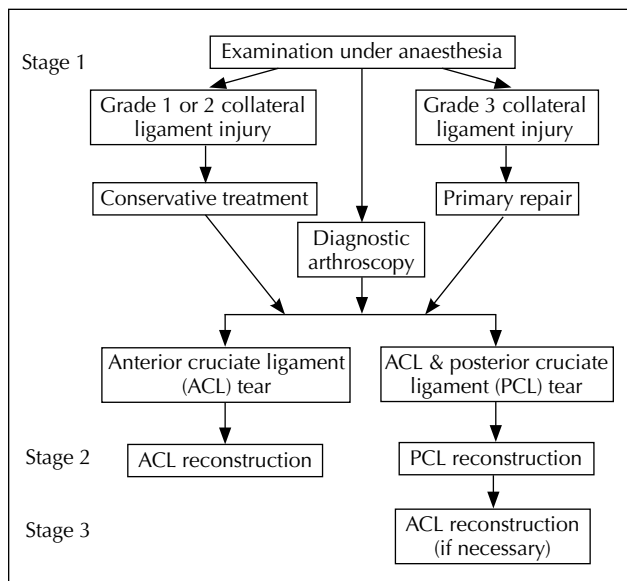


Figure 1 Staged protocol for treatment of multiple ligament injuries of the knee.



Figure 2 (a) Complete avulsion of the medial collateral ligament (MCL) from its tibial attachment. (b) Fixation of the MCL insertion to its tibial attachment by a spiked washer and a screw.

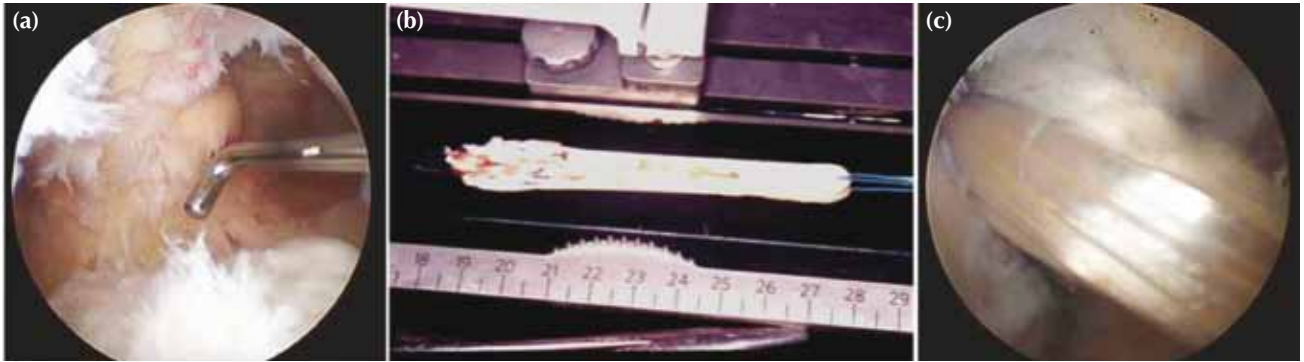


Figure 3 (a) Complete tear of the anterior and posterior cruciate ligaments. (b) The quadrupled hamstring autograft is used for posterior cruciate ligament reconstruction. (c) The hamstring autograft *in situ* after reconstruction.

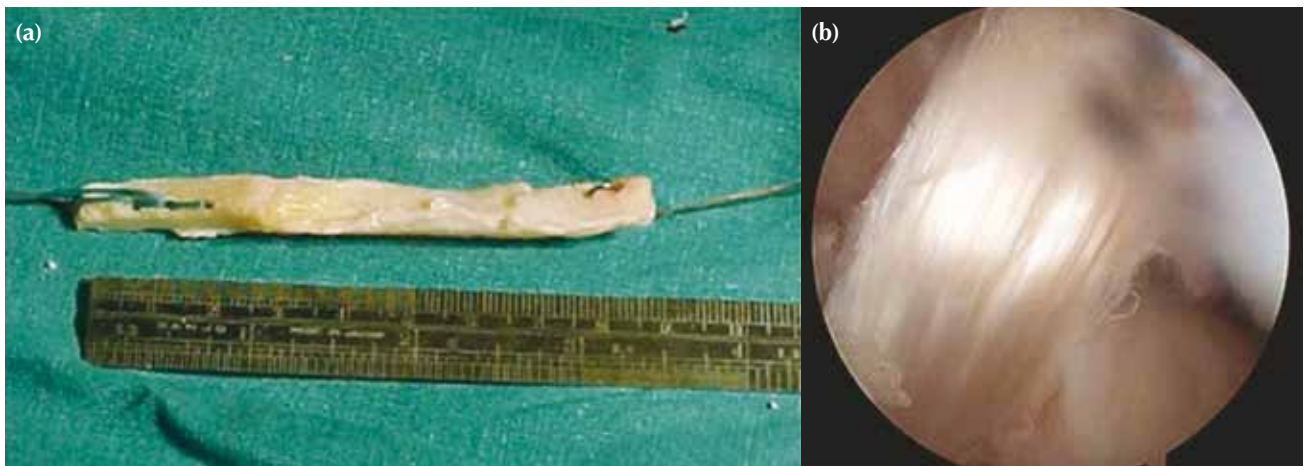


Figure 4 (a) The bone-patellar tendon-bone (BPTB) autograft for anterior cruciate ligament reconstruction. (b) The BPTB autograft *in situ* after reconstruction.

and inner third tears were treated with partial meniscectomy to achieve a stable rim. Mid-substance tears of the medial collateral ligament (MCL) were repaired using non-absorbable sutures. Avulsion fractures or ligamentous rupture from femoral or tibial attachments were fixed with ligament staples or spiked washers and 5.0 mm cancellous screws (Fig. 2). Posterolateral corner injuries were reconstructed.¹⁰ The knee was then immobilised in a knee brace in extension for 3 weeks and then in a hinged knee brace. Acute anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL) tears were managed conservatively in stage 1, irrespective of the injury grade.

In stage 2, after the knee had regained a minimum 110° flexion and full extension, the PCL tear were reconstructed arthroscopically using the ipsilateral autologous quadrupled hamstring autograft (Fig. 3), whereas the ACL tear was managed non-operatively. In those with combined collateral ligament injury and

ACL tear without a PCL tear, ACL reconstruction was performed in stage 2 using the bone-patellar tendon-bone (BPTB) graft (Fig. 4).

In stage 3, ACL reconstruction was performed for patients with a strenuous occupation or those with persistent instability. In patients with low demands and without instability, the ACL injury was managed non-operatively with hamstring-based rehabilitation exercises.

An exception to this protocol included patients with a chronic grade 1 or 2 collateral ligament injury combined with ACL and PCL tears with good range of motion and without an extension deficit. They underwent PCL reconstruction in stage 1 and ACL reconstruction in stage 2.

Outcome was evaluated by 2 orthopaedic surgeons who were not the part of surgical team, using the Lysholm knee score¹¹ and International Knee Documentation Committee (IKDC) knee ligament evaluation form.¹²

Table 1
Patients with multiple ligament injuries of the knee

Patient no.	Sex/age (years)	Interval between injury and surgery (days)	Ligaments injured*	Ligaments treated conservatively*	Follow-up (months)	Lysholm score	Overall International Knee Documentation Committee grading	Complication
1	M/25	90 (chronic)	ACL, PCL, MCL	-	16	84	B	-
2	M/42	120 (chronic)	ACL, PCL, LCL	ACL, LCL	18	94	D	Deep infection, flexion loss
3	M/40	4 (acute)	ACL, MCL	-	20	96	B	-
4	M/42	45 (chronic)	ACL, MCL	-	14	100	B	-
5	M/35	10 (acute)	ACL, PCL, MCL	ACL	23	100	B	-
6	M/45	6 (acute)	ACL, PCL, MCL	ACL	18	96	C	Posterior drawer
7	M/36	12 (acute)	ACL, MCL	-	14	85	B	-
8	M/33	1 (acute)	ACL, PCL, MCL	-	27	99	B	-
9	M/24	60 (chronic)	ACL, LCL	-	19	90	C	Grade C in subjective assessment
10	M/47	575 (chronic)	ACL, PCL	-	27	82	D	Posterior sag
11	M/55	48 (chronic)	ACL, PCL, LCL	LCL	15	90	B	-
12	M/23	30 (chronic)	ACL, PCL	-	15	95	B	-
13	M/30	2 (acute)	ACL, PCL, MCL	ACL	27	100	B	-
14	M/36	14 (acute)	ACL, PCL, MCL	ACL	30	85	B	-
15	M/30	3 (acute)	ACL, PCL, MCL	-	25	81	B	-
16	M/37	2 (acute)	ACL, PCL, MCL	ACL	26	90	B	-
17	M/30	3 (acute)	ACL, PCL, MCL	-	25	99	B	-
18	M/39	60 (chronic)	ACL, PCL	-	33	85	B	-
19	M/32	2 (acute)	ACL, MCL	-	25	95	B	-

* ACL denotes anterior cruciate ligament, PCL posterior cruciate ligament, MCL medial collateral ligament, and LCL lateral collateral ligament

Univariate analysis by the Fisher's exact probability test was used to compare proportions between the 2 groups. Range of motion was classified into IKDC grade A, B, C, and D; the number of patients in each group was then compared with the Lysholm score groups. A p value of ≤ 0.05 was considered statistically significant. Inter-observer reliability between 2 independent observers for the assessment of IKDC grading was analysed using the kappa statistics.

RESULTS

19 patients aged 24 to 55 (mean, 36) years were followed up for a mean of 22 (range, 14–33) months. The remaining 2 patients were lost to follow-up after 9 and 11 months (Table 1). 12 patients sustained high-velocity injury, whereas 7 had low-velocity injury during sports activities. 11 patients underwent surgery within 3 weeks, and 8 after 3 weeks owing to late presentation. The mean interval between injury and surgery was 5.4 (range, 1–14) days in the acute group and 4.2 (range, 1–18) months in the chronic group. Of the 19 patients, 9 injured their ACL, PCL,

and MCL; 2 injured their ACL, PCL, and lateral ligament complex; 4 injured their ACL and MCL; one injured their ACL and lateral ligament complex; and 3 injured their ACL and PCL.

Of the 16 patients with meniscal injuries, 2 underwent repair by the inside-out technique for a longitudinal tear in the posterior third of the peripheral part of meniscus, and 14 underwent partial meniscectomy leaving behind a stable meniscal rim for tears in the white-white or red-white zone of the meniscus involving the medial meniscus (n=9), lateral meniscus (n=3), and both (n=2). Of the 13 patients with a grade-3 MCL injury, 10 underwent primary end-to-end repair for mid-substance tears using non-absorbable sutures, and 3 underwent screw fixation with spiked washers for MCL avulsion from the femur or tibia. Of the 3 patients with a lateral ligament complex injury, only one had grade-3 laxity and underwent reconstruction using the biceps tendon,¹⁰ owing to late presentation. The remaining 2 patients (with grade-2 laxity) were managed non-operatively with a hinged knee brace. Of all 19 patients with an ACL injury, 13 underwent ACL reconstruction, and the remaining 6 patients with less strenuous occupations and without instability

were managed non-operatively with hamstring-based ACL strengthening exercises. Their Lysholm scores were satisfactory (range, 85–100). 14 patients had a complete tear of the PCL and all underwent reconstruction.

At the final follow-up, the mean Lysholm score was 92 (standard deviation, 7). The mean scores for patients treated within and after 3 weeks were 93 and 90, respectively ($p > 0.05$). The Lysholm scores for the 2 patients lost to follow-up were 96 and 94.

For subjective knee evaluation of the IKDC grade, 17 patients rated their knee to be nearly normal (grade B) and the remaining 2 rated as abnormal (grade C). With regard to symptoms, 11 patients considered their knee as normal (grade A), 7 as nearly normal (grade B), and the remaining one as abnormal (grade C). With regard to the range of motion, all patients regained full extension, whereas only 12 regained full flexion (grade A). Seven patients had a mean loss of flexion of 15° , with grade B in 5, grade C in one, and grade D in one. For the overall ligament grading, 17 knees were grade B, one was grade C, and one was grade D. For the overall IKDC grading (the lowest grade obtained in any of the above 4 categories), 15 knees were grade B, 2 were grade C, and 2 were grade D. The overall IKDC grading for the 2 patients lost to follow-up was grade B. Of 11 patients who underwent surgery within 3 weeks, 10 were IKDC grade B and one grade C. Of 8 patients who underwent surgery after 3 weeks, 5 were grade B, one grade C, and 2 grade D).

One patient had a grade C posterior drawer but the Lysholm score was good (96) and his knee was considered satisfactory without instability. For the 2 patients with grade D, one presented 19 months after the injury and had persistent posterior sag (secondary to capsular contracture) that did not affect activities of daily living and his occupation. His Lysholm score was 82. The second patient developed a deep infection within a week following PCL reconstruction and underwent arthroscopic lavage and debridement. He endured a flexion loss of 30° but had a satisfactory Lysholm score of 94.

There was no significant difference between acute and chronic groups and between low- and high-velocity groups in terms of the Lysholm score, the IKDC grade, the range of movement, and the functional outcome.

One patient developed a deep infection 4 days after PCL reconstruction, for which he underwent arthroscopic debridement and the PCL graft was left *in situ*. Intravenous antibiotics were given for 6 weeks until the infection subsided. No patient had any neurovascular injury.

DISCUSSION

There is no consensus in the management of multiple ligament injuries of the knee. Surgical treatments are superior to immobilisation using plaster of Paris.^{3,8,9,13,14} Some advocate early surgical repair of all ligaments,^{3,15} but arthrofibrosis is a major concern.¹⁶ Others recommend reconstruction of the collateral ligaments and PCL first and deferring ACL reconstruction until development of rotatory instability.¹⁷ Acceptable functional outcome can be achieved following conservative treatment for an ACL injury if the patients can avoid strenuous activities.¹⁸ Most patients with an isolated grade 1 or 2 PCL injury can return to activity after non-operative treatment, but those with combined injuries had greater laxity and some even had rotational instability.¹⁹ Our protocol aimed to reconstruct PCL tears as this ligament is located near the centre of rotation and is the primary static stabiliser of the knee joint.^{17,20,21}

Regarding the timing of surgical repair of these ligaments, some favour early reconstruction and report satisfactory outcome with mean Lysholm scores of 75 to 87.^{7,15,16} Satisfactory results are achieved when complete repair is performed within 10 days of injury.²² Other studies found no significant difference between early and delayed surgery.^{8,9,23} Delayed ligament reconstruction is recommended until the patient regains full knee extension and $>90^\circ$ flexion.¹⁷ In our study, clinical outcomes did not differ significantly between patients having early versus delayed reconstructions. Delayed reconstructions of injured ligaments yield similar outcomes in terms of stability, compared to acute surgery.²⁴ Staged procedures produce better subjective outcome and less range-of-movement deficits, whereas joint stiffness is common in acutely managed patients.^{24,25}

By staging the procedures, the need for subsequent ACL reconstruction can be better evaluated. ACL reconstruction is not necessary in patients with multiple ligament injuries without instability following reconstruction of other ligaments, especially in persons not undertaking strenuous activities. Staging also enables restoration of satisfactory knee movements before subsequent procedures are undertaken.^{24,25} This enabled satisfactory restoration of function, ligamentous stability and range of movement in most of our patients.

The main limitations of this study were the small number of patients and the heterogeneity of the injuries, which made comparisons difficult. A longer follow-up was needed to determine whether patients could retain the same level of function, especially in those with ACL tears that were conservatively treated.

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