Fracture Dislocation of the Knee: A Prospective Evaluation of Fracture Fixation and Early Ligament Reconstruction with the Use of a Hinged External Fixator

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Introduction

Fracture dislocations of the knee are high-energy injuries that usually involve tibial plateau fractures associated with multi-ligament injuries. Published literature more than twenty years old documents the severity of ligament injuries associated with tibial plateau fractures and the importance of restoring stability in order to obtain good functional results.[1,2] Numerous small studies on tibial plateau fractures have documented an extremely high (often 50 – 90%) incidence of associated knee pathology involving both ligaments and menisci.[3-17] The published results following surgical stabilization of tibial plateau fractures have often been disappointingly poor,[4,6,7,11,16,18-20] with some authors noting a relationship between poor outcomes and fracture dislocations.[1,2,7,16,21,22] Remarkable advances have been made regarding the surgical stabilization of complex tibial plateau fractures over the past decades with developments such as locked plating.[15,23] However, effective treatment protocols that yield good results following fracture dislocations have remained elusive.

Early motion rehabilitation protocols have become well established following ligament reconstruction surgery of the knee in order to prevent pain and limitations of motion as a result of arthrofibrosis. Similarly, early motion protocols after reconstruction following knee dislocations have led to remarkable improvements in motion from a mean of 106º without immediate motion to a mean arc of motion of 124º with immediate motion rehabilitation protocols.[24-34] Early motion is equally critical following fracture dislocations, where both the fracture and ligament injury can benefit from the prompt initiation of motion. However, obtaining adequate stability of both the skeletal and soft tissue injuries to allow early motion has remained an elusive challenge. In order to obtain good motion knee stability of both the fracture and the ligament injury is critical. Failure to obtain adequate stability will frequently result in poor motion and arthrofibrosis.[35,36]

The Compass Knee Hinge (CKH) (Smith & Nephew, Memphis, TN) is a hinged external fixator that allows sagital plane motion while minimizing rotation and coronal plane motion. The CKH was adapted from the Compass Hinge that was initially designed for the elbow. There has been only one published clinical series using the CKH, and it involved patients following knee dislocation.[35] The purpose of this study was to report on a prospective series of patients with fracture dislocations of the knee, who were treated using a protocol featuring early fracture stabilization, followed by ligament repair or reconstruction within the first month, with the addition of the CKH combined with early knee motion and aggressive rehabilitation. The focus of this paper is to detail the outcomes of the soft tissue stabilization (ligament repair and reconstruction) and report on the outcome of the knee.

Materials and Methods

Twenty-seven patients with thirty fracture dislocations of the knee were enrolled in our prospective outcome study between February, 1999, and October, 2002, with a minimum two year follow-up. This study was approved by the Institutional Review Board at our hospital. This study is a consecutive series of all patients that sustained tibial plateau fractures associated with multi-ligament knee injuries. All patients have been prospectively enrolled and clinically followed.

All patients in this study were treated using a treatment protocol involving the use of Magnetic Resonance Imaging (MRI) within a few days of injury, followed by skeletal stabilization of the fracture and repair of any bony ligament avulsions within one week. The exact time to fracture stabilization depended on a number of factors including the condition of the patient's soft tissue envelope and the time necessary to obtain an MRI scan. Following fracture fixation, patients were treated with a knee immobilizer and did not attempt knee motion prior to ligament reconstruction. Spanning external fixators were only used if the knee joint would not stay reduced in the immobilizer, which was very rare. Repair or reconstruction of ligament damage was delayed for three to four weeks from the time of injury in our treatment protocol, to allow time for knee capsule and soft tissue healing. The Compass Knee Hinge was applied at the time of initial ligament reconstruction, and an early range of motion rehabilitation protocol was initiated on the first day following surgery.

Our post-operative protocol included initiating motion from a range of 0 - 30º on the first day following surgery using a Continuous Passive Motion (CPM) machine, with increases of no more than 10º per day until 90º of flexion is achieved. It is difficult to achieve more than approximately 110º of flexion while the CKH is on due to discomfort at the femoral pin sites in extremes of flexion. Patients are encouraged to lock the hinge in full extension for at least an hour per day to prevent the development of any flexion contracture. Most patients are able to achieve full extension with the CKH without difficulty. Limited strengthening exercises are initiated over the first six weeks following ligament reconstruction as motion is obtained and pain improves. Patients are allowed to weight bear as tolerated while the hinge is in place. The CKH was removed approximately six weeks after it was placed on the knee. In patients with bicruciate injuries, the reconstruction of the ACL was delayed until six weeks following the repair or reconstruction of all other knee ligament injuries. The CKH was removed at the same time as the ACL was reconstructed in patients with bicruciate ligament injuries. Eight ACL reconstructions were delayed for approximately four months because screws used for fracture fixation were blocking the tibial tunnel or severe comminution prevented adequate fixation of the graft in the tibia.

Data collected in this study included demographic data on our patients as well as initial hospitalization data. We also recorded physical examination results during serial clinic follow-up appointments, regarding both the fracture and the knee reconstruction. Pain was recorded on a scale from 0 to 10, with 0 representing no pain and 10 representing the most severe pain the patient had ever experienced. Patients were advised that a score of 0 – 3 was considered mild pain, 4 – 6 moderate pain, and 7 – 10 was considered severe pain. Anterior-posterior and lateral radiographs were obtained at the time of injury, as well as at 6 weeks, and 3, 6, and 12 months following injury. Additional radiographs were obtained as needed to monitor the healing of the fracture. Outcome scores obtained during clinical follow-up included the: Lysholm knee score; International Knee

Documentation Committee (IKDC) score; and Short Form – 36 (SF – 36) functional outcome score.

Ligament stability was assessed using KT-2000 ligament arthrometer examinations in addition to clinical stability examinations. Patients were scored on a 0 – 3+ scale, with 0 reflecting no laxity, 1+ representing 5º or 5mm of laxity depending on the test, 2+ was 10º or 10mm, and 3+ was 15º or 15mm or more of laxity when comparing the two sides. Anterior stability was tested using the Lachmans test at 30º as well as the pivot shift, posterior stability was tested with the posterior drawer. The PMC was tested with valgus stress at 0º and 30º of flexion. The PLC was tested with varus stress and the dial test. The dial test was performed with patients in a prone position when performed in the clinic, and in a supine position when performed as part of an examination under anesthesia prior to the surgical reconstruction. The test was conducted at both 30º and 90º of flexion. Great care must be taken to keep the knees together while applying the external rotation force. Again, results were scored on a scale from 0 – 3+. Zero represented a knee with less than 5º difference between the two legs. 1+ was a leg with 5 - 10º, 2+ for 10 - 15º, and 3+ for more than 15º of difference between the two legs. In both tests, a grade of 0 or 1+ represented a successful result, and a score of 2+ or 3+ was considered a failure. Complications were also recorded as they occurred.

Results

Thirty patients with 33 knee fracture dislocations have been entered into our study. Three patients sustained bilateral injuries. Three patients have been lost to follow-up despite exhaustive efforts to locate them and obtain data. Twenty-seven patients with 30 fracture dislocations have a minimum clinical follow-up of 24 months. Mean follow-up on our patients was 42 months, with a range of 25 to 58 months. All of our data and conclusions will be based on the patients with at least two years of follow-up.

The mean age of our patients was 41 (range 18 – 63) years old. There were 15 males and 12 females enrolled in our study. The mean weight of our patients was 194 pounds, with a range of 130 – 318 pounds. Nearly all of our patients were involved in high-energy trauma, with the following mechanisms of injury: motor vehicle accident – 13; fall – 7; pedestrian versus automobile accident – 3; motorcycle accident – 2; and sports injuries – 2. The only patients whose trauma may not be a high-energy accident were the two patients involved in athletic accidents. They were injured in an equestrian accident and a high speed skiing accident respectively. In both cases the fracture pattern was a high-energy (Schatzker VI) pattern. The mean Injury Severity Score on our patients was 14 (9 – 38).

All of our patients were evaluated using a selective arteriorgraphy protocol.[37] One patient had an abnormal vascular examination with decreased peripheral pulses. Arteriogram demonstrated a complete disruption of the popliteal artery, and he underwent successful emergent vascular bypass grafting. The remaining 26 patients had normal vascular physical examinations, and none of these patients had significant vascular injuries. Seven patients (26%) of our patients sustained peroneal nerve injuries, with three of them resolved at most recent clinical evaluation.

Soft tissue injury was assessed using the classification of Gustillo[38] for open fractures and the Tscherne classification for closed injuries (Table 1). Four fractures were open and 26 were closed injuries. The open fractures included one Type IIIC, one Type IIIA, and two Type II injuries. The closed fractures had a mean Tscherne score of 1.96, with a range of one to three.

The tibia plateau fractures were classified based on the AO/OTA classification[39] as well as the Schatzker classification.[40] The majority of fractures were high-energy patterns based on both classifications. The AO/OTA classifications were: 41B – 10 fractures; and 41C – 20 fractures. The Schatzker classifications of the fractures were: Type I – III – 6; Type IV – 4; Type V – 4; and Type VI – 16.

The fracture dislocations were classified based on the anatomic classification described by Schenck and modified by Stannard.[37] In that classification, I – IV are isolated ligament injuries, and V is a fracture dislocation. A V.1 is a fracture that does not have an associated bicruciate ligament injury, a V.2 is a fracture with a bicruciate injury, a V.3 is a fracture with a bicruciate injury and either a posteromedial or posterolateral corner injury, and a V.4 is a bicruciate injury with both the posteromedial and posterolateral corners also being torn. Our patients were classified as follows according to the Schenck classification: V.1 – 8 knees; V.3 – 16 knees; and V.4 – 6 knee’s.

Patients in this study required a mean of 4.8 surgical procedures per patient, with a range of two to eight. Knee motion at the most recent follow-up ranged from 1 (0 – 10) to 128 (90 – 150) degrees. Most patients in this study complained of pain in their knee. However, the vast majority noted that it was mild pain which was scored at a mean of 1.8 (0 – 9) on a scale of 1 – 10. Current employment status has been obtained on our patients: 21 (78%) patients returned to full time work at their previous occupation; three (11%) returned to full time work at a different occupation; one (4%) patient returned to light duty only; and 2 (7%) have not returned to any type of work.

All of the fractures in this series went on to union without additional surgical procedures to achieve union. Two patients had malalignment of 5º or greater, one with 8º of varus and 5mm of condylar widening and the other with 10º of varus.

Nineteen of our 30 knees (63%) sustained torn menisci. There were 14 lateral and 12 medial meniscus tears. Fourteen (54%) of the tears were peripheral and were repaired. The remaining 12 tears were not amenable to repair and were treated with partial meniscectomy.

Ligament injuries in our patients were tabulated as either ACL, PCL, posterolateral corner (PLC) or posteromedial corner (PMC). Patients in this series underwent 24 ACL reconstructions. There were ten PCL reconstructions and nine repairs of PCL avulsions with large bone fragments attached. Sixteen patients had PLC reconstructions and another 13 had primary repairs of the posterolateral corner. There were four reconstructions and six repairs of the PMC.

Ligament stability was assessed using a combination of clinical examination and a KT-2000 ligament arthrometer. Clinical examination of the ACL included assessment of both the Lachmans and Pivot Shift tests. Twenty-nine knees had a final Lachman grade of 0, while one patient had a 1+. All 30 knees had a final pivot shift grade of 0. PCL examination yielded a grade of 0 for 28 knees, 1+ for one, and 2+ for the final knee. The patient with the 2+ knee was diagnosed with a partial PCL injury and the PCL was not treated surgically. The PCL has become more lax as the rehabilitation process has been completed, but the patient has declined surgical correction of the instability. Clinical examination of the PMC has yielded 27 knees with a grade 0 stability and 3 with a grade 1+ stability. The posterolateral corner was assessed both for instability to varus stress and external rotation. The final grades for our patients regarding varus stability included 22 grade 0, seven grade 1+, and one grade 2+ knee. The grades for external rotation included 27 grade 0 and 3 grade 1+ knees. The patient with the grade 2+ knee regarding varus instability has declined additional surgery and expressed that she is satisfied with her knee stability. Please see Table 2 for details regarding the clinical examination of knee ligament stability on our patients.

KT-2000 ligament arthrometer exams were completed on 27 knees in this series. The mean for the injured knee at 30º anterior was 7.7mm compared to 8.3 mm for the uninjured knee. The mean posterior translation at 30º was 3.6 mm for the injured knee compared to 3.9mm for the uninjured knee. The results were similar at 70º of flexion: anterior translation was a mean of 5.9mm for the injured knee compared to 7.6mm for the uninjured; and the posterior translation was a mean of 2.5mm for the injured knee compared to 2.7mm for the uninjured knee. The mean translation was lower for the injured knee at both 30 and 70 degrees both for anterior and posterior translation. We have also evaluated total anterior and posterior translation at 30 and 70 degrees. This figure prevents false negative arthrometer exams due to starting the PCL exam with the knee sagging posteriorly. If this error occurs, it will lead to an increase in the anterior translation and will be reflected in the total translation number. Twelve of the 27 knees (44%) had greater total translation at 30º on the injured side than on the uninjured side, however only four (15%) had translation greater than 5mm different, and three of them were 6mm greater and the fourth was 7mm greater than the uninjured side. Seven of the 27 knees (26%) had a greater total translation at 70ºon the injured side when compared to the uninjured side. None of seven patients had more than a 5mm increase when comparing the injured and uninjured sides at 70 degrees. Table 3 documents the KT-2000 data for our patients including total anteroposterior translation.

Fifteen out of 82 (18%) ligament repairs of reconstructions required revision due to failure on both clinical and KT-2000 ligament arthrometer exams. Eight out of 54 (15%) ligament reconstructions required revision compared to seven out of 28 (25%) repairs. When evaluating individual ligament groups, the results were as follows: ACL – 3 revisions out of 24 reconstructions (12.5%); PCL reconstruction – 0 failures; PCL repair – 2 revisions out of 9 (22%); PLC repair – 4 revisions out of 13 primary repairs (31%);

PLC reconstruction – 5 revisions out of 16 (31%); PMC repairs – 1 revision out of 6 primary repairs (17%); and PMC reconstructions – 0 failures. Some patients had multiple ligaments fail and require revision. Nine of the 30 knees (30%) required revision of at least one ligament group.

Knee specific outcome scores were obtained on all of the patients in our study using both the Lysholm and IKDC scores. The mean Lysholm knee score was 91 (71 – 100). Only five knees (17%) had scores less than 80 and there were no knees with scores less than 70. The objective IKDC scores were as follows: Normal knee – 12 (40%); nearly normal knee – 8 (27%); abnormal knee – 8 (27%); and severely abnormal knee – 2 (7%). Subjective IKDC scores were obtained on 21 of the 27 patients, with a mean score of 62 (33 – 97).

SF – 36 scores were obtained on a sequential basis during our patients' rehabilitation from their knee injury (Table 4). Final SF – 36 scores for the physical component (PCS) were a mean of 36.4 (21 – 59). Final scores for the mental component (MCS) were a mean of 51.8 (15 – 68). There was a marked improvement in our patients PCS scores over time, but no significant change in their MCS scores over time. The PCS scores at 6, 12, and 24 months were 30.3, 35.7, and 34.3 respectively. Most of the improvement in scores occurred in the first 12 months. MCS scores remained consistent throughout the study period. The score was a mean of 50.4 at 6 months, 51.1 at 12 months, and 50.3 at 24 months follow-up.

None of the patients in study were competitive athletes at the time of their injury. Ten were recreational athletes, twelve participated in hobbies such as hunting and fishing, and five were sedentary individuals. We classified whether the patient was able to return to their prior level of activity. Sixteen (59%) patients were able to resume their prior level of activity, while ten (37%) were not able to be as active as they were prior to their injury. One patient (4%) went from being a recreational athlete to being sedentary as a result of their traumatic injuries.

There were a total of 21 complications that occurred in our patients. Fifteen of the thirty knees (50%) experienced at least one complication. The most common complications involved infection. One knee (3%) developed a deep infection that required multiple surgical debridements and long-term intravenous antibiotics. Six knees (20%) developed either a superficial (4) or a pin tract (2) infection that required short term antibiotic treatment only. Four knees (13%) developed arthrofibrosis that required manipulation under anesthesia and arthroscopic lysis of adhesions. Another patient (3%) developed significant heterotypic ossification that caused pain and limited motion and required surgical excision of the excess bone. Two patients developed hardware failures that required revision or removal of the hardware. Two more patients healed with malalignment of their fracture greater than 5 degrees. Two of the knees have gone on to develop severe post-traumatic arthritis. One patient (3%) developed a fistula that required surgical closure, and another developed a compartment syndrome as a result of the fracture dislocation. Aggressive treatment was able to resolve the majority of the complications and yield good final functional results in most patients.

Discussion

Fracture dislocations of the knee have been associated with poor outcomes and high morbidity in the limited publications in the orthopaedic literature.[1,2,7,16,21,22] Diagnosis of fracture dislocations can be very challenging, since it is virtually impossible to perform a good ligament examination on a patient with a tibial plateau fracture, both as a result of pain and the instability that is present as a result of the fracture. Several small studies have been published using MRI or arthroscopic techniques to evaluate the integrity of the soft tissue structures around the knee following fractures of the tibial plateau. The results of the studies indicate that between 33 – 90% of patients with tibial plateau fractures have concomitant torn knee ligaments. The studies conclude that MRI is vastly superior to other imaging studies at detecting associated soft tissue injuries, and also provides adequate detail of the skeletal injury.[41-45] Bennett and Browner published a prospective study that combined examination under anesthesia with arthroscopy in thirty patients following tibial plateau fractures. Their study documented that 56% of their patients had associated soft tissue injuries.[3]

Poor clinical outcomes are common following high-energy tibial plateau fractures, whether associated ligament injuries are diagnosed or not.[1,2,4,6,7,11,16,18-21] The poor results are often presumed to be due to the damage to the bone and articular cartilage. However, two long term follow-up studies have reported that severe arthrosis is not necessarily an automatic result following high-energy tibial plateau fractures. They also noted that it is a rare development if it has not occurred in the first one or two years following injury. They both noted that good long term clinical results are possible following severe tibial plateau fractures.[46,47] It is well established that early motion and aggressive rehabilitation are beneficial in order to avoid a stiff and painful knee secondary to arthrofibrosis following knee dislocations.[24-33] In patients following fracture dislocation of the knee, adequate stability of both the tibial plateau and the knee must be achieved to allow early functional rehabilitation and minimize the morbidity associated with arthrofibrosis in patients following fracture dislocation of the knee.[35,36,48]

Our treatment protocol recognizes that it is important to diagnose a fracture dislocation in order to treat the entire injury, rather than just the fracture. MRI scanning and increased clinical vigilance minimize the problem of missed fracture dislocations. The use of the CKH at the time of ligament reconstruction has allowed early and aggressive motion postoperatively. While the early motion has helped us achieve an outstanding final arc of motion in our patients, early and aggressive motion can create problems with wound healing. In the early portion of this study, many patients had their motion advanced more quickly than ten degrees per day and had an increased risk of wound dehiscence, fistula formation, or infection. As a result, we have now adopted the policy of no more than ten degrees of increased flexion per day to allow for soft tissue healing in addition to obtaining knee motion.

The results of our protocol of early diagnosis of the fracture dislocation, followed by skeletal stabilization within one week and ligament stabilization combined with a CKH with one month has yielded encouraging final results. Our patients did experience an 18% incidence of ligament repair or reconstruction failure when evaluating all of the procedures used to stabilize the knee. There was a trend toward better stability with reconstruction than with repair in these patients. This may be due to the combination of both skeletal and ligament injury making repair too tenuous even with the additional stability afforded by the CKH. 37% of patients in the sixteen published studies since 1990 have post-operative knee instability following knee dislocations.[24-31,33-35,49-53] There are not adequate contemporary published studies regarding fracture dislocations, but we would expect the failure rate of the combination injury to be as high as with an isolated dislocation. The coronal plane and rotational stability provided by the CKH allow ligament reconstruction healing while aggressive rehabilitation is provided.

The failure rate of repairs or reconstructions of the posterolateral corner was higher than any other ligament groups within the knee. While final results were generally good, 31% of our patients with either a *PLC repair or reconstruction* required revision. This is remarkably worse than our published results with an 8% failure rate using the modified two-tailed PLC reconstruction.[54] Those results did not involve patients with the addition of a fracture. While we believe an aggressive protocol with early reconstruction leads to an earlier return to normal work and recreation activities, it may be prudent to delay PLC reconstruction until the skeletal injury to the tibial plateau has undergone additional healing.

Early and aggressive rehabilitation has yielded an outstanding knee range of motion in most of our patients. The mean arc of motion of 1 - 128º obtained by our patients surpasses the published results in most series for either tibial plateau fractures[1,2,4,6,7,11,16,18-22] or knee dislocations.[24-34] We believe it is critical to obtain stability of both the bone and joint in order to pursue aggressive rehabilitation. The combination of fracture fixation within the first week, early ligament reconstruction and the addition of the CKH achieve adequate stability to pursue early motion. The compass hinge is a critical component of stability that has allowed us to pursue early motion rehabilitation without losing fracture fixation and with a lower prevalence of ligament failure than what is currently reported for knee dislocation without fracture.

The results of the objective joint specific outcome scores in our patients have been very good. The mean Lysholm knee score at the most recent follow-up was 91, and only five patients had scores less than 80. The objective IKDC scores were also very encouraging with 67% of our patients achieving normal (A) or near normal (B) knees. Both outcomes compare favorably with published outcomes regarding knee dislocation without an associated fracture. Published Lysholm knee scores regarding knee dislocations since 1990 yielded a mean score of 82[29,32-34,52,55] while published IKDC scores had the following results: Normal knee 1%; Near normal knee 35%; Abnormal knee 49%; and Severely abnormal knee 16%.[28,50,52,53] There have not been adequate contemporary studies published regarding fracture dislocations to allow a direct comparison. We believe the addition of a fracture likely makes it more difficult to achieve good objective knee scores.

Objective outcome scores have been gratifying, but subjective outcomes have been less encouraging. The SF-36 patient outcome survey documents a trend toward significant improvement over time, but these patients remain greater than one standard deviation below age-matched controls following fracture dislocation of the knee. The difficulty in achieving complete recovery relates to injuries other than the knee in many cases in these multiple trauma patients. The subjective portion of the IKDC also documents that these patients have not completely recovered their pre-injury capabilities. This finding is corroborated by our results in terms of recreational and athletic activity. Forty-one percent of our patients have not been able to return to their pre-injury activity level. The impact has not been as great when we evaluated patient employment. Seventy-eight percent of our patients have been able to return to their pre-injury job, and another 11% returned full time to a different job. Clearly, our patients achieved adequate stability and motion to allow a return to work. However, in many cases patients did not feel they were capable of a full return to leisure and athletic activities.

Fracture dislocation of the knee is a severe and complex injury that often leads to severe morbidity. The surgical treatment of these complex patients is very challenging. The consistent application of our prospective protocol featuring aggressive diagnosis and treatment of the ligament injuries, application of a hinged external fixator, and early motion rehabilitation has allowed good clinical outcome results. However, associated complications occur frequently and often require additional surgery to correct. Based on our results, we believe that this aggressive approach yields results far better than previously published outcomes for this challenging injury. Direct comparisons are difficult due to very limited contemporary publications regarding fracture dislocations. Arthrofibrosis, pain, and knee laxity, while remarkable improved with this protocol, remain major problems for these patients. Based on our results we believe it may be prudent to delay PLC reconstruction until the CKH is removed, allowing additional healing of the fracture. This may improve graft fixation and decrease the need for revision of the PLC. The Compass Hinge allowed early aggressive motion in the saggital plane while controlling coronal and axial plane motion. We believe this controlled early motion was critical in allowing our patients to achieve outstanding objective results. As the complication rate documents, these remain very challenging injuries. We continue to evaluate our surgical and rehabilitation methods with the goal of decreasing the complication rate and improving clinical outcomes.

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TABLE 1. Fracture Classification

AO/OTA	SCHATZKER	SCHENCK
41A = 0	Low-Energy (I-III) = 6	V.1 = 8
41B = 10	IV = 4	V.2 = 0
41C = 20	V = 4	V.3 = 16
	VI = 16	V.4 = 6

TABLE 2: Ligament Examination Results

Patient	ACL		PCL	PMC	PLC	
Initials	**Lachman**	**Pivot**	**Post. Drawer**	**Valgus**	**Varus**	**External Rotation**
RA	0	0	0	0	0	0
PA	1	0	0	0	0	0
LA	0	0	0	0	0	0
AB	0	0	0	0	1	0
CB	0	0	0	0	0	0
MB	0	0	0	0	0	0
TC	0	0	0	0	0	0
JD	0	0	0	1	0	0
CE	0	0	0	0	2	0
SF (R)	0	0	0	0	1	1
SF (L)	0	0	1	0	0	0
MF	0	0	0	0	1	0
JG	0	0	0	0	0	0
JH	0	0	0	0	0	0
JRH	0	0	0	0	1	1
CJ	0	0	0	0	1	0
KL	0	0	2	0	0	0
JL	0	0	0	0	0	0
EM (R)	0	0	0	0	0	0
EM (L)	0	0	0	0	0	0
NM	0	0	0	0	0	1
PP	0	0	0	0	0	0
CP	0	0	0	1	0	0
AS	0	0	0	0	0	0
MS	0	0	0	0	1	0
TT	0	0	0	0	0	0
NT (R)	0	0	0	0	0	0
NT (L)	0	0	0	1	1	0
TW	0	0	0	0	0	0
RW	0	0	0	0	0	0

TABLE 3: Total KT-2000 Translation

Patient	Ant.30 Max		Post.30 Max		Ant.70 Max		Post.70 Max		Total Anterior/Posterior Translation 30º Flexion		Total Anterior/Posterior Translation 70º Flexion	
Initials	Injured	Uninj.	Injured	Uninj.	Injured	Uninj.	Injured	Uninj.	Injured	Uninj.	Injured	Uninj.
RA	8	11	3	4	7	8	3	2	11	15	10	10
PA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LA	4	11	3	4	3	10	1	3	7	15	4	13
AB	5	7	5	6	6	7	3	3	10	13	9	10
CB	12	11	3	4	11	7	3	3	15	15	14	10
MB	8	7	2	3	4	4	2	1	10	10	6	5
TC	1	5	1	2	1	5	0	2	2	7	1	7
JD	10	6	7	5	6	5	4	4	17	11	10	9
CE	14	10	3	3	5	9	2	2	17	13	7	11
SF (R)	17	11	4	4	12	10	4	4	17	13	7	11
SF (L)	11	17	4	4	10	12	4	4	15	21	14	16
MF	14	8	3	3	6	7	1	2	17	11	7	9
JG	5	12	3	6	1	14	3	6	18	18	4	20
JH	4	6	3	4	3	4	2	4	7	10	5	8
JRH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CJ	10	14	4	6	12	16	2	2	14	20	14	18
KL	6	5	10	4	2	4	9	2	16	9	11	6
JL	3	3	4	2	5	5	2	2	7	5	7	7
EM (R)	6	5	3	1	8	5	2	2	9	6	10	7
EM (L)	5	6	1	3	5	8	2	2	6	9	7	10
NM	6	5	3	3	2	4	1	1	9	8	3	5
PP	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CP	10	6	2	3	4	4	2	2	12	9	6	6
AS	7	5	7	6	9	9	1	2	14	11	10	11
MS	9	15	2	5	7	9	2	3	11	20	9	12
TT	6	8	4	4	3	8	3	3	10	12	6	11
NT (R)	8	6	5	3	11	9	3	2	13	9	14	11
NT (L)	6	8	3	5	9	11	2	3	9	13	11	14
TW	6	7	4	2	3	5	2	2	10	9	5	7
RW	6	10	1	6	5	6	3	5	7	16	8	11

TABLE 4. SF-36 RESULTS

	PCS	MCS
6 MONTHS	30.3	50.4
12 MONTHS	35.7	51.1
24 MONTHS	34.3	50.3
FINAL	36.4	51.8