Management of Intraoperative Medial Collateral Ligament Injury During TKA

Gwo-Chin Lee MD, Paul A. Lotke MD

Published online: 5 August 2010
© The Association of Bone and Joint Surgeons® 2010

Abstract

Background Intraoperative injuries to the medial collateral ligament are often unrecognized and failure to appropriately manage ligament loss may result in knee instability and loosening.

Questions/purposes We compared the functional scores in patients with iatrogenic injury to the medial collateral ligament (MCL) treated with additional constraint to those without.

Methods We retrospectively reviewed the records of all 1478 patients (1650 knees) who underwent primary TKA between 1998 and 2004. Thirty-seven patients (2.2%) had recognized intraoperative injury to the MCL; the remaining 1441 patients (1613 knees) served as controls. We attempted to repair the ligament in 14 patients; increased prosthetic constraint over that planned was used in 30 of the 37 patients. We determined Knee Society scores (KSS) in all patients. Three patients were lost to followup. The minimum followup was 36 months (average, 54 months; range, 36–120 months).

Results The mean KSS for all MCL injury knees for pain and function averaged 81 and 74 points, respectively, compared with 91 and 87 for the control group. However, in the 30 knees in which the MCL insufficiency was treated with increased constraint, the mean scores for pain and function increased to 88 and 83 points, respectively. Four of the seven patients treated without increased prosthetic

constraint were revised for instability; no revisions for instability were performed in the 37 patients treated with additional constraint.

Conclusions Recognition of MCL injury during TKA is crucial, since using nonstabilizing inserts was associated with residual instability requiring revision.

Level of Evidence Level IV, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

Introduction

The integrity to the medial collateral ligament (MCL) of the knee is crucial to the proper function and longevity of nonconstrained TKA [2, 5, 16, 19, 20]. MCL laxity and medial instability usually result from prior trauma or valgus deformity. Occasionally, the MCL can be injured during TKA [14]. Loss of the MCL leads to instability that can lead to accelerated wear and failure of the TKA. When iatrogenic injury to the ligament occurs, treatment options include primary repair, augmentation, or use of a constrained knee prosthesis [6, 9, 14]. However, there is no consensus for the management of this problem. Although several studies [10, 13, 19] suggest the use of increased constraint enhances coronal stability in cases with MCL laxity or incompetence, most of these studies involve patients with abnormal ligaments preoperatively. Furthermore, increasing constraint results in increased stress across the implant-cement and implant-bone interfaces that can lead to loosening [11, 13, 19]. Therefore, the use of constraint in routine primary TKA should be avoided.

Some authors have reported successful treatment of intraoperative injury to the MCL using nonconstrained

One or more of the authors (PAL) is a consultant for Stryker and DePuy and is Senior Associate Editor of CORR.

G.-C. Lee (✉), P. A. Lotke
Department of Orthopaedic Surgery, University of Pennsylvania,
1 Cupp Pavilion, 39th and Market Streets, Philadelphia,
PA 19104, USA
e-mail: gwo-chin.lee@upenn.edu

prostheses and direct repair, augmentation, or thicker polyethylene inserts [9, 11, 14]. Leopold et al. [14] reported mean KSS scores of 93 points and no failures in 16 knees with intraoperative MCL injuries treated with repair and a nonconstrained posterior cruciate ligament retaining knee, whereas Koo and Choi treated 15 TKAs complicated by medial instability after medial release treated with thicker polyethylene inserts without development of late instability [11].

Therefore, the purposes of this study were to (1) compare the Knee Society scores for pain and function of patients with iatrogenic injury to the MCL during TKA to those in patients undergoing primary TKA without MCL injury; (2) compare the KSSs of ligament repair or augmentation and use of nonconstrained TKA with patients managed with constrained prostheses; and (3) compare the KSSs of patients with ligament injuries managed with constraint compared with control subjects.

Patients and Methods

We retrospectively reviewed the medical records of all 1478 patients (1650 knees) who underwent primary TKA from 1998 to 2004. Intraoperative MCL disruption was recognized when there was unexpected medial laxity in a patient with no preoperative medial instability. Patients with prior MCL injuries or surgeries and those patients with valgus deformity were excluded. There were 37 patients with recognized intraoperative MCL injury (2.2%). There were 18 men and 19 women with an average age of 60 years. The preoperative diagnosis was osteoarthritis in 35, inflammatory arthritis in one, and posttraumatic gonarthrosis in one patient. The preoperative alignment of the knee averaged 4° of varus (range, 10° degrees to 1° valgus). The minimum followup was 36 months (average, 54 months; range, 36–120 months). Three patients were lost to followup. No patients were recalled specifically for this study; all data were obtained from the medical records.

All surgery was performed by a single surgeon (PAL). The knee was approached through a standard medial parapatellar approach. A standard medial release of the MCL off the proximal tibial metaphysis was carried out. In no cases were the pes anserine tendons released. The etiology of MCL disruption was transection in 28 cases and avulsion of the collateral ligament from the tibial metaphysis in the remaining nine cases. Each injury was confirmed by the senior surgeon with exposure and direct visualization of the ligament midsubstance or insertion. Transection of the MCL occurred during tibial resection or the posterior condylar resection, whereas avulsion of the MCL insertion occurred with hyperflexion during exposure of the knee. There was an attempt to repair the ligament in

14 cases; five patients had suture repair of the MCL and in nine cases, the ligament was stapled to the proximal tibia. One of two posterior stabilized knee implants was planned for use in all patients: the PFC sigma (DePuy, Warsaw, IN) or the Scorpio PS (Stryker, Mahwah, NJ). However, in 30 of 37 patients, increased constraint (TCIII; DePuy) was used on recognition of iatrogenic MCL disruption. No hinged knee designs were used in this study.

Postoperatively, patients treated with the TCIII knee prosthesis were allowed early motion and immediate weightbearing. Four of seven patients treated with repair or augmentation and a nonconstrained posterior cruciate ligament substituting knee prosthesis were casted for 4 weeks; the remainder was not immobilized after surgery. All patients received 325 mg aspirin orally twice a day for 6 weeks for deep venous thrombosis prophylaxis.

Patients were followed up at regular intervals (2 weeks, 6 weeks, 3 months, 1 year, 2 years, 5 years). We obtained Knee Society scores (KSS) for pain and function [8] and radiographs were reviewed for evidence of loosening [4]. One of us (GCL) reviewed all radiographs. Parameters for evaluation of KS pain scores included pain, ROM, and knee stability. Functional scores were calculated by distance walked, ability to go up and down stairs, and whether gait aides were required for ambulation. For consistency, clinical scores reflect patient pain and function before any revision surgery. Minimum radiographic followup was 36 months (average, 44 months; range, 36–108 months). Radiographs were evaluated for the presence of radiolucent lines, lytic lesions, and component migration. In cases with present radiolucent lines, serial radiographs were compared for progression of lucent lines or shift in component position. There were no missing radiographic or clinical data.

The KSSs for pain and function were compared with the clinical scores of patients undergoing primary TKA in the same period who did not have iatrogenic MCL disruption (1613 knees). We plotted the distribution of KSS for pain and function (our primary outcomes of interest) on a histogram, and they were normally distributed. Additionally, we performed a Levene test for equality of variance to ensure relative homogeneity of variance. We determined the differences in KSSs for pain and function in patients with iatrogenic MCL injuries compared with patients without ligament injury using the Student's *t*-test. Furthermore, we compared the KSSs for pain and function between patients with MCL injuries managed with TCIII compared with our control group using the Student's *t*-test.

Results

For all 37 patients with MCL injuries, the KSSs for pain and function averaged 81 and 74 points, respectively.

Table 1. Clinical results after intraoperative medial collateral ligament (MCL) injury

Clinical outcome	Study group MCL injury (n = 37)	Control group No MCL injury (n = 1613)	Constraint only MCL injury + TCIII (n = 30)
KS pain	81	91	88
	p < 0.01		p = 0.19
KS function	74	87	83
	p < 0.01		p = 0.10

MCL = Medial collateral ligament; KS = Knee Society.

Both of these scores were lower ($p < 0.01$ for pain, $p < 0.01$ for function) compared with the average pain and function scores of 91 and 87 points, respectively, from the 1613 control knees that did not have an MCL injury during primary TKA. Comparing patients treated with ligament repair/augmentation and a cruciate substituting knee with patients with MCL injuries treated with a TCIII knee design, the mean KS score for pain was 65 (range, 18–72) versus 88 (range, 68–95) points and for function was 49 (range, 19–68) versus 83 (range, 60–95). Finally, at last followup, patients treated with TCIII knees had similar Knee Society scores compared with patients who did not have a ligament injury during TKA (88 versus 91 for pain ($p = 0.19$) and 83 versus 87 for function ($p = 0.10$) (Table 1).

Revision surgery for instability was performed in four of the seven knees treated with unconstrained inserts at an average of 7 months (range, 3–12 months). These knees were revised to TCIII with cemented femoral and tibial stems. At last followup, all four knees were well fixed with no evidence of residual instability. Three of the 30 patients treated with TCIII prostheses, after recognition of MCL injury, required subsequent revision surgery (one for infection and two for aseptic loosening) at an average of 50 months. At last followup, all three knees were functioning well without evidence of infection, instability, or loosening. Over the same period, 25 (1.5%) knees from the control group underwent revision knee arthroplasty (15 infection, two fracture, five aseptic loosening, two flexion instability, one stiffness).

Discussion

Intraoperative injuries to the collateral ligaments are often unrecognized and rarely discussed. Failure to recognize ligament dysfunction may result in knee instability, accelerated wear, and loosening [13, 16]. For patients with deficiency of the MCL, many have advocated the use of constrained implants or have described techniques for medial-sided reconstruction [5, 7, 10, 12]. Although some

studies have reported successful management of iatrogenic disruptions of the MCL with either repair or augmentation and a nonconstrained implant [9, 14], others have advocated conservative treatment with a thicker polyethylene insert without residual coronal instability [11]. Therefore, the purposes of this study were to (1) evaluate the Knee Society scores of patients with iatrogenic injury to the MCL during TKA compared to patients undergoing primary TKA without MCL injury; (2) to compare the Knee Society scores of ligament repair or augmentation and use of nonconstrained TKA with patients managed with constrained prostheses; and (3) to compare the scores and durability of patients with ligament injuries managed with constraint compared with control subjects.

There are several limitations to this study. First, our retrospective study is subject to recall bias and limited in its ability to generate details about the injury to the MCL. Second, because the degree of injury to the MCL was not quantified, there could be a threshold of injury under which patients with lesser partial or incomplete injuries may do well with a thicker polyethylene insert or repair, augmentation, and nonconstrained implants. Third, only 7 of 37 knees were treated with repair and a nonconstrained implant. This limits one's ability to determine if repair or constraint is the most effective way to manage intraoperative MCL injuries.

We found patients with iatrogenic MCL injuries had lower mean KS pain and function scores than patients without MCL injuries treated with primary TKA. Overall, the mean KSSs for pain and function were 81 and 74 points, respectively, in the MCL injury group compared with 91 points for pain and 87 points for function in the control group. At first glance, our findings appear inferior to other published reports on this subject. Leopold et al. reported mean KSS scores of 93 points in 16 knees with intraoperative MCL injuries treated with repair and a posterior cruciate ligament retaining knee prosthesis [14]. In another series, Koo and Choi conservatively managed patients with MCL avulsions during TKA by increasing the thickness of the polyethylene and reported average KSSs of 91 [11]. When comparing our series with other series, we had a higher number of patients with low KSS scores and failures. However, when comparing patients with MCL injuries managed with TCIII prostheses, the clinical scores were similar to our control group and are more consistent with previously published reports on intraoperative MCL disruptions (Table 2).

Our data suggest recognition of collateral ligament injury and use of increased constraint are the major factors contributing to a favorable outcome. Patients in whom an unconstrained posterior cruciate substituting knee was used had higher failure rates compared with those treated with constraint regardless of the repair technique used on the

Table 2. Comparison of clinical results of patients with intraoperative MCL injuries

Studies	N	KSS	Prosthesis	Failures
Leopold et al. [14]	16	93	CR	0
Koo and Choi [11]	15	91	13 PS / 2 CR	0
Lee and Lotke [current study]	37	81	7 PS / 30 TCIII	4
Lee and Lotke [current study] (TCIII only)	30	88	TCIII	0

KSS = Knee Society Score.

MCL. Our findings differ from those of the other published studies on iatrogenic MCL injuries during TKA [9, 11, 14]. Leopold et al. reported 16 of 600 (2.7%) knees had intraoperative injuries to the MCL [14]. Midsubstance tears were treated with direct repair and avulsions were treated with suture anchor fixation. All patients were treated with a nonconstrained posterior cruciate retaining TKA and were braced for 6 weeks postoperatively. At a mean followup of 45 months, they reported no failures or revisions for instability [14]. These differences may be explained by their use of a posterior cruciate retaining TKA and by the PCL's ability to impart medial stability to the knee [1]. Sacrifice of the PCL leads to substantially increased medial gapping [15]. However, Koo and Choi [11] successfully treated 15 knees (13 using PS knee designs) with MCL avulsion injuries simply by upsizing the size of the polyethylene insert. They reported no difference in KSSs between their MCL injured knees and control subjects and no cases of coronal instability or cases requiring revisions [11]. In contrast, we found conservative treatment of MCL injuries resulted in high rates of instability requiring revision. A possible explanation for this difference may be differences in the healing potential of the MCL that is severed at its midsubstance (most common in our study) compared with a ligament avulsed from its tibial insertion as a continuous sleeve [8].

We found the use of increased constraint when MCL injury is recognized frequently leading to satisfactory clinical outcomes. The KSSs for pain and function were similar to patients undergoing primary TKA during this period. However, there may be a risk from using constrained implants from potential decreased implant longevity [2, 17, 18]. Although constraint is frequently used in revision surgery, few studies deal with the use of constraint in the primary setting [3, 5, 10, 20]. One study reported long-term followup on a series of 54 constrained condylar knees performed for complex primary TKA. The authors reported a 10-year survivorship rate of 96% and concluded that despite low rates of failure, they believed constrained implants only remained indicated for knees

with severe valgus, incompetent MCLs, and severe flexion contractures in which the knee cannot be balanced [13]. In our series, three (10%) patients treated with constraint underwent subsequent revision TKA (one infection, two aseptic loosening). Consequently, although we recognize the use of constraint may lead to increased forces placed across the implant interface and be a risk factor for wear or loosening, in cases when the MCL is compromised, the use of constraint provided reliable function at short-term followup.

Iatrogenic injury to the MCL can occur during various stages of performing a TKA. Recognition of the injury is imperative. Despite reports of successful management of MCL injury using nonconstrained knee prostheses in combination with repair, augmentation, or thicker inserts, we found use of an unlinked constrained prosthesis (TCIII) provides the most reliable salvage for this problem.

References

1. Barton TM, Torg J, Das M. Posterior cruciate ligament insufficiency. A review of the literature. *Sports Med.* 1984;1:419.
2. Cameron HU, Hunter GA. Failure in total knee arthroplasty. Mechanisms, revisions, and results. *Clin Orthop Relat Res.* 1982; 170:141.
3. Easley ME, Insall JN, Scuderi GR, Bullek DD. Primary constrained condylar knee arthroplasty for the arthritic valgus knee. *Clin Orthop Relat Res.* 2000;380:58.
4. Ewald FC. The Knee Society total knee arthroplasty—roentgenographic evaluation and scoring system. *Clin Orthop Relat Res.* 1989;248:9–12.
5. Giori NJ, Lewallen DG. Total knee arthroplasty in limbs affected by poliomyelitis. *J Bone Joint Surg Am.* 2002;84:1157.
6. Hartford JM, Goodman SB, Schurman DJ, Knoblick G. Complex primary and revision total knee arthroplasty using the condylar constrained prosthesis. An average 5 year follow up. *J Arthroplasty.* 1998;13:380.
7. Healy WL, Iorio R, Lemos DW. Medial reconstruction during total knee arthroplasty for severe valgus deformity. *Clin Orthop Relat Res.* 1998;356:161.
8. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system. *Clin Orthop Relat Res.* 1989; 248:13–14.
9. Jung KA, Lee SC, Hwang SH, Jung SH. Quadriceps tendon free graft augmentation for a midsubstance tear of the medial collateral ligament during total knee arthroplasty. *Knee.* 2009;16: 479–483.
10. Kim YH, Kim JS, Oh SW. Total knee arthroplasty in neuropathic arthropathy. *J Bone Joint Surg Br.* 2002;84:216.
11. Koo MH, Choi CH. Conservative treatment for the intraoperative detachment of medial collateral ligament from the tibial attachment site during primary total knee arthroplasty. *J Arthroplasty.* 2009;24:1249–1253.
12. Krackow KA, Jones MM, Teeny SM, Hungerford DS. Primary total knee arthroplasty in patients with severe varus deformity. A comparative study. *Clin Orthop Relat Res.* 1991;273:19.
13. Lachiewicz P, Soileau E. Ten year survival of and clinical results of constrained components in total knee arthroplasty. *J Arthroplasty.* 2006;21:803.

14. Leopold SS, McStay C, Klafeta K, Jacobs JJ, Berger RA, Rosenberg AG. Primary repair of intraoperative disruption of the medial collateral ligament during total knee arthroplasty. *J Bone Joint Surg Am.* 2001;83:86.
15. Luring C, Hunter T, Perlick L, Bathis H, Krettek C, Grifka J. The effectiveness of sequential medial soft tissue release on coronal alignment in total knee arthroplasty using a computer navigation model. *J Arthroplasty.* 2006;21:428–434.
16. Naudie DDR, Rorabeck CH. Managing instability in total knee arthroplasty with constrained and linked implants. *Instr Course Lect.* 2004;53:207.
17. Puloski SK, McCalden RW, MacDonald SJ, Rorabeck CH, Bourne RB. Tibial post wear in posterior stabilized total knee arthroplasty: an unrecognized source of polyethylene debris. *J Bone Joint Surg Am.* 2001;83:390.
18. Scuderi GR. Revision total knee arthroplasty. *Clin Orthop Relat Res.* 2001;392:300.
19. Sculco TP. Total condylar III prosthesis in ligament instability. *Orthop Clin North Am.* 1989;20:221.
20. Whiteside LA. Correction of ligament and bone defects in total knee arthroplasty of the severely valgus knee. *Clin Orthop Relat Res.* 1993;288:234.