

Surgical Treatment of Ligamentous Instability After Total Knee Arthroplasty

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Summary. During the period of January 1, 1972 through October 31, 1982 seven knees in seven patients had ligamentous reconstructions for instability following total knee arthroplasty. The type of ligamentous instability included severe medial instability in six and a combined severe medial and mild lateral instability in one patient. The surgical technique utilized to reconstruct the ligaments included proximal and distal advancement of the medial collateral ligament. In five of the seven, additional soft tissue surgery was combined with tightening of the medial collateral ligament. Unfortunately, ligamentous reconstruction failed to restore stability to the knee in any of the seven patients. Four patients required revision total knee arthroplasty. Instability of the knee necessitated full-time support with a brace and the seventh patient manages his instability without a brace. Ligamentous reconstruction without component revision is inappropriate in the treatment of the unstable knee following total knee arthroplasty.

Zusammenfassung. In der Zeit vom 1. Januar 1972 bis 31. Oktober 1982 erfolgte bei 7 Kniegelenken von 7 Patienten eine Bandrekonstruktion wegen Instabilität nach Implantation einer Kniegelenk-Totalprothese. Bei 6 Patienten bestand eine schwere Instabilität des medialen Längsbandes und bei einem Patienten eine schwere mediale Instabilität, kombiniert mit einer leichten lateralen Instabilität. Die operative Technik zur Wiederherstellung der Bandfestigkeit bestand in einer Versetzung des proximalen und distalen Ansatzes des medialen Längsbandes. In 5 der 7 Fälle wurden zusätzliche Weichteiloperationen mit der Anspannung des medialen Längsbandes kombiniert. Bedauerlicherweise hat die Rekonstruktion des Band-

apparates bei der Wiederherstellung der Kniegelenkstabilität in allen 7 Fällen versagt. Bei 4 Patienten war eine Auswechslung der Knieprothese erforderlich. Die Knie-Instabilität erforderte die dauernde Versorgung mit einer Orthese, nur einer der 7 Patienten kam ohne eine Orthese mit der Instabilität zurecht. Eine Bandrekonstruktion ohne eine Auswechslung des Kunstgelenkes ist ein ungeeignetes Vorgehen bei der Behandlung einer instabilen Kniegelenk-Totalprothese.

During the initial experience with total knee arthroplasty, significant angular and ligamentous deformities in the arthritic knee were usually managed by bone resection and the implantation of an articulated prosthesis. The articulated implants had the advantage of being easily aligned and inserted, and frequently the short-term relief of symptoms was excellent. However, long-term follow-up has shown a high incidence of loosening. Because of this experience, patients with significant deformities were treated with less constrained arthroplasties. Unconstrained surface replacements were also utilized in the treatment of patients with minimal deformity and with relatively good ligamentous stability.

Bioengineering investigations and improvement of material properties, fixation and design led to the current practice of using the least constrained design possible with maximal preservation of bone stock. Balanced ligamentous stability is achieved by means of proper size of components, soft tissue release, and proper alignment. The articulated prosthesis is now indicated mainly in salvage procedures.

Occasionally, ligamentous instability is encountered in a patient with a semi-constrained or an

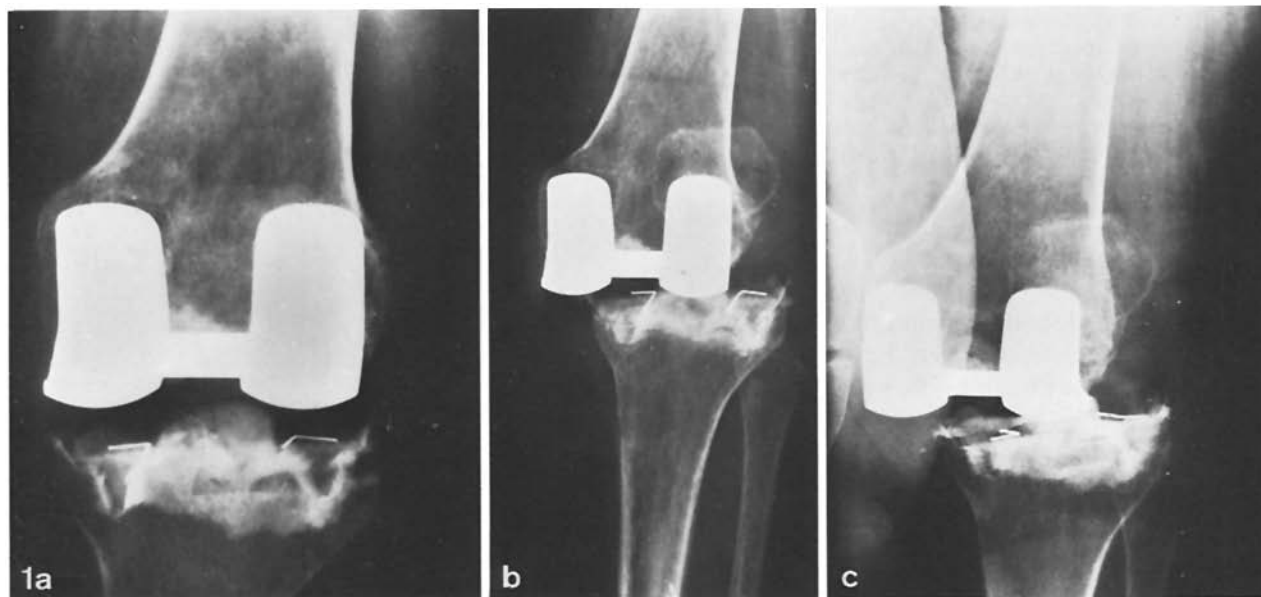


Fig. 1. **a** Postoperative roentgenographic examination of a 70-year-old female with degenerative joint disease who had valgus angulation of 15 degrees preoperatively. The valgus alignment has been corrected to 5 degrees. **b** Subluxation occurred one week following the arthroplasty. **c** Instability persists despite distal advancement of the medial collateral ligament and medial capsule

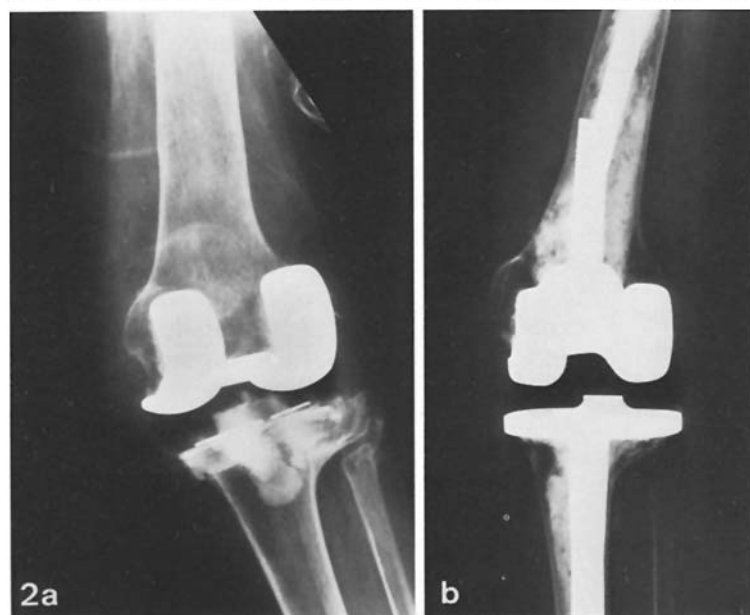


Fig. 2. **a** Medial instability two months following a geomedic arthroplasty in a 45-year-old female with rheumatoid arthritis. **b** Instability persisted despite distal advancement of the medial collateral ligament and reinforcement with the semimembranosus tendon. Revision to a custom total condylar total knee arthroplasty restored stability to the knee

unconstrained total knee arthroplasty. The instability may be immediate due to inappropriate technique, or it may be late due to trauma or gradual attenuation of the ligaments. Instability may cause pain, giving way, loosening of components and deformation of components vs. bone.

The treatment of ligamentous instability may be non-surgical or surgical. Non-surgical treatment usually consists of muscle rehabilitation, the use of a brace, and external walking aids—cane or crutches. Surgical treatment can include revision total knee arthroplasty with implantation of a more constrained and/or a thicker component(s) or ligamentous reconstruction. Revision total knee surgery is often difficult

and has been associated with an increased incidence of postoperative sepsis.

Ligamentous repair and reconstruction has been mentioned in the past as a possible form of treatment for instability after total knee arthroplasty [2] but, to date, no one has addressed this specific problem. We wish to detail our experience with seven patients with total knees in which ligamentous reconstruction was attempted.

Materials

The records of the Mayo Clinic during the period of January 1, 1972 through October 31, 1982 were reviewed to identify all the

patients who had a total knee arthroplasty performed. Information was obtained from the patients' medical history, operative reports, X-rays and the Mayo Clinic standard knee sheets. During this period, there were 5,716 primary total knee arthroplasties performed at the Mayo Clinic. One hundred and twelve patients required revision surgical treatment for instability following total knee arthroplasty.

Results

Seven of the 112 patients with a total knee arthroplasty requiring additional surgery for instability had ligamentous reconstruction following total knee arthroplasty. Five of the seven patients with ligamentous reconstruction were female. The age of these seven patients ranged from 41 to 74 years (mean: 64 years). Three patients had rheumatoid arthritis (patients 3, 4, and 5), one had gouty arthritis (patient 6), and three had degenerative joint disease (patients 1, 2, and 7). One patient had an old fracture of the tibial plateau (patient 3) and one had a failed MacIntosh prosthesis (patient 4). Six of the seven patients had knee instability prior to the total knee arthroplasty. Two had medial instability of the knee graded +3 and +4 (patients 2 and 5) on a scale of one (normal) to four (complete). Three had medial instability of the knee graded +3 combined with lateral instability of the knee graded +2 (patients 3, 4, and 7), and one had medial instability of the knee graded +4, lateral instability graded +3, and anterior instability of the knee graded +3. Six knees (six patients) were in excessive valgus alignment of more than 12 degrees (Figs. 1a, 2a) and one knee was in anatomical varus alignment of 30 degrees before the total knee arthroplasty.

The type of prosthesis implanted at the time of total knee arthroplasty varied: in five knees a Geomedic total knee arthroplasty was performed (patients 2, 3, 4, 5, and 6), in one knee a polycentric total knee arthro-

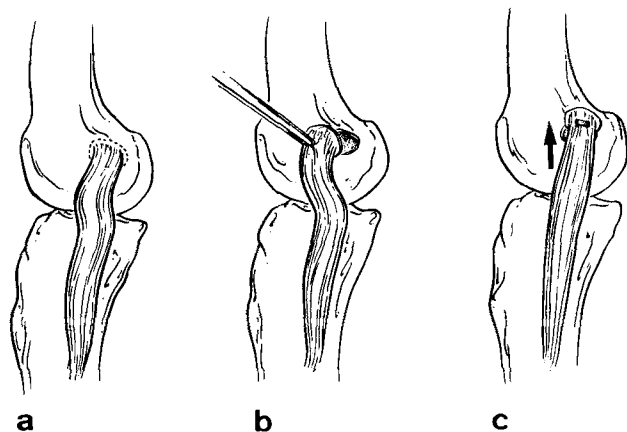


Fig. 3. a Lax medial collateral ligament. b Proximal release of the medial collateral ligament with bony attachment. c Proximal advancement and staple fixation (arrow)

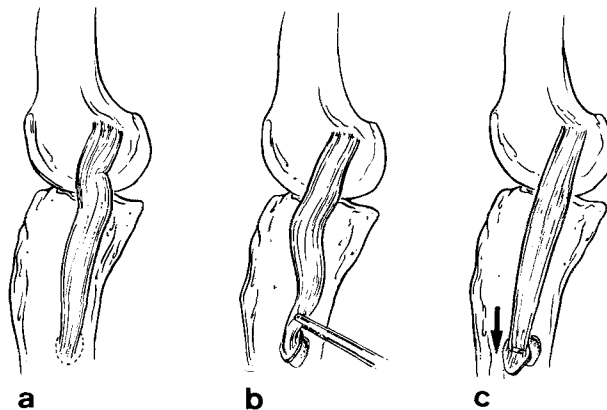


Fig. 4. a Lax medial collateral ligament. b Distal release of the medial collateral ligament with bony attachment. c Distal advancement and staple fixation (arrow)

plasty was performed (patient 1) and in the final knee a total condylar prosthesis (patient 7).

Following the total knee arthroplasty, five knees were in good anatomic alignment of 0–12 degrees valgus (Fig. 1a) and two were still in excessive valgus alignment of more than 12 degrees.

Following total knee arthroplasty, four patients had medial instability of the knee graded +4 immediately after surgery (Figs. 1 and 2). In two patients, medial instability of the knee graded +3 and +4 developed within two months following arthroplasty.

The remaining patient had medial instability of the knee graded +3 and lateral instability of the knee graded +2 immediately postoperatively.

The type of ligamentous reconstruction performed varied with the pathological alterations encountered (Table 1).

Transfer of the origin of the medial collateral ligament to a more proximal anatomic location was performed in four patients (Fig. 3). It was combined with additional soft tissue surgery in three of the four patients. A pes anserine transfer, a semitendinosus reinforcement, or imbrication of the medial capsule was combined with the proximal advancement of the medial collateral ligament in one patient each (Table 1). Advancement of the insertion of the medial collateral ligament was performed in three patients (Fig. 4). It was combined with a pes anserine transfer in one patient. In another patient, it was combined with distal advancement of the capsule (Table 1).

Two patients had a second ligamentous reconstruction after failure of the initial procedure which included: proximal advancement of the medial collateral ligament and iliotibial band release (patient 3) and proximal advancement combined with pes anserinus transfer (patient 7).

Two methods of immobilization were utilized: a toe to groin cylinder cast for six weeks or cast bracing

Table 1. Summary of clinical history, treatment, and results of the seven patients with ligamentous instability after total knee arthroplasty

Case No.	Underlying condition	Preop alignment	Preop instability	Type of TKA	Postop alignment	Postop instability, time of development	Reconst proc and immobilization	Interval of failure	Additional reconst proc	Final results
1	DJD	Val 15°	Stable	Polycentric	Val 19°	2 months Med +3	Proximal tightening of MCL + pes ans transfer + cast brace	3 months		In brace for 5 years
2	DJD	Val 30°	Med +3	Geometric	Val 10°	2 months Med +4	Distal tightening MCL and capsule + pes ans transfer + cast brace	3 months		Revised to Guepar
3	RA old Fx tibial plateau	Val 35°	Med +3 Lat +2	Geometric	Val 10°	Immediate postop Med +4	Prox tightening MCL + semitendinosus reinforcement + cylinder cast	Immediate post immobilization	At 5 years release ilio-tibial band + prox tightening MCL	Revised to total condylar
4	RA failed Mac-Intosh	Val 15°	Med +3 Lat +2	Geometric	Val 13°	Immediate postop Med +4	Prox tightening MCL + cast brace	1 year		Uses no brace — 10 years
5	RA	Val 20°	Med +4	Geometric	Val 5°	Immediate postop Med +4	Prox tightening MCL + duplication med capsule + cylinder cast	6 weeks		Revised to large Tavernetti
6	Gouty arthritis	Var 30°	Med +4 Lat +3 Ant +3	Geometric	0°	Immediate postop Med +4	Distal tightening MCL	6 weeks		Revised elsewhere
7	DJD	Val 15°	Med +3 Lat +2	Total condyl	Val 5°	Immediate postop Med +3 Lat +2	Distal tightening MCL + capsule + knee brace	Immediate post immobilization	1 year prox tightening MCL + pes transfer	In brace 1 year

for at least eight weeks. Following immobilization, a muscle strengthening program was initiated in all seven patients. All of the patients were treated with knee braces for at least six months after the reconstruction.

Two knees (two patients) were found to be unstable immediately after discontinuing the immobilization. Four developed instability within three months after discontinuing the immobilization, and one developed instability one year following the reconstruction (Table 1).

Four of the seven patients eventually required revision total knee arthroplasty (patients 2, 3, 5, and 6). Two patients preferred wearing a knee brace permanently (patients 1 and 7). The remaining patient has persistent instability but continues ambulation

without a brace five years following the failure of ligamentous reconstruction (patient 4).

Discussion

Medial instability of the knee is a well known entity and the surgical reconstruction procedures were first described by Lexer in 1909 [4]. Since then, several methods have been described. Mauck popularized the distal advancement of the tibial attachment of the medial collateral ligament [5]. Slocum and Larson contributed to the understanding of the anteromedial instability by developing the pes anserinus transfer [7], and Gillespie combines distal advancement of the medial collateral ligament with pes anserinus transfer [3]. O'Donoghue emphasized the role of the postero-

medial capsule while Warren et al. claimed that the long fibers of the superficial medial collateral ligament are the primary stabilizers [6, 8].

Different methods were used to correct the medial instability in the seven patients described. None proved to be satisfactory. Although the current concept of mechanical analysis favors distal advancement, both proximal (patients 1, 3, 4, and 5) and distal (patients 2, 6, and 7) advancement failed [1]. Dynamic reinforcement (patients 1 and 2) and static reinforcement (patient 3) were not superior to tightening of the ligament alone or in combination with the capsule. Complete immobilization did not differ from protected mobilization.

Since the prognosis following medial reconstructions of the knee in young, healthy patients remains guarded, one must question the application of these techniques to a patient with an unstable artificial knee where unphysiological forces may play a major role. The mean age of these patients, the poor tissue quality, and underlying disease (e.g., rheumatoid arthritis) may further compromise the various procedures.

In view of our experience, we feel that ligamentous reconstruction alone is inappropriate for the treatment of the unstable total knee arthroplasty. When a patient develops significant instability following total

knee arthroplasty, revision surgery with thicker components or a more constrained arthroplasty should be performed.

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