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Original article

Anterior cruciate ligament reconstruction combined with valgus high tibial osteotomy allows return to sports

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ABSTRACT

Introduction: This study reports a series of patients operated on by anterior cruciate ligament (ACL) reconstruction combined with valgus high tibial osteotomy (HTO) for chronic anterior knee instability associated with medial tibiofemoral osteoarthritis. It was hypothesized that the combined surgery would enable return to sport, stabilize the knee and relieve medial pain.
Patients and methods: A retrospective study enrolled a continuous series of 29 patients (20 males, nine females; mean age, 43 years (range, 25–56 yrs), at a mean 14 years (range, 2–29 yrs) after the initial injury. ACL autograft used a bone-patellar tendon-bone transplant in 12 patients and hamstring tendon transplant in 17. Medial opening wedge HTO used an asymmetric wedge plate. Results were assessed on subjective and objective IKDC scores, monopodal weight-bearing and full-leg radiographs, telemetry and Merchant view at a mean 6 years follow-up (range, 25 months to 12 years).
Results: At follow-up, 23 patients had resumed sports activities, with 45% in competitive sports; 28 were free of instability and 21 free of pain. Mean subjective IKDC score was 77 (34–97) and 70% had A or B global objective IKDC scores. The knee axis was in 2.5° valgus.
Discussion: Combined ACL graft and valgus HTO relieved pain in 70% of cases, and restored knee stability enabling return to sport in 80%.
Level of evidence: Level IV. Retrospective therapeutic study.

1. Introduction

Anterior cruciate ligament (ACL) tear induces progressive deterioration in knee structures [1–3]. In the meniscus, secondary lesions are often medial, occurring within 5 to 10 years after the ligament lesion, and are followed by cartilage lesions that lead to osteoarthritis [4–6]. Osteoarthritis involves usually the medial tibiofemoral compartment, especially following medial meniscectomy [7,8].

ACL reconstruction achieves knee stability [9–12] and can limit the osteoarthritic process. Valgus high tibial osteotomy (HTO) limits the evolution of medial tibiofemoral osteoarthritis in varus knees [13–16].

Combined ACL reconstruction and valgus HTO (ACL-HTO) stabilizes the knee and counters osteoarthritic evolution. It has been described elsewhere, and assessed at medium-term follow-up [17–21]. None of the reported series, however, focused on return to sport. The present study hypothesized that this combined procedure enables resumption of sport activity, stabilizes the knee and relieves pain.

2. Patients and method

2.1. Series

Between January 1997 and 2009, 34 consecutive patients underwent 1-step ACL-HTO in our department. All presented with chronic anterior laxity with associated early osteoarthritis (IKDC grade B or C) or medial tibiofemoral osteoarthritis (IKDC grade D) [22]. Minimum follow-up for inclusion was 2 years. A retrospective series of 29 patients was followed up for a mean 6 years (range, 25 months to 12 years).

There were 20 male and nine female patients, with a mean age of 29 years (14–45 yrs) at the time of the ACL tear. Eight had no history of knee surgery and 21 had had at least one previous operation (Table 1).

Mean age at surgery was 43 years (25–56 years), for a injury-to-surgery interval of 14 years (2–29 years). All patients had episodic instability and medial pain. Pre-operative meniscal-ligamentous lesion assessment found isolated anterior laxity in five cases, associated medial meniscal lesion in two, associated lateral meniscal

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Table 1
History of surgery before ACLreconstruction + valgus HTO.

Number of patients	1st procedure	2nd procedure	3rd procedure
1	BTB	MM	MM
1	BTB	MM	Arthrolysis
1	Lateral tenodesis	LM	PCL reinsertion + ML
1	Artificial ACL	BTB + lat tenodesis	MM
4	Lemaire	MM	
1	BTB + lat tenodesis	McIntosh	
1	Lemaire + MM	BTB	
2	BTB	MM	
2	MM	McIntosh	
1	ACL reinsertion		
5	MM		
1	Popliteal cyst resection		

BTB: bone-tendon-bone; ACL: anterior cruciate ligament; PCL: posterior cruciate ligament; MM: medial meniscectomy; LM: lateral meniscectomy.

lesion in three, bi-meniscal lesion in one, posteromedial tear in 12 and lateral decoaptation in six.

2.2. Surgery

Surgery used a single anteromedial approach. It consisted in arthroscopic ACL reconstruction by autograft of the mid-third of the patellar tendon [11] in 12 patients and free quadruple-strand single-bundle hamstring tendon transplant [23] in 17. The medial opening wedge valgus HTO was fixed using an asymmetric wedge Puddu plate® (Arthrex), with the medial opening filled with bone substitute (Endobon™). Lateral extra-articular tenodesis was associated in three cases.

Weight-bearing was proscribed for 6 weeks; passive mobilization was allowed as of the day after surgery, without limit on range of motion.

3. Methods

All patients were assessed at follow-up on subjective and objective IKDC 2000 scores [22].

Radiologic assessment, pre-operatively and at end of follow-up, comprised AP and lateral monopodal weight-bearing views in 20° flexion [24], AP bipodal weight-bearing view in 45° flexion (the so-called Schuss position) [25], comparative lateral views in passive anterior tibial translation at 150 Newtons on the TELOS device, lower-limb telemetry in standing position with knees in extension, and Merchant view in 60° flexion. Cartilage degeneration was assessed on the IKDC classification [22]: A, normal space; B, normal space with osteophytes; C, <50% joint line narrowing; and D, >50% narrowing. Pre- and post-operative patellar height was calculated from lateral views following Caton and Deschamps [26] and tibial slope and anterior tibial translation following Insall and Salvati [27,28]. Patellar osteoarthritis was assessed from the Merchant views. The pre- and post-operative overall mechanical axis of the knee was calculated from the lower-limb telemetry results. Bone healing was assessed on AP and lateral views.

Data were expressed as mean ± standard deviation. Normal distribution was checked on Agostino-Pearson test. Continuous variables were compared on Student *t* test in normal distributions or Mann-Whitney U test in non-parametric distributions.

4. Results

4.1. Return to sport

Pre-operatively, no patients were practicing intensive sport; postoperatively, 80% (23/29) resumed some sports activity, and 45% (13/29) intense or very intense activity (Table 2). For the other 6 patients, sports activity was not resumed not due to the knee but to a change in social habits.

Table 2
Pre- and post-operative sports level.

Subjective IKDC: activity	A (soccer) Very intense	B (tennis, skiing) Intense	C (jogging) Moderate	D (gardening) Mild
Pre-op	0	0	9	20
FU	3	10	10	6

4.2. Medial pain

Pre-operative medial pain was systematic. At end of follow-up, 21 out of 29 patients (70%) were free of pain. Eight scored pain as four out of 10 on VAS (range, 3 to 8).

4.3. Knee stability and residual laxity

All patients showed pre-operative functional instability of the knee. By end of follow-up, 28 of the 29 (97%) were free of instability; 27 had normal or nearly normal and 2 abnormal manual Lachman scores (IKDC C). Translation on TELOS at 150 N was normal or nearly normal in 24 cases and abnormal (IKDC C) in 5. Mean differential laxity was 2.65 mm (range, −1 to 9 mm). Pivot-shift test was negative in 24 cases, glide in 4 and positive in 1. There were no cases of frontal laxity.

4.4. Subjective and objective IKDC scores

Mean subjective IKDC score at 6 years' follow-up was 77 (34–97). All but one patient were satisfied or very satisfied; all but one would undergo the procedure again or recommend it to a friend. None reported locked knee; six reported episodic swelling, on intense activity in three cases and moderate in three.

Twenty-one patients (70%) had A or B objective IKDC grades at follow-up (Table 3). Twenty-eight had complete or nearly complete extension; 1 had >5° flexion contracture (IKDC C or D).

4.5. Radiography

At end of follow-up, all patients showed consolidation. There was no radiolucency between bone substitute and bone, even in the eight patients with residual pain (Fig. 1).

Twenty-five patients had C or D IKDC grades pre-operatively and 22 at end of follow-up.

Six had pre-operative medial tibiofemoral osteoarthritis (IKDC D) and 8 at end of follow-up (Table 4). Three of the patients with IKDC C (Fig. 1) were graded B at end of follow-up, and 2 D (pre-operative medial meniscectomy, and complementary peroperative meniscectomy).

Pre-operatively, the mean axis was 175° (171–180°) (Table 5). Postoperatively, all patients were in valgus except for three with

Table 3
Objective IKDC score.

	IKDC A	IKDC B	IKDC C	IKDC D
Hydrarthrosis	30	0	0	0
ROM	10	15	3	1
Flexion	20	6	2	1
Extension	11	15	3	1
Laxity	15	8	5	1
Manual Lachman	17	10	2	0
Radiologic Lachman	15	8	5	1
Pivot shift	24	3	2	0
Global IKDC	9	12	6	2