Consequences of pain on isokinetic performance after anterior cruciate ligament reconstruction using a semitendinosus and gracilis autograft

Étude longitudinale

Conséquences des douleurs à l’effort sur les performances isocinétiques après ligamentoplastie du genou aux tendons ischio-jambiers

M. Dauty *, L. Tortelier *, D. Huguet **, M. Potiron-Josse *, C. Dubois *

* Pôle de MPR et Médecine du Sport, Hôpital Saint-Jacques, CHU de Nantes, 5, place Alexis-Ricordeau, 44093 Nantes Cedex 01.
** Polyclinique de l’Atlantique, rue Claude-Bernard, BP 419, 44800 Saint-Herblain Cedex.

RÉSUMÉ

Le but de cette étude était de connaître l’évolution sur 12 mois des paramètres isocinétiques après ligamentoplastie du genou aux tendons ischio-jambiers (DIDT, 4 brins), en fonction de la présence ou non de douleurs postopératoires rapportées uniquement à l’effort.

Soixante-quinze patients, âgés de 29 ans ± 8,5, ont bénéficié d’une ligamentoplastie DIDT et d’un suivi isocinétique du genou à 4, 6 et 12 mois postopératoires. Au 4e mois, 4 populations ont été identifiées en fonction de la présence de douleurs du genou à l’effort : population sans douleur (n = 52), population avec douleurs postérieures (n = 7), population avec douleurs antérieures (n = 9) et population avec douleurs diffuses et défaut de mobilité de genou (n = 7).

Les patients qui souffraient de douleurs postérieures à l’effort présentaient un déficit des fléchisseurs (32 % ± 18 versus 18 % ± 15 ; p = 0,04). Les patients qui souffraient de douleurs antérieures à l’effort présentaient un déficit des extenseurs (45 % ± 7 versus 30 % ± -14 ; p = 0,02). Les patients qui souffraient de façon diffuse de leur genou présentaient un déficit des extenseurs (58 % ± 9 versus 30 % ± 14 ; p < 0,001) et des fléchisseurs (39 % ± 21 versus 18 % ± 15 ; p = 0,01). À 1 an, certains déficits n’étaient pas encore comparables à ceux de la population non douloureuse.

L’origine exacte des douleurs de genou après ligamentoplastie n’est pas toujours facile à déterminer. Après technique au DIDT, les douleurs postérieures sont souvent attribuées au prélèvement des tendons ischio-jambiers. Les douleurs antérieures sont multifactorielles (fémoro-patellaire, rétraction du tendon patellaire...). Les douleurs diffuses avec défaut de mobilité peuvent être en rapport avec un syndrome neuro-algodystrophique mineur.

Les tests isocinétiques quantifient la récupération du genou opéré. À 1 an, un déficit de 10 % au niveau des fléchisseurs et des extenseurs est attendu en l’absence de douleur. En cas de phénomènes douloureux à l’effort, les tests isocinétiques objectivent dès le 4e mois postopératoire des retards de récupération. La durée nécessaire afin de retrouver une fonction optimale du genou est alors allongée.

Key words: Genou, ligament croisé antérieur, ligamentoplastie, ischio-jambiers, douleurs, isocinétisme.

ABSTRACT

Purpose of the study

The purpose of this study was to investigate isokinetic performance of the knee twelve months after ligamentoplasty of the anterior cruciate ligament using four-strand hamstring autografts. We wanted to ascertain the effect of exercise-induced postoperative pain.

Material and methods

Between January 2001 and January 2003, at total of 75 patients underwent arthroscopic hamstring ligamentoplasty performed by the same surgeon. Isokinetic measurements were obtained at 4, 6, and 12 months postoperatively. At 4 months, four subpopulations were identified depending on the presence or absence of exercise-induced pain.

Reprints: M. Dauty

E-mail: marc.dauty@chu-nantes.fr
Results
Fifty-two patients were pain-free, seven presented exercise-induced posterior pain, nine exercise-induced anterior pain, and seven diffuse pain with more than 5° limitation of extension and 10° for flexion. Isokinetic measurements at an angular speed of 60°/s performed at the 4th postoperative month were compared with the pain-free population and demonstrated a significant flexion deficit in patients with exercise-induced posterior pain (32% vs 18%, \( p = 0.04 \)), significant extension deficit in patients with exercise-induced anterior pain (45% vs 30%, \( p = 0.02 \)), and significant deficit in extension (58% vs 30%, \( p = 0.001 \)) and flexion (39% vs 18%, \( p = 0.01 \)) in patients with diffuse pain and limited joint motion. Certain deficits persisted 1 year after surgery. Patients did not achieve their prior level in contact pivot sports if they presented exercise-induced anterior pain. The population with diffuse pain and limited joint motion only resumed line sports.

Discussion
It is not easy to ascertain the origin of knee pain after ligamentoplasty. Posterior pain at the harvesting site occurs after hamstring reconstruction (defective regeneration or incomplete disinsertion with muscle retraction). The hamstring technique can also lead to anterior pain involving all the structures of the extension system. Diffuse pain with limited joint motion is related to “minor” reflex dystrophy.

Conclusion
A mean 10% extensor and flexor isokinetic deficit can be expected 1 year after four-strand hamstring ligamentoplasty. Iso-kinetic tests performed 4 months postoperatively in patients with exercise-induced pain can provide objective evidence of difficult recovery. Posterior exercise-induced pain is associated with a flexion deficit of more than 30%. Anterior pain with exercise is associated with 45% extensor deficit. Diffuse pain with limited joint motion is associated with more than 40% flexor deficit and more than 55% extensor deficit. These quantitative results enable the surgeon to inform the patient concerning potential sports level after repair since recovery will be longer with greater deficit.

Key words: Knee, anterior cruciate ligament reconstruction, hamstring, pain, isokinetic.

INTRODUCTION
Reconstruction of the anterior cruciate ligament with the ligamentoplasty technique, using the patellar tendon, is an option [Shelbourne and Gray (1)]. However, arthroscopic semitendinosus and gracilis autograft ligamentoplasty is also frequent [Franceschi et al. (2)]. Many studies have attempted to compare the two techniques to determine the advantages and disadvantages of each of them [Freedman et al. (3), Lebel et al. (4)]. The evaluation scales used (International Knee documentation Committee [IKDC], Arpège, Lysholm, etc.) gather very different data referring to symptoms (pain, swelling, instability), clinical signs (laxity), deficiencies in joint motion and functional capacity (walking, etc.) [Chaory and Poiraudreau (5)]. Evaluation of muscular strength is not taken into account, any anomaly in neuromuscular control is shown by a strength deficit that may manifest during extension and/or flexion of the knee [Rochcongar (10)]. With this in mind, the objective of our study was to prospectively evaluate isokinetic strength of the knee having undergone ligament reconstruction using four-strand hamstring autografts, at 4, 6, and 12 months after surgery and relate the results to the exercise-induced pain described by the patient.

MATERIAL AND METHODS
Population
This was a prospective study conducted over 2 years, from January 2001 to January 2003, including adult patients under 40 years of age having undergone arthroscopic knee ligamentoplasty by the same surgeon, using the four-strand hamstring autograft technique, with or without meniscal intervention. Patients were excluded if they had had a second ligament reconstruction, surgery, or a known pathology in the contralateral knee, or a history of serious muscular lesion of the quadriceps or hamstrings. Also excluded were patients who presented a spontaneously painful knee or intra-articular effusion at the 4th postoperative month, but none of the patients were in this case and only one patient was excluded for a mobility defect in the knee at the 4th postoperative month, caused by a technical defect in the alignment of the bony tunnels, which was discovered on postoperative follow-up x-rays.

Patients who presented postsurgical infection (one case), repeated rupture of the transplant (two cases), or meniscus pathology in the year that followed the knee ligamentoplasty (two cases) were excluded. The two early transplant ruptures occurred because postoperative instructions were not followed, i.e., going back to the contact pivot sports prematurely at 4 and 5 months after surgery. The two cases of meniscus lesions were related to aggravation of a known lesion on the medial meniscus that had not been resected during reconstruction surgery.

Seventy-five patients were followed up for 1 year and all had three isokinetic tests at 4, 6, and 12 months after
surgery. The population included 60 men and 15 women aged 29 years ± 8.5 (weight, 73 kg ± 11; height, 175 cm ± 8).

Sports played before ligamentoplasty

Before the knee surgery, the sports played were football (41%), handball, or basketball (9%), skiing (9%), and other sports with or without pivoting. In 55% of the cases, these patients competed in their sport.

Surgical management

Ligament reconstruction was done a mean 3 ± 5 months (1-15 months) after the knee sprain. Thirty-one percent of the patients had a partial meniscectomy (23 for the medial meniscus, seven for the lateral meniscus, and one for both menisci).

The ligamentoplasty was done using the hamstring autograft technique with four strands fixed with interfragmentary screws under arthroscopic guidance. High condylar fracture was carried out when the notch was deemed to be too narrow. The tibial fixation was reinforced using tibial staple fixation.

Rehabilitation protocol

Physical therapy and massage began immediately after surgery to reduce knee volume, recover knee locking and joint range of motion. Walking was started as soon as possible with complete weight-bearing authorized with an extension splint and two crutches. The patient was sent to a rehabilitation center (55% of cases) or outpatient rehabilitation (45% of cases) with the objective of returning to sedentary lifestyle in 1 month according to a standardized protocol. The objective was to recover joint amplitude (flexion > 120° and no flexum) and walking without a splint or crutches. The splint was removed as soon as knee locking was sufficient with weight, and the crutches were terminated when single-foot weightbearing was possible for longer than 5 s and there was no limping with a comfortable walking speed. No muscle stretching or strengthening of the hamstrings was authorized for the 1st month. Then cycling and pool cycling was recommended beginning the 6th week and jogging was not allowed until the isokinetic test at the 4th postoperative month.

Isokinetic tests and study parameters

The isokinetic tests were done at the 4th, 6th, and 12th postoperative months using the Cybex Norm isokinetic dynamometer (Ronkonkoma, NY, USA) following a standardized procedure: 10 min warmup on the bicycle, familiarization on the isokinetic machine doing five submaximal movements then two maximal movements, then the isokinetic test at the 4th postoperative month beginning with the nonoperated healthy side. The protocol consisted in three repetitions at an angle speed of 60°/s followed by five repetitions at an angle speed of 180°/s. Twenty seconds of recovery were authorized between the two series. The follow-up tests were then done with the same rehabilitation medicine physician, using the same procedure and the same patient position (computerized recording) and beginning randomly by either knee. The dynamometer was calibrated manually according to the instructor’s recommendations. The knee extensor and flexor peak torque evaluated at two angle speeds (60°/s and 180°/s) were retained as study parameters so as to calculate the current strength deficit compared to the healthy contralateral knee [1 - (strength peak operated side /strength peak healthy side)].

Secondary study parameters

The inclusion criteria were age, weight, height, sex, the sport played, and the patient’s return-to-sport objective on the Tegner scale, the presence or absence of a meniscal lesion treated at the same time as the ligamentoplasty, and whether rehabilitation took place at the center or on an outpatient basis.

At the 4-month follow-up, four subpopulations were identified depending on whether they experienced exercise-induced knee pain or not. Patients were questioned on this pain and were asked to describe it for exercise related to their professional activity, daily and home activities, climbing stairs, prolonged standing, or during lifting. The pain was classified according to its location: anterior in terms of the extensor system, posterior at the harvest site, and diffuse with associated joint motion limitation greater than 5° for extension and 10° for flexion.

We also studied the Tegner activity scale (0-10) and the Lysholm knee scoring scale (0-100) at 4, 6, and 12 months. The Lysholm scale was weighted at 12 months as indicated by the patient’s return-to-sport objective according to the formula: Lysholm at 12 months × Tegner at 12 months/ Tegner objective. The Arpège score was calculated at 12 months. The one-leg hop test was measured at 12 months, taking into account the highest hop during three consecutive tries beginning with the healthy side [Noyes et al. (11)]. The results were expressed in percentages in relation to the healthy side. Laxity and clinical stability were assessed with the arthrometer for 89 N (KT 1000, Medmetric Corp., San Diego, CA, USA) and according to the subjective search for the Lachman sign (1+ = 5 mm) and the pivot shift sign (absent, beginning, or present). These clinical tests were carried out by an independent surgeon who had not operated on the patients.

Statistical analysis

The parameters were expressed as mean and standard deviation, except for the Tegner scale, which was a discontinuous variable.

The four subpopulations (not painful, with exercise-induced anterior ligament pain, with exercise-induced posterior ligament pain, and diffuse pain combined with limited joint motion) were compared using an ANOVA.
analysis of variance. A Bonferroni test was then applied to determine the subpopulations that presented differences. A chi square test at 4 degrees of freedom compared the qualitative variables. Statistical significance was set at p < 0.05.

RESULTS

Results at 4 months

At the 4th postoperative month, 52 patients (67%) presented no pain in the operated knee. Nine patients (12%) presented exercise-induced anterior knee pain, seven (9%) presented exercise-induced posterior knee pain, and seven (9%) presented diffuse pain with limited joint range of motion. No difference was found between the different subpopulations in terms of age, weight, height, sex, or association with meniscal surgery or rehabilitation in a center or on an outpatient basis. The Lysholm score was significantly lower in the group with diffuse pain with limited joint range of motion: 76 ± 7 versus 89 ± 5, 84 ± 5, and 85 ± 6 (p < 0.001) for populations with no pain, with exercise-induced anterior pain, or exercise-induced posterior pain, respectively.

The flexor deficit was significantly greater in the groups with posterior pain and diffuse pain with limited joint range of motion (p < 0.009). On the other hand, the extensor deficit was greater in the group with exercise-induced anterior pain and diffuse pain with limited joint range of motion (p < 0.0001) (table I).

The Lysholm score was comparable for the different subpopulations. However, the Lysholm score weighted by the Tegner scale and the Arpège score were significantly lower in the population with diffuse pain and limited range of motion. The one-leg hop demonstrated a significant asymmetry in patients with anterior pain (p = 0.04) (table II). Comparing the return-to-sport objective and the sport activity at 12 months, quantified according to the Tegner scale, showed that the population with posterior pain had reached the return-to-sport objective within 1 point. However, six patients out of nine with anterior pain presented a difference of 2 points and three patients out of seven with diffuse pain and limited range of motion had not returned to contact pivot sports such as football, with a difference of 3-6 points. In comparison, all the patients in the group without pain who had played a contact pivot sport (football, basketball, or handball: 30/52) had resumed their sport, achieving the same level in 65% of cases (21 patients) or a lower level by 1 point in 15% of cases (three patients) or by 2 points in 20% of cases (six patients) (table III).

TABLE I. – Isokinetic results at 4 postoperative months by subpopulation.

<table>
<thead>
<tr>
<th>Deficit (%)</th>
<th>PF</th>
<th>AKP</th>
<th>PKP</th>
<th>DPLJM</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensors 60°/s</td>
<td>30 ± 14</td>
<td>45 ± 7a</td>
<td>24 ± 11a</td>
<td>58 ± 9a</td>
<td>0.0001</td>
</tr>
<tr>
<td>Extensors 180°/s</td>
<td>23 ± 14</td>
<td>33 ± 14b</td>
<td>24 ± 15b</td>
<td>52 ± 10b</td>
<td>0.0001</td>
</tr>
<tr>
<td>Flexors 60°/s</td>
<td>18 ± 15</td>
<td>19 ± 16</td>
<td>32 ± 18c</td>
<td>39 ± 21c</td>
<td>0.009</td>
</tr>
<tr>
<td>Flexors 180°/s</td>
<td>15 ± 14</td>
<td>15 ± 9</td>
<td>24 ± 15</td>
<td>34 ± 11</td>
<td>0.09</td>
</tr>
</tbody>
</table>

* Significant difference between the pain-free population and the population with diffuse pain and limited joint motion.

TABLE II. – Lysholm, Arpège score and one-leg hop by subpopulation at 12 postoperative months.

<table>
<thead>
<tr>
<th></th>
<th>PF</th>
<th>AKP</th>
<th>PKP</th>
<th>DPLJM</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lysholm</td>
<td>96 ± 5</td>
<td>92 ± 8</td>
<td>99 ± 1</td>
<td>90 ± 11</td>
<td>0.09</td>
</tr>
<tr>
<td>Weighted Lysholm</td>
<td>89 ± 12</td>
<td>75 ± 16</td>
<td>90 ± 7</td>
<td>67 ± 3a</td>
<td>0.004</td>
</tr>
<tr>
<td>Arpège</td>
<td>40 ± 1.3</td>
<td>40 ± 1.3</td>
<td>40 ± 1.5</td>
<td>37 ± 2a</td>
<td>0.003</td>
</tr>
<tr>
<td>One-leg hop (%)</td>
<td>12 ± 13</td>
<td>30 ± 20c</td>
<td>9 ± 9</td>
<td>15 ± 10</td>
<td>0.04</td>
</tr>
</tbody>
</table>

* Significant difference between the pain-free population and the population with diffuse pain and limited joint pain.

Results at 12 months

At 12 months, the four subpopulations were comparable for laxity and clinical stability as measured by the arthrometer, the Lachman maneuver, and the presence of a pivot shift. Of the total population, 77.5% presented a Lachman sign of less than 1+ (0: 30%; 0.5: 47.5%; 1+ with a sudden stop: 17.5%). As for clinical stability, no external pivot shift was present in 84% of the cases. There was a slip in ten cases and a pivot shift in two cases. The arthrometry evaluated by the KT 1000 for 89 N showed a mean differential compared to the contralateral side of 2.3 mm ± 2.1 (range, 1-17 mm).

The Lysholm score was comparable for the different subpopulations. However, the Lysholm score weighted by the Tegner scale and the Arpège score were significantly lower in the population with diffuse pain and limited range of motion. The one-leg hop demonstrated a significant asymmetry in patients with anterior pain (p = 0.04) (table II). Comparing the return-to-sport objective and the sport activity at 12 months, quantified according to the Tegner scale, showed that the population with posterior pain had reached the return-to-sport objective within 1 point. However, six patients out of nine with anterior pain presented a difference of 2 points and three patients out of seven with diffuse pain and limited range of motion had not returned to contact pivot sports such as football, with a difference of 3-6 points. In comparison, all the patients in the group without pain who had played a contact pivot sport (football, basketball, or handball: 30/52) had resumed their sport, achieving the same level in 65% of cases (21 patients) or a lower level by 1 point in 15% of cases (three patients) or by 2 points in 20% of cases (six patients) (table III).
From a isokinetic point of view, there was a 15% extensor deficit and a 10% flexor deficit for the overall population (table IV). The strength deficit in extension remained significant at 12 months for the patients with anterior pain and diffuse pain with limited range of motion \((p < 0.0001)\). The flexor deficit was still present but not significant for the patients with posterior pain and diffuse pain with limited range of motion \((p > 0.05)\) (table V). From these results, it was possible to determine how well the knee had recuperated strength in flexion and extension in relation to the presence or absence, at 4 months, of exercise-induced pain at an anterior or posterior site or one associated with limited joint range of motion (fig. 1, fig. 2 and fig. 3).

**DISCUSSION**

Interest in pain after knee ligamentoplasty has been growing in the past 10 years, given that ten indexed articles per year have been published, whereas fewer than five articles a year were referenced before 1994 (Medline). Exercise-induced pain is reported particularly after knee ligamentoplasty using the patellar tendon technique. However, few articles describe pain after the ligament reconstruction using four-strand hamstring autografts, other than anterior pain, a parameter that can be used to compare these two techniques.

Posterior pain is described sporadically, with a frequency ranging from 1.5% to 22% [Collobet et al. (12), Feller et al. (13), Scranton et al. (14)]. Only Feller et al. (13) described short-term progression of posterior pain, with 49%, 21%, and 21% at 2, 8, and 20 weeks after surgery. At 4 months, we report a lower rate of 9% (7/75), even though this was systematically verified. The morbidity of the donor site seems to be the main causal factor. In a study on nine subjects, Eriksson et al. (15) showed a regeneration defect of the hamstring tendons in three cases after biopsy and nuclear MRI. Savalli et al. (16) also described the possibility of complete rupture in case of stretching or

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**Table III.** Return to pivot sport at 12 months of different subpopulations (according to Teccner score).

<table>
<thead>
<tr>
<th>Return to sport (Tegner)</th>
<th>PF ((n = 30/52))</th>
<th>AKP ((n = 9/9))</th>
<th>PKP ((n = 6/7))</th>
<th>DPLJM ((n = 4/7))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same level</td>
<td>21</td>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Level 1 point less</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Level 2 points less</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Level ≥ 3 points less</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

PF: pain free; ALP: anterior knee pain; PLP: posterior knee pain; DPLJM: diffuse pain limited joint motion.

**Table IV.** Progression of muscular deficit in total population over 12 months.

<table>
<thead>
<tr>
<th>Deficit (%)</th>
<th>4 months</th>
<th>6 months</th>
<th>12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensors 60°/s</td>
<td>34 ± 16</td>
<td>23 ± 16</td>
<td>14 ± 15</td>
</tr>
<tr>
<td>Extensors 180°/s</td>
<td>27 ± 16</td>
<td>19 ± 15</td>
<td>11 ± 12</td>
</tr>
<tr>
<td>Flexors 60°/s</td>
<td>22 ± 8</td>
<td>12 ± 13</td>
<td>11 ± 14</td>
</tr>
<tr>
<td>Flexors 180°/s</td>
<td>18 ± 5</td>
<td>12 ± 14</td>
<td>11 ± 14</td>
</tr>
</tbody>
</table>

**Table V.** Isokinetic muscle deficit at 12 months after surgery by subpopulation.

<table>
<thead>
<tr>
<th>Deficit (%)</th>
<th>PF</th>
<th>AKP</th>
<th>PKP</th>
<th>DPLJM</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensors 60°/s</td>
<td>10 ± 13</td>
<td>23 ± 13</td>
<td>3 ± 6</td>
<td>39 ± 7*</td>
<td>0.0001</td>
</tr>
<tr>
<td>Extensors 180°/s</td>
<td>9 ± 10</td>
<td>20 ± 14</td>
<td>3 ± 5</td>
<td>28 ± 7*</td>
<td>0.0001</td>
</tr>
<tr>
<td>Flexors 60°/s</td>
<td>10 ± 14</td>
<td>8.5 ± 11</td>
<td>16 ± 14</td>
<td>11 ± 14</td>
<td>0.6</td>
</tr>
<tr>
<td>Flexors 180°/s</td>
<td>8.5 ± 13</td>
<td>8.3 ± 9</td>
<td>20 ± 18</td>
<td>17 ± 16</td>
<td>0.2</td>
</tr>
</tbody>
</table>

* Significant difference between the pain-free population and the population with diffuse pain and limited joint motion. PF: pain free; ALP: anterior knee pain; PLP: posterior knee pain; DPLJM: diffuse pain limited joint motion.

**Fig. 1.** Comparison of percentage of knee extensor (Q) and flexor (IJ) strength deficit between the pain-free population and the population with exercise-induced anterior knee pain. O: no pain. DLA: anterior knee pain.
muscular reinforcement with additional resistance before the end of the 1st month after operation. Sometimes the patient reports the onset of an acute pain when rising from a chair or when putting on socks or shoes. At 4 months, patients who describe exercise-induced posterior ligament pain present a significant 32% strength deficit of the flexors of the operated knee at the slow speed of 60°/s compared to the contralateral side. However, there was no pain during or after the isokinetic test representing exercise, admittedly maximal, but lasting only a short period during which the overall body mass does not need to be controlled because the patient is seated. The strength deficit expresses an anomaly in the patient’s mechanical ability to produce substantial force during a knee flexion motion compared to the contralateral side. Neuromuscular inhibition mechanisms are undoubtedly also involved. These results can be compared to the results by Yasuda et al. (17), who showed a 30% isometric deficit at 6 months in 60° and 90° flexion positions. However, according to these authors, the initial serious sprain and the intra-articular surgery also participate in the strength deficit in patients who have undergone surgery but for whom the presence of pain was not taken into consideration.

At the 4th postoperative month, posterior pain does not contraindicate jogging, but pain can be the most intense from the 6th month because of returning to runs with maximal accelerations. At 12 months, returning to sports at the same level is not compromised, notably for pivot sports with contact such as football. Our results, evaluated on the Tegner scale, confirm this, with the nuance that only one of our patients who presented exercise-induced posterior pain competed in football at a national level. Yet strength deficit remains present even if it is no longer significant compared to a population without pain (16%-20% versus 8%-10%). Parisaux et al. (18) also showed a 15%-24% deficit persisting until 24 months, taking as a reference value the peak torque value at 75° of flexion. However, this study makes no reference to exercise-induced posterior pain that certain patients could have or would have presented because of an absence of regeneration or the presence of hamstring rupture after ligament reconstruction.

On the other hand, anterior knee pain has been more widely studied. Freedman et al. (3) reported a frequency of 11.5% based on a meta-analysis that included 390 patients operated on with the hamstring autograph technique. Depending on the study, the frequency is very different, ranging from 2.5% to 30% [Colombet et al. (12), Scranton et al. (14), Aune et al. (19), Beynon et al. (20), Cooley et al. (21), Goradia and Grana (22), Otero and Hutcheson (23)]. The cause of anterior pain is not unequivocal. For Aglietti et al. (24), the tibial screw is the cause in 6% of cases. A possible meniscal lesion does not explain the exercise-induced anterior pain that we report in that we were careful to rule out this cause in the exclusion criteria [Cooley et al. (21)]. However, Goradia and Grana (22), as well as Otero and Hutcheson (23), explain the anterior pain as patellar anomalies with chondromalacia or tendinopathy. Unfortunately, this causal relation remains difficult to affirm because clinical and radiological data did not match. After the patellar tendon technique, several authors have looked for a relation between anterior pain and a lowered patella on x-ray [Chase et al. (25), Mueller et al. (26), Tria et al. (27), Boszotta and Prunner (28)]. No relation was established, even if nonsignificant associations are present in 12%-30% of cases depending on the series. In addition, Jarvela et al. (29) did not find a relation between anterior
pain and knee stability, the x-ray of the knee, and the strength deficit after the patellar tendon technique.

The association with sensory problems in relation with the medial saphenous nerve has also been described, with a highly variable frequency from 4% to 30% of cases [Gobbi et al. (30), Soon et al. (31), Spicer et al. (32)]. Our population did not present this type of complication. It is possible that the short incision, present at the anteromedial and superior level of the tibia, which makes it possible to perform the tibial tunnel and the harvesting of the tendons necessary to reconstruction, spares this sensitive ramus located higher in the knee.

From an isokinetic point of view, 4 months after surgery, the population that presented exercise-induced anterior pain was identified by a significant 45% strength deficit of the extensors measured at 60°/s versus 30% in cases without pain. Yet no pain was present during or after the isokinetic test for the above-mentioned reasons. The deficit observed reflects a defect in the patient’s mechanical ability to produce substantial force during knee extension motion compared to the contralateral side. At 12 months, the deficit, which remains although to a lesser extent, makes it difficult to resume contact pivot sports activity at the same level as before surgery, as shown by a difference of at least 2 points on the Tegner scale. Furthermore, the one-leg hop remains significantly inadequate. Functionally, Spicer et al. (32) showed that anterior pain was bothersome long after the intervention in climbing stairs (5%), in occupational activities (7%), and in daily activities (2%). Kneeling was difficult in 12% of cases after the hamstring autograft procedure.

The combination of diffuse pain and restricted joint range of motion after ligament reconstruction using hamstring autografts has not been extensively described. Colombet et al. (12) report 4% at 24 months, when taking into account patients with limited joint range of motion and patients who had arthroscopic arthrosis secondary to ligament reconstruction. Nevertheless, the association of pain, flexum greater than 5°, patellofemoral instability, and the isokinetic strength deficit of the knee extensors at 60°/s, is well known after the patellar tendon technique [Jarvela et al. (29), Sachs et al. (33), Natri et al. (34)]. According to Sachs et al. (33), when there is no pain or flexum, at 12 months 54% of patients presented a greater than 20% extensor deficit, whereas when both symptoms were present, 84% presented a deficit greater than 20%. The knee’s stability, the patient’s age and sex, as well as the previous level of activity did not influence pain [Kobayashi et al. (35)]. No other English-language author and few of the French authors dare to speak of a neuroalgodystrophic syndrome to describe this symptomatic association, since this type of complication is present in 0% of cases according to Sachs et al. (33) where the patellar tendon technique is considered. Colombet et al. (12) report 2% of cases after the hamstring autograft technique. Actually, this syndrome is difficult to diagnose after knee ligament reconstruction because patients present clinical forms that are often benign or minimal, whose symptoms disappear in a few months. However, from an isokinetic point of view, the population that suffers from exercise-induced pain that is not systematic, with exercise with range of motion that is still limited at 4 months in both extension and flexion, presents a different strength profile with prolonged the deficit of both extensors and flexors. This deficit is more severe compared to the population that presents exercise-induced pain only anteriorly or posteriorly. At 12 months, this particular population also has problems returning to contact pivot sports at the same level as prior to reconstruction, since only one patient out of four who played football was able to begin jogging at this time. Therefore, 24 months of follow-up seems indispensable to help the patient return to contact pivot sports or a conversion to a line sport or complete cessation of sports activity.

CONCLUSION

Twelve months after four-strand hamstring ligamentoplasty, a 10% isokinetic deficit evaluated at 60°/s is expected in knee extensors and flexors. At the 4th postoperative month, the mean knee extensor and flexor deficit was 30% and 20%, respectively. On the other hand, the deficits were greater in patients describing exercise-induced pain.

With exercise-induce posterior pain, a mean deficit of 30% was shown. When there is exercise-induced anterior pain, a mean extensor deficit of 45% was present. Cases with diffuse pain and limited joint motion, a mean extensor deficit of 55% was observed and a mean 40% deficit of knee flexors.

Based on a systematic search for pain with exercise with detailed figures obtained during isokinetic measurements at an angle speed of 60°/s at the 4th postoperative month, we can better advise the patient. Return to physical activities should be progressive and pain-free. Resuming sports will be longer with greater strength deficit.

References


