

## Clinical comparison of cross-pin and EndoButton for fixation of hamstring grafts in reconstruction of the anterior cruciate ligament

### Ön çapraz bağ rekonstrüksiyonunda cross-pin ve EndoButton ile yapılan hamstring greft fiksasyonunun klinik karşılaştırılması

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#### ABSTRACT

**Objectives:** A comparison of the clinical outcomes of EndoButton and cross-pin femoral fixation techniques in anterior cruciate ligament (ACL) reconstruction using hamstring tendons.

**Materials and methods:** In our clinic, between January 2006 and December 2009 patients who underwent surgery due to ACL rupture were retrospectively reviewed. Of the patients, 50 underwent arthroscopic anterior cruciate ligament reconstruction with an autogenous hamstring tendon graft using the cross-pin technique, and the remaining 50 patients underwent arthroscopic anterior cruciate ligament reconstruction with the EndoButton technique. Preoperative and postoperative clinical evaluation of the patients in both groups was performed according to the International Knee Documentation Committee (IKDC) and Lysholm II knee scoring systems.

**Results:** In the cross-pin group, 52% of the patients had IKDC scores of A, 40% B and 8% C in the last control. In the EndoButton group, 48% of the patients had IKDC scores of A, 42% B and 10% C. Postoperatively, 48% of the patients in the cross-pin group had excellent, 44% good and 8% fair Lysholm scores. Fifty percent of the patients in the EndoButton group had excellent, 44% good and 6% fair Lysholm scores. There was no difference between the groups in additional diseases, IKDC and Lysholm scores and complications. The mean operative time was shorter in the EndoButton group.

**Conclusions:** No statistically significant difference was found between the clinical outcomes of the femoral fixation techniques. The shorter operative time and easier learning curve are advantages of the EndoButton technique in ACL reconstruction. *J Clin Exp Invest* 2012; 3(1): 7-12

**Key words:** Anterior cruciate ligament, hamstring tendon graft, femoral fixation

#### ÖZET

**Amaç:** Hamstring tendonları kullanılarak yapılan ön çapraz bağ (ÖÇB) rekonstrüksiyonlarında EndoButton ve cross-pin femoral tespit yöntemlerinin klinik sonuçlarının karşılaştırılması.

**Hastalar ve yöntem:** Kliniğimizde Ocak 2006 - Aralık 2009 tarihleri arasında ÖÇB rüptürü nedeniyle opere edilen hastalar geriyeye dönük olarak incelendi. Hastaların 50 tanesine cross-pin, 50 tanesine ise EndoButton yöntemi kullanılarak, otojen hamstring tendon grefti ile artroskopik ön çapraz bağ rekonstrüksiyonu yapılmıştı. Her iki grupta hastaların ameliyat öncesi ve sonrası klinik değerlendirilmesi uluslararası diz dökümantasyon sistemi (IKDC) ve Lysholm II skorlama sistemine göre yapıldı.

**Sonuçlar:** Ameliyat sonrası cross-pin grubunda IKDC skorlama sistemine göre hastaların, %52'sinde A, %40'ında B, %8'inde C skoru bulundu. EndoButton grubunda hastaların %48'inde A, %42'sinde B, %10'unda C skoru bulundu. Ameliyat sonrası cross-pin grubunda Lysholm II skorlama sistemine göre hastaların %48'inde mükemmel, %44'ünde iyi ve %8'inde orta sonuç bulundu. EndoButton grubunda hastaların %50'sinde mükemmel, %44'ünde iyi, %6'sında orta sonuç bulundu. Gruplar arasında ek hastalık, IKDC ve Lysholm II skorları ve komplikasyonlar açısından fark yoktu. EndoButton grubunda ortalama ameliyat süresi daha kısaydı.

**Sonuç:** Her iki femoral tespit tekniğinin, klinik sonuçları arasında istatistiksel olarak anlamlı fark bulunmadı. Ameliyat süresinin daha kısa, öğrenme eğrisinin daha kolay oluşu ÖÇB rekonstrüksiyonunda EndoButton tekniğinin avantajlarıdır.

**Anahtar kelimeler:** Ön çapraz bağ, hamstring tendon grefti, femoral tespit

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## INTRODUCTION

Rupture of the anterior cruciate ligament (ACL) is one of the most common injuries of the knee leading to knee instability.<sup>1</sup> In the past, it was commonly believed that the ACL had not have an important function, and a ruptured ACL could be removed or treating a ruptured ACL was not necessary.<sup>2</sup> However, today, it is well known that the ACL is required to maintain normal biomechanical function of the knee, and loss of the ACL may result in major degenerative changes.<sup>3</sup> Whether the injury is recent, the presence of other lesions, patient's age, activity level, severity of the instability, type of ligament injury and the patient's compliance with the treatment plan are factors that should be taken into consideration in treatment planning.<sup>4</sup> A number of methods such as interference screws, EndoButton (Smith & Nephew Inc., Andover, MA, USA) and femoral cross-pin can be used for femoral fixation in ACL reconstruction using hamstring tendons.<sup>5</sup>

In the present study, we compared the mid-term outcomes of the EndoButton and cross-pin (Trans-Fix; Arthrex, Inc., Naples, FL, USA) techniques in arthroscopic ACL reconstruction using an autogenous hamstring tendon graft.

## MATERIALS AND METHODS

Fifty patients with chronic ACL rupture underwent arthroscopic ACL reconstruction with autogenous hamstring tendon graft using the cross-pin technique, and the remaining 50 underwent arthroscopic ACL reconstruction with autogenous hamstring tendon graft using EndoButton between January 2006 and December 2009 in our clinic. The patients were preoperatively diagnosed with the Lachman, Pivot Shift and anterior drawer tests. The diagnoses were confirmed with magnetic resonance imaging (MRI). Functional insufficiency during daily or sports activities and the presence of an arthroscopically diagnosed complete rupture of the ACL were defined as the indications for reconstruction. Exclusion criteria were patients who were referred to the hospital for revision ACL surgery, those with additional ligament injury and those with degenerative changes. The patients were evaluated with preoperative and postoperative standard history and examination. The outcomes were evaluated using International Knee Documentation Committee (IKDC) and Lysholm II scoring systems (Table 1). All operations were carried out by the same surgeon with equal and adequate experience in both fixation techniques.

**Table 1.** Preoperative and postoperative evaluation methods

Clinical history	Clinical examination	Lysholm II scores	IKDC scores
Anterior pain	Anterior drawer	>90 excellent	A normal
Medial pain	Lachman test	84-90 good	B close to normal
Lateral pain	Pivot shift	65-83 fair	C abnormal
Locking	Varus/valgus stress	< 65 poor	D severe abnormal
Instability	Range of motion		
Swelling	Effusion		
	Tenderness		

The operations were performed with the patients under general or spinal anesthesia. After anesthesia administration, instability tests were repeated in all patients (Pivot shift, Lachman, anterior drawer). The operations started with arthroscopy. The diagnosis of an anterior cruciate ligament rupture was confirmed. Patients with a meniscal tear underwent a partial meniscectomy. Then the autogenous semitendinosus and gracilis tendons were harvested. The harvested grafts were prepared and, folded in two, one over the other, to make four strands. The diameter of the graft was measured, and tibial and femoral tunnels were prepared accordingly. The femoral tunnel was prepared using a transtibial technique. After the grafts were placed in the tunnels, femoral fixation was performed using the cross-pin or EndoButton. Tibial fixation was performed with an interference screw and staple.

Both groups followed the same postoperative rehabilitation program. Isometric quadriceps and flexion exercises were begun at once. The patients were mobilized using crutches for four weeks with as much full weight bearing as could be tolerated. We did not have our patients use kneepads. Activities of daily living were permitted and increased gradually up to the fourth week. Sports-related exercises were started at 12 weeks. Original sports activities were not permitted before one year.

Preoperative, intraoperative and follow-up data were recorded, and statistical analysis was performed using SSPS 15 for Windows 2006. Student's t and Chi-square tests were used for statistical analysis. A p value less than 0.05 was considered statistically significant.

## RESULTS

All patients in the transfix group were male. The mean age was 28 years (range 18-48 years). Of all injuries, 84.6 % were sports or fall-related injuries. The mean time from injury to surgery was 11 months (range 3-27 months). The mean operative time was 87 min (range 70-130 min). The mean follow-up time of the patients was 36 months (range 26-47 months). Thirty-seven of the patients (74%) had a right knee ACL rupture and 13 (26%) a left knee ACL rupture. Fifteen patients (30%) had a medial meniscal tear, 5 (10%) a lateral meniscal tear, and 4 (8%) both medial and lateral meniscal tears; these patients underwent a partial meniscectomy.

Of the patients in the EndoButton group, 49 (98%) were male and 1 (2%) female. Eighty-one percent of all injuries were sports or fall-related injuries. The mean time from injury to surgery was 14.02 months (range 2-52 months). The mean operative time was 72 min (range 60-120 min). The mean follow-up time for the patients was 29 months (range 22-36 months). The mean age was 26 years (range 17-38) years. Seventeen of the patients had a medial meniscal tear (34%), 3 a lateral meniscal tear (6%) and 5 (10%) both medial and lateral meniscal tears; these patients underwent a partial meniscectomy.

There was no statistically significant difference in age, gender or additional pathologies, but a statistically significant difference was found in operative time between the patients in the two groups (Table 2).

**Table 2.** Preoperative comparison of patients that were made Endobutton and cross-pin

	Cross-pin	EndoButton	P
Mean age	28	27	0.72
Gender	50 M	49 E / 1 F	0.32
Mean time from injury to surgery	11 months	14 months	0.17
Medial/Lateral Meniscus lesion	24	25	0.99
Mean operative time	87	72	0.001

Pre- and postoperative outcomes were evaluated using the IKDC and Lysholm II scoring systems. There was no statistically significant difference among the preoperative scores. Postoperatively, 26 patients (52%) in the cross-pin group had IKDC scores of A, 20 patients (40%) B and 4 patients (8%) C. Twenty-four patients (48%) in the EndoButton

group had IKDC scores of A, 21 patients (42%) B, and 5 patients (10%) C. A comparison of the IKDC scores of both groups revealed no statistically significant difference (Table 3). Postoperatively, 24 of the patients (48%) in the cross-pin group had excellent, 22 patients (44%) good and 4 patients (8%) fair Lysholm II scores. In the EndoButton group, 25 patients (50%) had excellent, 22 patients (44%) good and 3 patients (6%) fair Lysholm II scores. A comparison of the groups' Lysholm II scores revealed no statistically significant difference (Table 4).

**Table 3.** Preoperative and postoperative IKDC scores of both groups

	A	B	C	D	P
Preoperatively					
Cross-pin	0	2	23	25	0.86
EndoButton	0	3	21	26	
Post-operatively					
Cross-pin	26	20	4	0	0.89
EndoButton	24	21	5	0	

**Table 4.** Preoperative and postoperative Lysholm II scores of both groups

	Excellent	Good	Fair	Poor	P
Preoperatively					
Cross-pin	0	3	11	36	0.83
EndoButton	0	2	13	35	
Postoperatively					
Cross-pin	24	22	4	0	0.92
EndoButton	25	22	3	0	

Two patients (4%) in the cross-pin group developed intra-articular infection and 1 patient superficial infection in the area where the graft was taken. Arthroscopic wash-out of the joint was performed, and follow-up with 6 weeks of intravenous antibiotic therapy was carried out. Removal of the interference screw was not required in this patient. The patient with superficial infection received oral antibiotic therapy. Two patients (4%) in the EndoButton group developed intra-articular infection. Arthroscopic wash-out of the joint was performed, and follow-up with 6 weeks of intravenous antibiotic therapy was carried out. One patient (2%) had thrombophlebitis, which resolved completely with medical treatment. A

comparison of complications in the groups revealed no statistically significant difference (Table 5). None of the patients had complications such as vascular injury, compartment syndrome, deep venous thrombosis, reflex symphatetic dystrophia, posterior cruciate ligament damage or graft falling on the floor.

**Table 5.** Postoperative complications

	Superficial infection	Intra-articular infection	Thrombophlebitis	P
Cross-pin	1	2	0	0.36
EndoButton	0	2	1	

## DISCUSSION

Graft selection is still a controversial issue in ACL surgery.<sup>6</sup> Today, synthetic grafts are almost never used because of the poor results reported by Chang et al.<sup>7</sup> Allografts are primarily preferred by some surgeons because the grafts are easy to obtain in the desired sizes and have low perioperative morbidity, shorter operative time and less motion restriction in the postoperative period. However, the main disadvantages of reconstruction with allografts include disease transport, immunogenic rejection of the graft, resorption in the tunnel, long remodeling period and high cost.<sup>8,9</sup>

Autograft material is usually taken from the patellar tendon, hamstring tendon and quadriceps tendon.<sup>10,11</sup> Even though the use of the bone-patellar tendon-bone autograft is considered the gold standard for ACL reconstruction by some surgeons, the quadriceps has many disadvantages such as weakness in muscle strength, loss of full extension and anterior knee pain in the postoperative period.<sup>12,13</sup> In a reconstruction with hamstring tendons, the preservation of the extensor mechanism prevents atrophy of the quadriceps muscle, and problems such as postoperative knee pain and extension deficit are rarely encountered.<sup>14,15</sup> The donor-site morbidity of hamstring tendons is much lower compared to that of the patellar tendon.<sup>12,13</sup> Since the cross-section area is larger compared to that in the patellar tendon, vascularization is also easier.<sup>16,17</sup> Hamstring tendons are biomechanically superior to the patellar tendon.<sup>18,19</sup> Isometry of the anterolateral and posteromedial parts of the normal anterior cruciate ligament varies depending on the degree of knee flexion. Due to the four-strand structure, hamstring tendon grafts mimic this characteristic of the anterior cruciate ligament most closely.<sup>20</sup> The use of quadruple hamstring grafts is not recommended in

overweight patients (more than 100 kg), sprinters and patients with medial laxity or with a pivot shift test result of 4 (+), which constitutes the limitations of quadruple hamstring grafts.<sup>21,22</sup>

Different techniques are used in femoral fixation of hamstring grafts. Cross-pin and EndoButton are the most commonly used techniques in femoral fixation.<sup>23</sup> In a study conducted on graft fixation materials by Brand et al, the transfix fixation method was found to be no weaker than EndoButton and other fixation methods in terms of force and loading; however, the disadvantages were reported to be the need for an additional incision and the occurrence of dilatation due to in-depth fixation in the tunnel.<sup>23</sup> A lateral incision presented no complications in our patients.

In an experimental study conducted by Monaco et al.<sup>24</sup> seven different ACL fixation techniques were biomechanically compared in terms of maximum failure load, stiffness and slippage. Maximum failure load was found to be significantly lower in the transfix-retroscrew group.

An experimental study by Shen et al. compared the EndoButton and cross-pin systems and found that one system was not superior to the other. In general, however, the cross-pin was more durable in cyclic loadings and may allow early rehabilitation.<sup>25</sup> In this study, patients who had undergone cross-pin and EndoButton femoral fixation followed an early rehabilitation program, and no insufficiency was observed in either group.

Yosmaoğlu et al.<sup>26</sup> compared hamstring and quadriceps muscle strength, neuromuscular coordination, joint position sense and anterior tibial laxity at postoperative month 12 in patients who had undergone ACL reconstruction with a hamstring graft and found no significant difference between the groups.

In a prospective study of 29 patients who had undergone ACL reconstruction with an autogenous hamstring graft, Price et al.<sup>5</sup> compared EndoButton versus transfix femoral fixation. No clinically significant difference was found; however, they reported that complications and additional procedures postoperatively occurred more frequently in the cross-pin group. In this study, no significant difference was found in clinical outcomes and complications.

In a study investigating the biomechanical strength of femoral fixation techniques in ACL reconstruction, Ahmad et al. reported the cross-pin and EndoButton systems to be superior among those tested.<sup>27</sup> Harilainen et al's study of ACL reconstruction with hamstring tendons, the arthrometry



results and IKDC scores of cross-pin versus metal interference screw femoral fixation were compared at 1 or 2 year follow-up examinations, and no statistically significant difference was found between both groups.<sup>28</sup>

There is no consensus on femoral fixation of the hamstring tendon in anterior cruciate ligament reconstruction. Both methods have advantages and disadvantages. However, no significant difference has been found between the clinical outcomes of the fixation techniques in the studies conducted so far. In the present study, we compared the outcomes of the cross-pin and EndoButton techniques for femoral fixation of the graft using an autogenous two-strand (four bands) hamstring tendon graft. In this study, where similar clinical and functional outcomes were obtained, shorter operative time and an easier learning curve take the EndoButton system one step further in ACL reconstruction.

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