Original Article

CLINICAL OUTCOMES OF THREE DIFFERENT MODES OF FEMORAL HAMSTRING GRAFT FIXATION IN ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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Abstract

Introduction. There are various methods of anterior cruciate ligament (ACL) reconstruction of which the two main choices in autograft reconstruction involve the use of the bone-patella tendon-bone or hamstring graft. Femoral fixation can be divided into three main types: cortical suspensory devices such as Endobutton (Smith & Nephew, Arthrex), interference screws, and femoral transfixation devices such as Transfix (Arthrex) and Rigidfix (Depuy-Mitek). The aim of this study was to compare the clinical outcome between Rigidfix, Transfix and Endobutton devices for soft tissue femoral fixation in primary ACL reconstruction using the autogenous hamstring graft.

Methods. We conducted our study in 48 patients admitted to our clinic, University Traumatology Clinic, Clinical Center "Mother Teresa", Skopje for ACL reconstruction from September 2009 to May 2013. The patients with ACL reconstruction were assigned as Rigidfix group (n=28), the second patients to Transfix group (n=13) and the third to Endobutton group (n=7). MRI of the knee joint was done prior to surgery. A data sheet, containing demographic data, examination findings and Tegner & Lysholm score, was completed for each patient.

Results. Tegner & Lysholm the average scores before surgery were 2.52 and 34.75 ($p>0.05$). Six month after arthroscopy, the average value of Tegner and Lysholm scores in patients with ACL reconstruction was 8.37 and 89.08. Comparison among them showed that the operative mode of Endobutton femoral fixation had the highest level of the Lysholm score.

Conclusions. Endobutton (Tight rope-RT) yielded a better outcome compared to the other two modes of femoral fixation in terms of instant stability of the graft and the general results.

Key words: anterior cruciate ligament, arthroscopy, femoral fixation

Introduction

There are various methods of anterior cruciate ligament

(ACL) reconstruction of which the two main choices in autograft reconstruction involve the use of the bone-patella tendon-bone or hamstring graft. Early rehabilitation and return to activity with a stable knee are the main goals of ACL reconstruction [1].

The weak link in hamstring graft lies in its femoral fixation, for which various devices and techniques have been described. They can be divided into three main types: cortical suspensory devices such as Endobutton (Smith & Nephew, Arthrex), interference screws, and femoral transfixation devices such as Transfix (Arthrex) and Rigidfix (Depuy-Mitek) [2].

Early instability (less than 6 months) may occur after surgery due to flawed surgical technique, inappropriate graft fixation, premature exercise or inappropriate physiotherapy, whereas delayed instability (beyond one year) develops as a result of repeated trauma to the ACL tissue [3].

Endobutton (Smith & Nephew, Andover, MA, USA) is a device placed against the anterolateral cortex of the distal femur, suspending the graft inside the femoral tunnel. In this type of fixation, vectors of resistance are parallel to and opposite the external forces, and they concentrate on the cortical bone of the distal femur, on the bone-device surface. Rigidfix (DePuy Mitek, Raynham, MA) is a transcondylar fixation system which uses one or more horizontal bars that cross the graft and femoral tunnel and create a bulge in graft. In this type of fixation, resistance is distributed along the surface between the device and bone and it depends on osseous density and length of the lever arm, considering the use of pulling forces (graft suspension point).

The Transfix device is a single cross-pin, which engages the graft in the femoral tunnel after passing it over a graft-passing wire with the graft lying perpendicular and over the Transfix device. The pin is inserted laterally through the lateral femoral condyle. When using the Transfix, the graft is wrapped around the pin instead of the pin piercing it and this has been suggested to reduce graft lengthening from slippage [4].

A powerful and stable fixation will prevent graft rupture and loss before it is fixed biologically. In addition, a weak initial fixation may compromise graft repair as stresses cause micro-motions of the graft, thus delaying or jeopardizing graft integration in the osseous canal [5-9]. There is no consensus as to which of the methods mentioned above is superior. It has been hypothesized that there are significant differences between different

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methods of femoral fixation and newer methods may have a better outcome.

The aim of this study was to compare the clinical outcome between Endobutton, Rigidfix and Transfix devices for soft tissue femoral fixation in primary ACL reconstruction using the autogenous hamstring graft.

Material and methods

In our study we involved 48 patients with history of knee injuries who were admitted in the University Traumatology Clinic, Clinical Center "Mother Teresa", Skopje. MRI of the knee joint was done before the admission or before the clinical examination.

ACL tears in our study were clinically examined and diagnosed by positive anterior drawer test, positive Pivot shift test and positive Lachman test. We also included other special tests to rule out any other associated structural damage to the knee.

All clinically diagnosed patients underwent diagnostic and therapeutic knee arthroscopy to assess the accuracy of clinical diagnosis after required investigations and consent in the University Traumatology Clinic, Clinical Center "Mother Teresa", Skopje during the period from 2009 to 2013. We conducted our study in 48 patients admitted to our clinic for ACL reconstruction from September 2009 to May 2013.

The patients with ACL reconstruction were assigned as Rigidfix group (n=28), the second patients to Transfix group (n=13) and the third to Endobutton group (n=7). MRI of the knee joint was done prior to surgery. A data sheet, containing demographic data, examination findings and Tegner & Lysholm score, was completed for each patient. Surgery was performed using tourniquet and in the supine position. All surgeries were performed by one single trauma surgeon and his team. All patients initially underwent diagnostic arthroscopy for evaluation of anterior and posterior cruciate ligaments as well as the medial and lateral menisci. Operative findings were documented in the official patient's records, which included the survey of the entire joint and anatomical structure, lesions involved with the presence or absence of tear, its location, status of the articular cartilage and others. ACL rupture was confirmed on arthroscopy and next surgery procedures were made as follows: initially, an an-

teromedial incision was made on the proximal tibia and the gracilis and semitendinosus tendons were detached from their insertions on tibia. Subsequently, the tendons were removed to fashion the graft for ACL reconstruction. A tibial canal was established; through this canal, the femoral canal was created under arthroscopy guide. Finally, the graft was passed through the canals as a single bundle. Based on the group the patient was assigned, the grafts were fixed in the femur using Rigidfix, Transfix or Endobutton. The grafts were fixed in the tibia with interference screws for all patients. We did not use control radiography in the surgery room. Knee drains, inserted in all patients, were removed after 24 hours.

After surgery, all patients were ordered to receive cold compression and limb elevation as well as conventional supportive knee braces. All surgical complications were documented during and after surgery. All patients received prophylactic antibiotics for 7 days and low molecular weight heparin for 14 days. All patients were discharged home after three days stay at our Clinic after surgery.

Knee physiotherapy, consisting of isometric quadriceps exercise, 2 to 1 hamstring/quadriceps strengthening, and continuous passive motions were initiated 24 hours after surgery. Sutures were removed after 2 weeks.

When the sutures were removed the patients started with standard physiotherapy rehabilitation program. Objective and subjective data were collected before surgery and at six months after surgery at our University Traumatology Clinic. Objective data included range of motion and anterior translation test. Subjective data included Lysholm and Tegner knee scores. Once the data sheets were completed, they were classified for analysis.

Statistical analysis was performed using the SPSS statistical package. Kruskal-Wallis test, ANOVA and other tests were utilized to compare variables between the groups. P-value <0.05 was considered to be significant.

Results

We had 48 patients in total, 6 (12.5%) were females and 42 (87.5%) were males. There was no significant difference between patients with ACL reconstruction in terms of preoperative scores and demographics (Table 1). Tegner & Lysholm average scores before surgery were 2.52 and 34.75 (p>0.05, respectively).

Table 1. Presentation of number and age of patients, modes of femoral fixation, Tegner and Lysholm scores

	ACL reconstruction n=48			p-value
	Rigidfix n=28(58.33%)	Transfix n=13(27.08%)	Endobutton n=7(14.58%)	
Mean age of patients and range /years	26.96 (16-46)	25.61 (16-43)	25.14 (19-39)	p>0.05
Tegner (pre-operative)	2.5	2.54	2.57	p>0.05
Tegner (post-operative)	8.32	8.31	8.71	p>0.05
Lysholm (pre-operative)	34.86	34	35.71	p>0.05
Lysholm (post-operative)	87.06	89.46	92.86	p<0.05

Six month after arthroscopy, the average value of Tegner & Lysholm scores in patients with ACL reconstruction was 8.37 and 89.08.

There was a significant overall improvement between preoperative and six months postoperative Tegner (2.52 versus 8.37, $p < 0.01$) and Lysholm (34.75 versus 89.08, $p < 0.01$) scores. There was no significant difference in the improvement between the three groups.

In terms of Tegner scores performed in patients preoperatively ($\chi^2 = 0.134$, $DF = 2$, $P > 0.05$) and postoperatively ($\chi^2 = 1.179$, $DF = 2$, $p > 0.05$) treated with different modes of femoral fixation (Rigidfix, Transfix, Endobutton) we found no statistically significant differences (Table 1 and Figure 1).

In terms of Lysholm scores performed in patients preoperatively ($\chi^2 = 1.261$, $DF = 2$, $P > 0.05$) treated with different modes of femoral fixation (Rigidfix, Transfix, Endobutton) we found no statistically significant differences (Table 1 and Figure 1).

Fig. 1. Tegner score average values in patients before and after arthroscopic ACL reconstruction with different 3 modes of femoral fixation

Fig. 2. Lysholm score average values in patients before and after arthroscopic ACL reconstruction with different 3 modes of femoral fixation

Postoperative average values of the Lysholm scores showed statistically significant differences ($p < 0.05$) in terms of the different modes of femoral fixation (Table 1 and Figure 2). Comparison among them showed that the Endobutton operative mode of femoral fixation had the highest value of the Lysholm score.

Discussion

Our findings indicate that all three modes of ACL reconstruction are associated with improved function and satisfaction of patients as demonstrated by the increase in Tegner & Lysholm score. Although the Lysholm scores were not significantly different prior to ACL reconstruction, comparison of Lysholm scores after surgery indicated Endobutton (Tight rope-RT) to yield better improvement of Lysholm score compared to Rigidfix and Transfix; the differences among the 3 modes of femoral fixation were not statistically significant.

The different biomechanical properties between the various femoral fixation devices for ACL reconstruction have been described previously in both cadaveric and animal studies using porcine parts [4]. The Endobutton has the reported disadvantage of tunnel widening by the bungee effect due to its fixation point being far from the joint line [10]. Hence the reported advantage of transfemoral fixation devices such as the Transfix and Rigidfix which are closer to the joint line compared to the Endobutton [11]. Being bioabsorbable, these devices do not have to be removed if further surgery is required in the future such as knee arthroplasty and they do not cause interference if subsequent magnetic resonance imaging scans of the operated knee are required.

In the present study, we did not observe a significant difference in anterior tibial displacement among the three groups. All three modes of fixation reduced anterior tibial displacement equally.

The Transfix can cause iliotibial band friction syndrome due to prominent lateral hardware though this was not found in our series of patients [12]. The Rigidfix pins can theoretically spear the graft which has been hypothesized to result in increased graft slippage compared to Transfix due to splitting of the collagen fibres of the graft [4]. This difference could explain the difference in anterior translation between the two groups in our study. Both devices require their own respective insertion techniques and apart from missing the femoral tunnel altogether during graft placement which can occur with both devices, other device specific complications have occurred with the Transfix device during insertion such as broken or twisted graft-passing wires [13].

Comparison between our series of patients with Transfix and Rigidfix mode of fixation resulted in no significant difference in the favourable clinical outcome despite differences in biomechanical properties between these two devices. This is in agreement with other studies which have not shown any clinical difference between the different transfemoral fixation devices [14-16].

Although Choi *et al.* (2012) reported tibial tunnel widening with the use of Transfix as compared to Rigidfix, the study did not report any significant difference in Lachman and pivot-shift tests and mean KT-1000 measurements. Any differences observed in our study between the two groups were neither statistically significant nor cli-

nically important with regards to outcome at six months. Our study protocol employed validated knee scores as an instrument to measure preoperative and postoperative function as well as objective clinical measurements with all surgery performed by a single surgeon [17].

All patients followed a standardized rehabilitation protocol conducted in various institutions and were followed-up for at least six months. There are certain limitations for our study; we only applied the Lysholm and Tegner score for evaluation of patients' outcome and did not use other methods of scoring such as IKDC. Furthermore, the follow-up period was limited. Future studies on larger populations and with longer periods of follow-up are recommended. We are currently awaiting longer term results to verify whether or not these early results persist. Another limitation of our study was the absence of knee muscle strength and single-leg hopping data. In conclusion, the Endobutton (Tight rope-RT) yielded a better outcome compared to the other two modes of femoral fixation in terms of instant stability of the graft and the general results.

Conclusions

There was no significant difference in the favourable clinical outcome between Rigidfix and Transfix modes for femoral tunnel graft fixation for ACL reconstruction in our study despite the different biomechanical properties of the two devices.

In our study, the Endobutton mode of femoral fixation (Tight rope-RT) yielded a better outcome compared to the other two modes in terms of instant stability of the graft and the general results according the values of the Lysholm score.

Conflict of interest statement. None declared.

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