Acta Orthop. Traumatol Turc. 25, 346-351, 1991

Comparison of tensor fascia lata+semitendinosus tendon and free patellar bone - tendon - bone graft reconstruction of the anterior cruciate ligament deficient knee

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Ön çapraz bağ yetersizliğinde Tensor Fasya+Semitendinos tendonu greftleri ile serbest patellar kemik-tendon-kemik greftlerinin karşılaştırılması.

Ön çapraz bağ yetmezliğinin tamiri genç ve fiziksel olarak aktif kişilerde evrensel olarak kabul görür. Eğer tedavisiz bırakılırsa daha sonraki ek yaralanma riski kaçınılmazdır. Ön çapraz bağ tamirinde değişik yöntemler tanımlanmıştır. Ekstraartiküler yöntemlerin uzun dönemli takip sonuçları yetersiz bulunduğu için ekstraartiküler yada intraartikuler ve ekstraartikülerin birlikte uygulandığı yöntemler seçilen genel tedavi yöntemleridir. Bu çalışmada 2 ayrı tamir tekniği karşılaştırılmıştır. 20 ön çapraz bağ yetersizliği olan diz 1983 ile 1987 yılları arasında Tensor Fasya lata+ semitendinosus yöntemi tedavi edilmiştir. İkinci grup serbest patellar kemik-tendon-kemik grefti ile tedavi edilmiş 20 hastadan oluştu. Birinci grubun ortalama yaşı 28, 15 yıl, ortalama takip süresi 71 ay, ikinci grubun ortalama yaşı 24, 55, ortalama takip 19, 2 aydı. Klinik testler, Artrometri testler (GENU COM Faro Medical Technologies İnc.) ve izokinetik kas testleri (LİDO ACTİVE İsokinotic system LOREDAN Biomedical İnc Col) uygulandı. Birinci grupta Jerk testi 3 haftada (% 15), ikinci grupta Jerk testi 3 haftada (% 15) pozitiftir. Isokinetik kas testleri ikinci grup hastalarda diz kontrolunun iyi olduğunu gösterdi. İkinci grup'un sonuçları TFL-ST grubuna göre daha iyiydi ancak her iki grubun takip süresi aynı değildi. Bu nedenle uzun dönem sonuçları yeniden değerlendirilmelidir.

Anahtar kelimeler: *Ön çapraz bağ rekonstrüksiyonu, kemik serbest patellar tendon grefti*

The reconstruction of anterior cruciate ligament deficient knee is now almost universall accepted in young and physically active patient.İf left untreated the risk for funther injury seems unavoidable. Many procedures have been described in the reconstruction of the anterior crucrate ligament (ACL) deficrent knee as the long term follow-up studies of extraarticular procedures have been unsatisfactory intraarticular procedures or a combination of the two are now the treatment of choice. Two separate techniques of reconstruction have been compared in this study. 20 ACLdeficirent knees had been operated by tensor fascia lata+semitendinosus (TFL-ST) technique between 1983-1987. The second group is made up of 20 patients who were treated with free patellar bone-tendon-bone greft. First group's mean, age was 28, 15 years and mean follow-up was 71 months. The second groups, mean age was 24, 55 years and mean follow-up 19, 2 months. Clinical testing, arthrometric testing (GENU COM Fore Medical Technologies inc.), and ısokinetic muscle testing (LİDO ACTIVE İsokinetic System LOREDAN Biomedical Inc. Cal) were done. For the first group jerk test was positive in 3 of patients (15 %). For the second group Jerks was positive in 3 of patients (15 %). Isokinetric muscle testing results have shown a good control of knee in the second group of patients. The results of group II are superrorto TFL-ST but follow-up period are not the same in both groups. Thus long term results should be verified.

Key words: ACL reconstruction, free patellar bone-tendon-bone greft

The reconstruction of the anterior cruciate ligament (ACL) deficient knee is now almost universally accepted in the young and physical active persons. If left untreated the risk for further injury seems unavoidable. Meniscal tears, cartilage lesions and eventual degenerative arthritis, streching of secondary restraints and worsening of the instability have been cited in the literature (1, 6).

Many procedures have been described in the re construction of the ACL deficient knee. As the long term follow-up results of extra-articular procedures have been unsatisfactory, intraarticular procedures or a combination of the two are now the treatment of choice. The evolution of arthroscopic techniques and instrumentation have greatly improved the outcome of the surgery, permitting a surgery with a minimum

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damage to surrounding structures and a possibility of early rehabilitation.

The rational of combining a static, a distally based fascia lata and a dynamic, proximally based semitendinosus tendon, is to preserve the role of the hamstring group muscles and to stabilize the knee actively at the same time. Second advantage of this technique is that it does not sacrifice important structures of the knee, on other hand due to active component of the procedure hamstring group of muscles is to be preserved strong enough. Early short term results of this technique were presented in Strasblourg, France 1985 after which it has appeared in the literature as "modified Zarins and Rowe" technique proposed by Dr. Sisk et al. (7, 8).

Patellar tendon with bony attachments at each end seems to be the ideal free autogenous greft because of its great tensile strength, secure fixation properties, nearly always sufficient length and arthroscopically guided applicability (9).

The aim of this presentation is to compare the clinical results of two different techniques that have done by the same surgeon (G. B.) at this Institute.

Material and method

Subjects

Forty patients (26 males, 14 females) who underwent surgical reconstruction for ACL deficient knee at the Institut Calot (IC) volunteered for participation in this retrospective study. All of the ACL reconstructions were done by the senior one of us (G. B.) between 1983-1990. The patients returned the IC for examination, interviews and objective testing during the period from April 91 to June 91. Patients ranged in age from 15 to 48 years (mean 26. 35) and were evaluted at an average of 45 months after ACL reconstruction (range 16-106 months).

20 subjects underwent reconstruction with Tensor Fascia Lata and Semitendinosus (TFL-ST) as ACL substitute between 1983-1987 at the same Institute (Groupe I). Patients (15 males, 5 females) ranged in age 20 to 48 years (mean 28. 15 years) and mean follow-up was 71 months (48 to 106 months). The average interval between injury and surgical reconstruction was 30 months (1 to 84 months).

Other 20 subjects underwent intraarticular reconstruction of ACL under arthroscopy using the central one-third of the patellar tendon as a free bone-tendon-bone (B-T-B) greft ACL substitute between february 1989 to november 1990 (Groupe II). Patients (11 males, 9 females) ranged in age 15 to 35 years (mean 24. 55 years) and mean follow-up was 19. 2 months (16 to 27 months).

The average interval between injuries and surgical reconstruction was 18 months (1 to 106 months). The detailed patient data is presented at (Table I.)

	TFL-ST	B-T-B
N	20	20
male	15	11
female	5	9
mean age +/-sd	28. 15+/-6. 1y	24. 55+/-5. 9y
(min.-max.)	(20-48 y)	(15-35 y.)
mean follow-up71 months		19. 2 months
(min.-max.)	(48-96 m.)	16-27 m.)
mean injury to surgery	30 months	18 months
(min.-max.)	(1-48 m.)	(1-106 m.)

Table I: Patient data

Thirty one (77. 5%) were involved in various levels of sports activities when they sustained ACL injury, while 3 (7. 5%) were injured during vehicle accidents, 2 (5 %) were injured in workrelated accidents (Table II).

	TFL-ST	B-T-B
	N (%)	N (%)
Sports trauma	15 (75 %)	16 (80 %)
Vehicle accidents	2 (10 %)	1 (5 %)
Work-related accidents	2 (10 %)	0
Other	1 (5 %)	3 (15 %)
Football	10	7
Ski	3	2
Handball	0	2
Judo	0	2
Other	2	3
TEGNER		
0-2	0	0
3-4	0	1 (5 %)
5-6	3 (15 %)	3 (25 %)
7-10	17 (85 %)	14 (70 %)
ARPEGE		
Competition	9 (45 %)	11 (55 %)
Leisure	11 (55 %)	6 (30 %)
Active	0	3 (15 %)
Sedentary	0	0

Table II: Etiology of ACL Injuries

The evaluative parameters were,

1. Orthopaedic clinical examination
2. Subjective rating and activity level
3. Instrumented measurement of knee ligament laxity
4. Isokinetic strength and work capacity.

From these 4 parameters 9 clinical and objective variables were identified to measure knee function and stability (Table III).

* Orthopaedic clinical examination:

All subjects underwent a clinical examination including anterior drawer test, Lachman test, jerk test, measurement of quadriceps athropy, lateral laxity testing and range of motion.

* Subjective rating and activity level:

Subjective ratings were done using the 100 points

1. Anterior drawer test	(0, 1+(0-5 mm, 2+ (6-10 mm, 3+(>10mm
2. Lachman test	(0, 1+ with endpoint, 1+ with no endpoint)
3. Jerk test	(negative, positive)
4. 100 points Lysholm questionaire	
5. Four level 27 points ARPEGE questionaire	
6. 10 points TEGNER activity score	
7. Lysholm and ARPEGE final evaluation	
8. GENUCOM	(Anterior drawer 30°, Anterior drawer 90° , Recurvatum)
9. LIDO ACTIVE	(100° /sec, 240°/sec, 400°/sec)

Table III: Knee function and stability parameters and objective variables

questionaire of Lysholm and 10 points activity level of Tegner (10).

* Instrumented measurement of knee ligament laxity:

A GENUCOM (FARO Medical Technologies Inc. Canada) device was used to obtain objective measurement of knee ligament laxity employing anterior drawer test at 30° and 90° of knee flexion and recurvatum tests.

* Isokinetic strength and work capacitly:

Patients in both groups underwent testing with LIDO ACTIVE device (Loredan, U. S. A.). The device was set to sitting position, extension/flekion motion, concentric/concentric mode and speeds the same for both motion sides. The tests that were done are: 100°/sec 5 repetitions (peak-Torque), 240° / sec minimum of 15 repetitions (Work/repetition), 400° /sec 7 repetitions (Peak-Torque)

Operative procedures

In group I patients the torn ACL was reconstructed with two transfers (Fascia Lata strip and Semitendinosus tendon). In this technique semitendinosus tendon is released from its attachement on the anterior crest of tibia distally and freed to its musculotendinous junction. It is then passed posterior to medial collateral ligament with a transosseous tunnel into the knee joint and through an isometric transosseous tunnel tendon is pulled to lateral surface of the lateral femoral epicondyle and secured with a staple. A stripe of 15 cm long fascia lata is then freed to the Gerdy's tubercule and brougth to the same femoral tunnel under the fibular collateral ligament and directed towards the anterior surface of tibial crest with another tibial tunnel and finally secured with a staple (7). In group II free autogenous central one third of patellar tendon, bone-tendon-bone grafts were used in arthroscopically guided intraarticular reconstruction of ACL as described by Clancy (9).

Results

In group I there were (25 %) patients complaining of the knee pain, and 2 (10 %) patients have had swelling after exercise. 3 patients (15 %) have had giving-way whilst doing sport, but there were no instability in daily life.

In group II 12 (60 %) subjects felt a slight pain on a "rainy day" 5 patients have had slight to moderate pain over the tibial screw. 3 (15 %) patients have had self resolving swelling after strenous exercise. There was no feeling of insecurity. One patient uses a knee brace while wind-surfing due to giving way but he has no instability in daily life.

We have found out that in group I 5 (25 %) patients had never practiced any kind of sport after reconstruction (3 of this 5 patients were either vehicule accident or work related accident) 8 patients continued the same level of sport for 2-4 years and then have changed to a level inferior or left over. 5 patients restarted practicing sport in a level inferior to previous one. Mean period passed for to take sportive activity was 11. 0 months.

In group II 5 (25 %) patients never started any kind of sportive activity, 6 (30 %) patients continued at the same level, 2 (10 %) stopped after starting at the same level, 7 (35 %) continued at a level inferior. Mean period to start sportive training was 8. 8 months and competitive events was 10. 8 months. Level of activity is presented in (Table IV).

	TFL-ST				B-T-B			
	preop		Last		preop		Last	
ARPEGE	n	(%)	n	(%)	n	(%)	n	(%)
Competition	9	(45)	1	(5)	11	(55)	6	(30)
Leisure	11	(55)	4	(20)	6	(30)	4	(20)
Active	0	(0)	13	(65)	3	(15)	8	(40)
Sedentary	0	(0)	2	(10)	0	(0)	2	(10)
TEGNER								
7-10	17	(85)	3	(15)	14	(70)	8	(40)
5-6	3	(15)	7	(35)	5	(25)	3	(15)
3-4	0	(0)	10	(50)	1	(5)	9	(45)
0-2	0	(0)	0	(0)	0	(0)	0	(0)

Table IV: Levele of activity according to ARPEGE and TEGNER

* Clinical examination

Patients in group I were presented as a poster presentation in 1985. 20 of that 25 patients accepted to volunteer for the last examination. Lachman and jerk tests were considered as positive or negative at that time. In preoperative evaluation anterior drawer test was 1+ in 8 (32 %) patients, 2+ in 12 (48 %) and 3+ in 5 (20 %) patients. Lachman test and jerk test were positive in all patients. Postoperative late evaluation have showed that 11 (55 %) had anterior drawer test 0, 8 (40 %) patients 1+, 1 (5 %) had 2+, no patients had 3+ anterior drawer test. Lachman test was 0 in 4 (20 %), 1+ with end point in 10 (50 %), 1+ with no end point in 6 (30 %) patients. Jerk test was positive in 3 (15 %) and trace in 3 (15 %) patients (Table V).

	TFL-ST				B-T-B			
	preop.		last		preop.		last	
Clinical ex.	n	(%)	n	(%)	n	(%)	n	(%)
AD Test 0	0	(0)	11	(55 %)	1	(5 %)	14	(70 %)
1+	8	(32 %)	8	(40 %)	18	(90 %)	5	(25 %)
2+	12	(48 %)	1	(5 %)	1	(5 %)	1	(5 %)
3+	5	(20 %)	0	(0 %)	0	(0)	0	(0 %)
Lachman 0	0	(0)	4	(20 %)	0	(0)	7	(35 %)
1+ endpoint	25	(100 %)	6	(30 %)	1	(5 %)	11	(55 %)
1+ no endpo.			10	(50 %)	19	(95 %)	2	(10 %)
Jerk 0	0	(0)	17	(85 %)	2	(10 %)	17	(85 %)
1+	25	(100 %)	3	(15 %)	18	(90 %)	3	(15 %)
Limitation in flex. < 5°			2	(10 %)			6	(30 %)
6°-10°			0				2	(10 %)
> 10°			0				1	(5 %)
Quadriceps atrophy			-1. 15cm				-0. 82 cm	
LYSHOLM mean (min.-max.)	65. 95 (40-81)		92. 1 (76-100)		67. 05 (45-85)		94. 7 (77-100)	
< 64 points	5	(25 %)	0		8	(40 %)	0	
64-83 points	15	(75 %)	5	(25 %)	11	(55 %)	2	(10 %)
84-94 points	0	(0 %)	4	(20 %)	1	(5 %)	2	(10 %)
> 94 points	0	(0 %)	11	(55 %)	0	(0 %)	16	(80 %)

Table V: Results of the clinical evaluation

In group II 95 % of the patients had 1+ or greater anterior drawer test, Lachman was positive in all, jerk was positive in 90 % of the patients preoperatively. Postoperatively there was 14 (70 %) AD 0, 5 (25 %) AD+, 1 (5 %) AD 2+, and no AD 3+. Lachman was 0 in 7 (35 %) patients, 1+ with end point in 11 (55 %) patients 1+ with no end point 2 (10 %) patients. Jerk test was positive in 3 (15 %) patients.

Flexion of the operated knee was superior to 120° in both groups but there were 2 (10 %) limitation of flexion <5° in group I; and 6 (30 %) <5°, 3 (15 %) >5° limitation of flexion in group II.

* Subjective rating:

Results were evaluated with two different questionnaires. We have found that preoperative and postoperative Lysholm values were alike in both groups. At the last evaluation 15 (75 %) of group I and 18 (90 %) of group II was rated as excellent/good (Table V).

* Instrumented measurement

All the tests were done by the same tester, and second tests were taken into consideration, because within the time patients get used to the device, they tend to decontract themselves. In group I; anterior drawer test done at 30° of knee flexion have showed that 5 (25 %) of the patients had less than 3 mm difference between the operated and non operated knees. On the other hand in group II 13 (72. 2 %) patients had less 3 mm difference. For anterior drawer test at 90° of knee flexion it is found that 9 (45 %) and 12 (66. 6 %) of the patients respectively had less than 3 mm difference between the operated and non-operated knees. These figures have showed us that there is more laxity in group I patients which is also concurrent with the clinical testing (Table VI).

	TFL-ST				B-T-B			
mm	non-op.		op.		non-op		preop.	last
AD 30° mean	7. 32		11. 94		8. 11		11.8	8. 84
AD 90° mean	4. 73		7. 265. 05				5. 93	6. 21
Op. -Nonop.	AD 30°		AD 90°		AD 30°		AD 90°	
	n	(%)	n	(%)	n	(%)	n	(%)
< 3 mm	5	(25)	9	(45)	13	(72.2)	12(66. 6)	
3-6 mm	7	(35)	9	(45)	3	(16. 6)	5(27. 7)	
> 6 mm	8	(40)	2	(10)	2	(11. 2)	1(5. 7)	

Table VI: Genucom results

tests	Mean Def. Ext. TFLST	BTB	Mean Def. Flex TFLST	BTB	Ratio of Hamstr. / Quadr. Operated TFLST	BTB	Non operated TFLST	BTB
100° / sec	-6. 2%	-15. 3%-6. 7%		+2. 1%	54. 7%	66. 3%	55. 3%	54. 6%
240° / sec	-8. 9%	-11. 7%-1. 6%		+6. 2%	75. 8%	73. 2%	70. 5%	61. 2%
400° / sec	-6. 2%	-8. 7%	-4, 3%	+5. 6%	74. 3%	80. 1%	72. 3%	70. 2%

Table VII: Lidoactive results

	Mean Deficit Tegner<5 TFL	BTB	Extensors Tegner>5 TFL	BTB	Mean Deficit Tegner<5 TFL	BTB	Flexors Tegner >5 TFL	BTB
100° / sec	-15. 6 %	-14. 3 %	+3. 3 %	-15. 3 %	-11. 4 %	0 %	+0. 6 %	+1. 8 %
240° / sec	-9. 8 %	-13 %	-7. 6 %-10. 3 %		-6. 7 %	+1. 2 %	+3. 7 %	+7. 5 %
400° / sec	-8. 1 %	-14. 3 %	-4. 2 % -6. 2 %		-1. 7 %	+4. 2 %	- 5. 4 %	+6. 2 %

Table VIII: Lidoactive results in relation with activity level

* Isokinetic strength and work capacity

Lidoactive results

It is generally accepted that if the mean deficits are less than 7-10% and the values are between 55%-60% of hamstring-quadriceps ratio they are considered as nonpathologic (11). Mean deficits of flexors and extensors of the group I was overall nonsignificant. However, when the level of activity is taken into the consideration (such as those who are Tegner <5 and Tegner >=5) there are less deficits in the group more active than others (Tegner >=5). In group II we have found that there is more deficit in extensors than in group I but on the other hand their flexors are more powerful (Table VII).

There was a considerable difference in between the deficits of the extensors and the flexors of group II. This, we believe that is the results of different rehabilitation programe that have been applied. In group II first flexors were actively rehabiltated before 2 months postoperatively with a 30°- 80° of range of motion. When level of activity is taken into consideration there were no differences in mean deficits of the group more active (Tegner >5) and less active (Table VIII).

Discussion

There are many conflicting reports concerning the various treatment for ACL injuries. Clancy et al. Reported considerably better results with patellar tendon reconstruction than nonoperative treatment in his prospective study (9).

The rationale behind the combined operative procedure was use two grafts to increase the tensile strength of the reconstruction, to combine extra articular and intra articular procedures, to leave extensor mechanism undisturbed and not to damage flexion action of the semitendinosus tendon.Techniques presented in this article differs in may ways. First, the follow-up periods are not identical which makes diffucult to compare, but on the other hand one year results are comparable. Second point is that though mean ages are more or less identical patients been operated in group I are now much older than in group II and most of them have given up active sports life. Since TFL-ST's one component depends on active semitendinosus tendon it is evident that it should be strong enough to stabilized the knee. The clinical testing results have shown that there is a difference in Lachman test findings when group I is divided into two subgroups, such as Tegner <5 and Tegner >5. In the subgroup Tegner <5 Lachman zero was 10% and on the contrary in the other subgroup it was 33%. Isokinetic test have shown that there were no global pathologic deficits in group I, but when the activity level is taken into consideration there is 18. 9% gap in the deficits of extensors (-15. 6%, +3. 3 %) and 12 % difference in the deficits of flexors (-11. 4%, +0. 6%) Table VIII. These findings are in accordance with the clinical findings and they support the idea that in order to stabilize the knee actively the hamstring group should be strong enough. Though our clinical test results are comparable with Zarins & Rowe, they have found a significant difference in the deficits of flexors and extensors; this we believe that is due to sacrifying the active role of semitendinosus (8).

The clinical results of BTB group are superior to TFL-ST though one year results are comparable. Genucom instrumented measurement have shown that there are significant differences in preoperative measurements between the nonoperated knee and operated knee. Postoperative one year values are well inferior to preoperative mean values and there is no distension of the graft over 3 mm after one year. Isokinetic testing values have shown a mean deficit of 12 % of extensors which we believe is due to the rehabilitation programme. Though there are no differences in 100° / sec and 240° / sec tests between extensors and flexors, at high speed 400° / sec there is 11. 6% difference in favour of flexors. Level of activity

again is important in the outcome of the clinical testing results: we found that there are more Lachman zero (45 %) in the subgroup that is more active than in the subgroup less active (22 %).

Thus with the data been collected it can be said that for group I patients, training of the hamstring group of muscles is important because of the active component of the technique. Though there is laxity when Lachman test is considered, there is no instability in daily life. It cannot be said if there were or will be instability in competitive sports because majority of the patients in this group have left over the active sports life. The results of group II are superior to TFL-ST, but follow-up periods are not the same in both groups. Thus long term results should be verified. The deficits in extensor group of muscles are thougth to be due to the rehabilitation programme that have been used.

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