

Knee Function After Nonsurgical Treatment of The Anterior Cruciate Ligament Injury

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ABSTRACT

An investigation of the effect of knee exercise program on the functional stability of the knee joint after anterior cruciate ligament (ACL) injury was conducted using a newly designed functional rating scale developed specifically for ACL deficient knee joint. Forty five patients with a total rupture of the ACL were included in the study. Before treatment mean total score was 79.00 points \pm 11.69 points. All patients underwent rehabilitation program for three months period. Post treatment mean total score was 178.93 points \pm 13.16 points. The differences were significant. This means that knee exercise program had a significant effect upon the knee subjective and objective scores.

Key words: Knee function, ACL treatment, Laxity, Stability, Knee rating scale.

INTRODUCTION

Knee injuries are among the most common problems confronting patients, physical therapists, and physicians today. The ACL is one of the most frequently injured major ligaments of the knee joint. Loss of the ACL has been shown to influence the mechanics of the knee joint by decreasing the overall stiffness of the knee or increasing the instability of the knee joint²¹. Pivoting and cutting in a specific direction commonly result in knee instability¹⁷. The appropriate treatment of complete tear of the ACL of the knee is controversial^{9,16}. There are proponents of acute surgical intervention, while others prefer conservative therapy^{4,19}. Functional stability of the knee can be achieved by compensation through the neuromuscular system. The purpose of this study was to

evaluate the results of conservative exercise program for the ACL deficient knees on increasing functional knee stability as measured by newly designed knee functional rating scale.

MATERIALS AND METHODS

Subjects:

Forty five subjects (39 males and 6 females) 18 to 35 years old (mean age, 25.7 years, standard deviation, 5.13 years) with confirmed ACL disruption, voluntarily participated in the study. All subjects met the following criteria: (1) a history of an ACL injury with positive clinical findings at the initial examination; (2) no previous knee injury, or general illness; (3) no simultaneous fracture of the injured knee; and (4) no sign of medial or lateral laxity > 5 mm when tested at 30 degrees flexion.

Instrumentation:

- KT-1000 knee ligament arthrometer (Med-metric Inc., San Diego, CA).
- Musculoskeletal Evaluation Rehabilitation and Conditioning (MERAC) system (universal gym equipment, Inc., Cedar Rapids, Iowa, USA).
- Universal goniometer with a full 360 degrees circle.
- Flexible measuring tape.
- Hand held stop watch.
- Balancing boards.

Procedures:**A) Evaluation:**

An initial two-visit assessment was done using functional rating scale developed

specifically for ACL deficient knee, total score for normal knee joint is 200 points (Table 1).

Each patient completed an extensive questionnaire that rated symptoms (pain, swelling, giving way); and function level and limitation with (walking, running, jumping, twisting, and turning).

The anterior knee laxity was measured using the KT - 1000 arthrometer for both knees from supine lying position. The test was repeated three successive times and the mean was calculated and recorded.

Thigh girth was measured using the flexible measuring tape for both extremities at 10 and 23 cm proximal to the medial joint line. The mean for three successive measurements was calculated and recorded.

Table (1): Knee functional rating scale

Parameter	Symptoms				total points
	pain	swelling	giving way (instability)		
	20	10	20		
	Knee function				
	overall activity level	walking	stairs	running	jumping or twisting
	20	10	10	5	5
	Clinical examination				
	anterior knee laxity	thigh circumference at 10 cm	thigh circumference at 23 cm	range of motion	
	5	5	5	5	
	Isokinetic testing				
	hamstring peak torque at 60 degree/sec.	quadriceps peak torque at 60 degree/sec.	hamstring peak torque at 270 degree/sec.	quadriceps peak torque at 270 degree/sec.	
	10	10	10	10	
	Performance testing				
	single hop for distance	triple hop for distance	timed hop for six meters	cross over hop for distance	
10	10	10	10		
200					

The active knee joint flexion and extension for both knees were measured using universal goniometer. The mean for three successive measurements was calculated and recorded.

On the second day of data collection, the maximum voluntary muscular torque outputs of the hamstrings and quadriceps for each patient were determined by the use of the MERAC isokinetic dynamometer. Both knees were tested at speeds of 60 and 270 degrees / sec. respectively. Testing of the involved knee was performed immediately after the testing of the noninvolved one.

The functional performance tests were performed on a marking strip extended on the floor for 6 meters. The patient stood on one leg, and he/she performed: (1) single hop as far as possible, the distance hopped was measured, (2) triple consecutive hops as far as possible and landed on the same foot. The distance hopped was measured, (3) consecutive hops, as fast as possible, landing on the same foot at the end of the 6 meter strip. The time needed was calculated by a stop watch; and (4) consecutive hops, crossing over the center strip on each hop as fast as possible, landing on the same limb. The time elapsed was calculated by a stop watch.

The measurement procedures were conducted once more immediately after completion of the treatment program.

B) Treatment:

The exercise program included the following: (1) hamstring muscles setting, isometric from 30 and 60 degrees of knee flexion⁶, and curl from 0 - 90 degrees knee flexion from prone lying position exercises^{3,15}; (2) quadriceps muscle setting, isometric from 80 to 120 degrees of knee flexion, curl from 90 to 30 degrees of knee flexion, and closed kinematic

chain exercises^{2,6,12,20}; (3) minisquatting exercise from 0 to 40 degrees¹⁸; (4) hip abduction, extension, and adduction exercises; and (5) neuromuscular coordination exercises for the quadriceps and hamstrings to respond quickly and adequately during an unexpected trauma using balancing boards^{7,10}. The patients received six sessions per week for 12 weeks.

RESULTS

The pre treatment total scores of the injured knee joints ranged from 71.1 to 117.2 points with mean value of 97 ± 11.69 points and standard error 2.14 points, while the post treatment total scores of the injured knees ranged from 138.4 to 194.7 points with mean value of 178.93 ± 13.16 points, and standard error 2.43 points (Fig. 1).

The t value for the pre and post treatment total scores was -32.74, and the 2 - tail probability was 0.001. These values indicate that there was a significant difference in the total scores of the injured knees after treatment ($P \leq .05$).

The analysis of pre and post treatment scores of the injured knees for the subjective and objective parameters showed significant differences in all parameters (Tables 2, and 3) and (Figs 2, and 3).

Scores above 182 points were rated excellent (23 cases, 51.1 percent); scores from 164 to 180 points were rated good (18 cases, 40 percent); scores from 120 to 162 were rated fair (4 cases, 8.9 percent); and scores below 118 were rated poor.

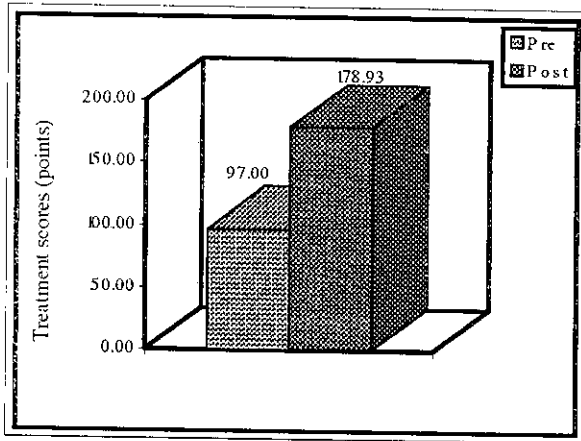


Fig. (1) The mean values of the pre and post treatment total scores.

Table (2): Comparison between the pre and post treatment scores of knee symptoms and function of the injured knees:

	Symptoms		Function	
	Pre treatment	Post treatment	Pre treatment	Post treatment
Range minimum	6.00	24.00	8.00	33.00
Range maximum	28.00	50.00	28.00	50.00
Mean	15.33	43.07	19.53	45.03
St. deviation	± 5.31	± 6.05	± 5.25	± 4.16
St.error	0.97	1.11	0.96	0.76
t- value	- 25.42		- 25.50	
2-Tail probability	0.001		0.001	

Table (3): Comparison between the pre and post treatment scores of clinical examination, isokinetic assessment and performance testing of the injured knees:

	Clinical Examination		Isokinetic Assessment		Performance Testing	
	Pre*	Post**	Pre*	Post**	Pre*	Post**
Range minimum	13.80	15.70	21.90	32.20	0.00	26.60
Range maximum	17.60	18.20	36.30	39.60	18.80	40.00
Mean	16.00	18.20	13.31	36.08	13.31	36.08
St. deviation	±0.93	±0.59	±3.84	±1.51	±6.00	±2.78
St.error	0.17	0.11	0.70	0.28	1.10	0.51
t- value	- 7.62		- 8.82		- 22.09	
2-Tail probability	0.001		0.001		0.001	

* Pre treatment
** Post treatment

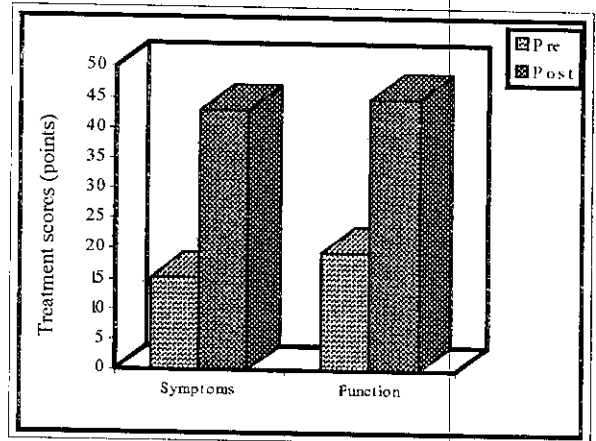


Fig. (2): The mean values of pre and post treatment scores of knee symptoms and knee function.

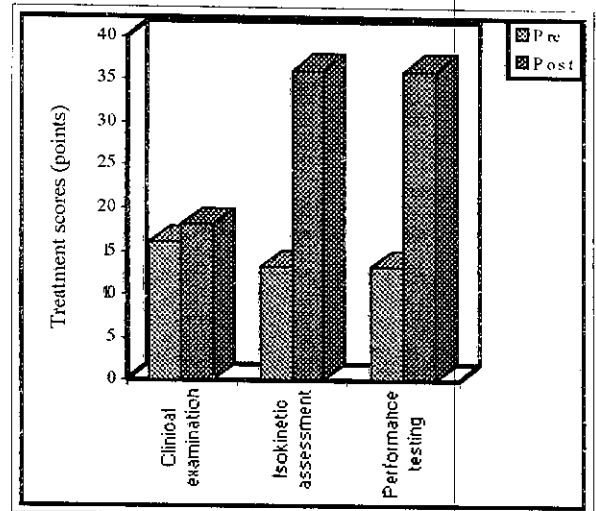


Fig. (3): The mean values of pre and post treatment scores of the clinical examination isokinetic assessment and performance testing.

DISCUSSION

All patients in this study had an ACL injury without surgery. It appears that the patients in this study had progressed quite well with the exercise program used. The program stresses thigh muscles strengthening with emphasis on hamstring muscles strength and coordination, together with dynamic joint control training,

and enough time to rehabilitate the knee adequately. The findings of the study supported the claim that strengthening the hamstrings can act to stabilize the tibia posteriorly on the femur and can replace the functions of the ACL^{1,14,22}. The hamstrings provide the knee joint with dynamic rather than static stability¹³ as shown in the post treatment total scores. It was proposed that the dynamic stability of the knee can be improved by proprioceptively based rehabilitation program¹⁰, it is therefore suggested that muscle strengthening as well as proprioceptive training should be included in all exercise programs for ACL injury to compensate for its functions.

The results for the majority of the patients, included in the study, were satisfactory. A delayed surgical procedure can effectively restore an acceptable level of activity in patient who do not respond to conservative treatment^{5,8,11}. In this case the exercise program should be considered for post operative rehabilitation.

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الملتقى العربي

وظيفة الركبة بعد العلاج الفيزيائي في حالة إصابة الرباط الصليبي الأمامي

يهدف هذا البحث لدراسة تأثير برنامج تمارين على درجة ثبات مفصل الركبة في حالات إصابة الرباط الصليبي الأمامي. اشترك في الدراسة خمسة وأربعون متطوعاً تتراوح أعمارهم بين ١٨ ، ٣٥ عاماً ، منهم خمسة وثلاثون من الذكور وعشرون من الإناث . وقد تم تقييم أداء مفصل الركبة باستخدام جدول تقييم الأداء الوظيفي لمفصل الركبة والذي تم تطويره خصيصاً ليستخدم مع حالات إصابة الرباط الصليبي ، ثم إتبع كل مريض برنامج تمارين لمدة ١٢ أسبوعاً بواقع ستة جلسات أسبوعياً . بعد إكمال البرنامج تم تقييم أداء مفصل الركبة باستخدام نفس الجدول .

أشارت نتائج البحث إلى وجود فروق معنوية بين أداء مفصل الركبة قبل وبعد العلاج مما يدل على تأثير برنامج التمارين على زيادة ثبات وتحسن وظيفة مفصل الركبة المصابة بقطع كامل في الرباط الصليبي الأمامي ، وكانت نسب التحسن كالتالي :-
٣٢ مريضاً (٥١,١ ٪ درجة تحسن ممتازة) ، ٦٨ مريضاً (٤٠ ٪ درجة تحسن جيدة) ، ٤ مريضاً (٨,٩ ٪ درجة تحسن مقبولة) .