Comparative Study between the Effects of Selected Exercises Program on Knee Stability after Two Different Techniques of ACL Reconstruction

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ABSTRACT

Although numerous studies reported the deficits after Anterior Cruciate Ligament (ACL) reconstruction, data gathered about muscular strength and functional level after reconstructive surgeries didn't provide us with sufficient knowledge about knee function. ***Purpose:*** *This study was designed to compare between the effect of exercise's therapy on dynamic knee stability after application of two different techniques of reconstruction as an accelerated physiotherapy program concerning proprioceptive.* ***Methodology:*** *Training exercises was applied to 30 Athletes with ACL reconstruction for three months where 15 subjects were reconstructed with BPTB graft (group A) and other 15 subjects reconstructed with ST graft (group B), their ages ranged from 17-33 years old. A newly designed subjective and objective rating scales was used to evaluate subject's functional performance as data gathered from reconstructed knees were compared with that of the other normal ones, giving scores for each variable and the total score was given a suitable grade then compare the two groups. What is new in this study that the scale obtained many variables each was given a reasonable scored weighing the actual shared of that variable in affecting dynamic stability of the knee. Also, biomechanical classification of variable and putting levels for evaluating short-term stability and what is needed on the long-term basis of dynamic stability.* ***Results:*** *showed that there is no significant difference between the mean values of "symptoms" score of both studied groups (t= 0.76 and P= 0.45). The mean values of "Functional tests" score show no significant difference (t= 0.18 and P=0.85). The mean values of "performance tests" score show significant difference between the studied groups (t= .17 and P= .86). As sown also, there are no significant differences between the mean values of "Clinical Examination" (t= 1.03 and p= .31)., "Isokinetic tests" (t= .22 and P= .82). and "general score" (t= .32 and p= .75), scale of group "A" and group "B". Conclusion: Student t-test used for statistical analysis demonstrated that there is no significant difference of the recorded parameters in both groups as the dynamic knee stability was the same.*

Key wards: *knee stability, ACL reconstruction.*

INTRODUCTION

Significant morbidity after ACL injury afflicts individuals enjoying a demanding active life style. A decision in the most appropriate treatment is so difficult and should be taken seriously because all treatment options require hard work for a successful outcome. Although numerous studies report the deficits after ACL reconstruction, data gathered about muscular strength and functional level after reconstructive surgeries doesn't provide us with sufficient knowledge about knee function[7,10].

Post operative morbidity following ACL reconstruction using different surgical technique reflects deficits especially when reconstructed knee is compared with the other normal one. The anterior knee pain (AKP), the

presence and size of effusion, and active and passive range of motion all are variables in need for precise assessment[5].

Being the commonest of the ligamentous injuries to the knee[3], ACL injuries have received a great deal of interest, and very successful operations to reconstruct the torn ACL have been designed to provide anteroposterior and anterolateral stability[8]. This is because of the great liability of this ligament to be injured during an atheletic activity and this liability has steadily increased over the past few decades. This is due to the fact that sports are an increasingly important part of day-to-day life[15].

Stability of ACL is enhanced by the dynamic action of muscles crossing the knee. Also reflex arcs exist between the ACL and its agonist muscles, so a proprioceptive role for the ACL is an integral function in cruciate reconstruction. The ACL provided 85.1% ± 1.9% of anterior restraining force while, all other ligamentous structures crossing the knee added little restraint to this motion. Although the contributions of the iliotibial band to lateral stability were small, a constant restraining moment was produced at all angels of lateral side of the joint hence, considered as a dynamic stabilizer of the lateral side of the knee. Once the ACL is removed, the iliotibial tract and band together with the midlateral and medial capsules all contribute some of the remaining anterior restraining force with the medial and lateral collateral ligaments. Therefore, surgical cues were taken place to regain the lost function using different graft types to compensate for the lost ligament[14].

The material used for substitution, weight bearing, range of motion, muscle strength, subjective findings, functional and performance measures and progression to previous activity are important determinants to understand functional stability of the reconstructed knees. The current popularity of bone patellar tendon bone (BPTB) reconstruction was initiated using the central one third of the patellar tendon had a good result on knee stability and better range of motion. Some surgeons prefer to use a semitendinosus (ST) autograft as its use didn't result in loss of hamstring strength although possesses similar biomechanical properties to the patellar tendon[6].

Reconstructive surgery for the ACL requires a long postoperative rehabilitation, as several common problems were encountered in postoperative rehabilitation such as pain, swelling, giving way. Immobilization following knee ligament surgery has a negative impact on articular cartillage as a result, it influences muscle strength and lower limb stability[1].

Before starting the rehabilitation program, both physician and physiotherapist should understand the stresses that they will be introducing to the patient's knee since each patient present with slightly different clinical results, as there's lake of standard rehabilitation procedures[13].

Therefore, this study was conducted to compare from the functional point of view between these two surgical techniques as a new scale is designed to achieve such purpose.

MATERIALS AND METHODS

A total of 30 subjects with ACL reconstructed knees participated in the study. They were 28 males and 2 females, aging between 17 and 33 years (Table1). The ACL of the right knee had been reconstructed in 17 subjects (56.67%), while the ACL of the left knee had been reconstructed in 13 subjects (43.33%). In 25 subjects (83.33%) the dominant leg was the left one. In 14 subjects (46.67%) the ACL had been reconstructed in

the dominant side and in 16 subjects (53.33%) it had been reconstructed in the non-dominant side.

Subjects were assigned into two groups according to the executed surgical technique. Patients reconstructed with BPTB graft are considered as (Group A), while those constructed with ST graft as (Group B). Both groups have received an accelerated rehabilitation program modified from the one designed by shellbourne et al. (1997)[16]. All subjects signed an informed consent form prior participating in the study. The data collected post the rehabilitative program from the score of the new designed rating system will be statistically analyzed using student paired t-test to compare between the sound and affected leg and between the two experimental groups.

Table (1): General characteristics of subjects in the study.

General characteristics		Number of Subjects	
		Group A	Group B
Sex	Male	14	14
	Female	1	1
Age	Min	17	19
	Max	33	33
Dominant leg	Rt.	13	12
	Lt.	2	3
Reconstructed leg	Rt.	10	7
	Lt.	5	8
Similarity between reconstructed & dominant leg	Reconstructed leg is the dominant one	8	6
	Reconstructed leg is the non-dominant one	7	9
Sports activity	Football	12	9
	Handball	2	6
	Basketball	1	0

Inclusion Criteria

All subjects met the following criteria:

1- ACL reconstructed single knees by BPTB or ST autograft, operated by the same surgeon to eliminate the effects that may result from individual variations in the surgical technique.
2- Age between 17 – 33 years.
3- Athletes.

Exclusion Criteria:

Subjects were excluded from the study for any of the following reasons:

1- Pervious knee injury, or general illness.
2- Meniscal tears.
3- Grade III collateral ligament damage.
4- Marked osteoarthritis.
5- Any symptoms in the contralateral limb.
6- Any associated hip, ankle or foot diseases.
7- Medial or lateral laxity.
8- Any history of neurological disease.
9- Any leg length discrepancies.

Instrumentation:

I- KT-1000 knee ligament arthrometer with a manual force of 15 Lb F (67N), 20 Lb F (89N) and 30 Lb F (143N). It measures the AP laxity (Medmetric Inc., San Diego, CA). Presence of laxity is detected through hearing audible beeps, also maximum

displacement can be tested by examiner's hand.

II- Evaluation of muscle power using the Biodex Dynamometer It is a dynamometer provided with a bench and computer system. It provides different modes for evaluative and therapeutic purposes as it offers isometric, isometric fatigue, isokinetic, isokinetic fatigue, isotonic and isotonic fatigue modes.

First, all data about the subject was supplied (name, age, sex, height, weight, dominance, diagnosis, evaluated joint and mode of muscle contraction).

Only eccentric / concentric isokinetic peak torque for the hamstrings and quadriceps muscles at low and high angular velocities were taken.The test was repeated three times. Then, print test results regarding the goal of the test and put the relative score as indicated in the new scale.

III- Universal goinometer to evaluate knee joint range of motion (ROM)

- 360 degrees circle.
- Fixed arm, correlates with motion of the vector.

IV- Ordinary tape measure: to measure thigh girth at different levels:

- Flexible, 150 cm long.
- Marked with 1/10 cm.b

V- Balance and Rocking Boards.

VI- Stationary Bicycle.

VII- Sand Bags with different weights.

Protocol of Measuring the Anteroposterior Knee Laxity Using KT-1000 Arthrometer

1- Patient position

Supine lying position hands on chest. The thigh support platform was positioned just above the level of the superior pole of patella. The foot support platform was positioned just below the lateral malleolus.

2- Arthrometer position

The patellar sensor pad was placed even with the inferior pole of patella. The tibial tubrcle sensor pad was positioned even with the tibial tubercle. The proximal velcro strap was tightened just below tibial tuberosity. The distal velcro strap was tighten just above the malleoli.

3- Measuring procedures of knee laxity

The quadriceps muscle was relaxed then, the examiner stood beside the tested knee so that a constant firm pressure be applied to the patellar sensor pad by the proximal hand which was maintained throughout the test to avoid variation of pressure which will alter the position of the patellar sensor pad secondary to soft tissue and cartillage compression and will result in inaccurate measurement (Figure 1). Giving a posterior load of a 20 pound then release repeating several times, then a 20 pound posterior force was applied and hence, the displacement reading denoted the actual Antero-posterior laxity. The posterior force was released and the dial returned to 0 ± 0.5 mm. A manual force applied anterior to the end of anterior displacement as indicated by the device. The test cycle was repeated three successive times and the mean was recorded and scored.

Fig. (1): Position during measuring knee laxity.

Protocol of Measuring Hamstrings and Quadriceps Isokinetic Peak Torque

Testing procedures

The limb was taken manually through the R.O.M to check the alignment and subject stabilization. E/C mode was adjusted at 60 deg/ sec and at 120 deg/sec respectively (Figure 2). Data was saved after 3 repetitions. Testing of the involved knee was conducted after that of the uninvolved one for bilateral comparison and scoring.

Fig. (2): Isokinetic testing with E/C mode.

Functional Assessment of the knee

The sensitivity of previous rating scales when compared with each other uncovered the fact that some functional scales were sensitive to documenting clinical examination at one follow up while others to changes overtime. Hence, the need to obtain a confidential rating system containing as many variables as we can. So, the presence of these variables necessitates to be classified and organized to allow the future research to develop it to the objectivity as much as possible.

The newly designed rating system

(A) Subjective assessment: (100 points) (Appendix I)

1- Knee symptoms:	Pain	(20)
	Swelling	(10)
	Giving way	(20)
2- Functional tests:	Overall activity level	(10)
	Walking	(10)
	Stairs	(10)
3- Performance tests: (**Subjective**)		
a- Single leg support activities:		(5)
	Side step up test	
	Single mini squat test	
b- Double leg support activities:		(5)
	Parallel squat position test	
	Inclined squat position test	
c- Swing activities	It includes	(10)

(Straight jog, backward jog, jog and cut, jog and stop, zigzag, cariocas, figure of 8 run, 100m run, controlled leap and shuttle run)

(B) Objective assessment: (100 points) (Appendix II)

1- Performance tests (objective):

Hopping criteria	(40)

It includes one leg hop for a distance, vertical jump, timed hop, triple hop, cross over hop for a distance, rope hop, stair hopple and side jump.

2- Clinical examination:

Anterior knee laxity	(5)
Thigh girth at 15 cm	(5)
Thigh girth at 22.5 cm	(5)
Range of knee joint motion	(5)

3- Isokinetic testing:

Dynamic hamstrings quadriceps ratio (DHQR) at 60°/sec	(20)
Dynamic hamstrings quadriceps ratio (DHQR) at 120°/sec	(20)

The maximum total score of this scale is 200. Asymmetry index for all variables is evaluated by dividing the mean of the involved limb by the mean of non involved limb and the result is multiplied by 100.

This scale is composed of three grading levels:

I- Athletic level:

a- Excellent: Scoring in above 182 point.

b- Good: scoring is above 164 to 180 points.

II- Normal performance level:

a- Fair: Scoring is above 146 to 162 points.

b- Functional: Scoring is above 120 to 144 points.

III- Poor performance level:

The (noncopers) can be subgraded to the following subgrades:

a- Dysfunctional: Scoring is above 98 to 118 points.

b- Morbid: Scoring is equal to or below 98.

Measurement procedures

Personal data (name, sex, age, address, telephone, occupation, sports activity, dominant leg, operated leg and date of reconstruction) were taken at first, one week post operatively before starting physiotherapy program.

Measurement of knee laxity

Using the KT 1000 arthrometer to determine the side to side difference of knee laxity. It measured laxity in (mm). Measurements was taken three times and the mean was taken.

Measurement of thigh girth

Using an ordinary measuring tape to detect any atrophy of muscles surrounding the knee. Measurements were taken as mentioned previously from center of patella at 15 cm and at 22.5 cm.

Range of motion of knee

Complete flexion and extension were measured from supine lying position by a universal goniometer as the axis of it corresponds with knee joint line.

Measurement of muscle strength

Using isokinetic testing with eccentric concentric mode of contraction with the patient in upright sitting position as mentioned previously.

Performance based measurements

I- Two-leg tests

1) Vertical jump test:

The subject stood one foot length away from the wall, bending down to knee flexion of 80 – 90 and jumped vertically. The test was performed three times and the highest jump was chosen. The therapist mark on the wall with a pen each trial. The distance from the floor to the pen marking was measured in cm.

2) Figure-of-Eight test

The subject ran two circles of 4m diameters each, repeating three times. The time was recorded in seconds.

3) Bilateral parallel squat

The subject bent his knees to an acute angle, maintaining back straight and maintained the position as much as he could. The test examined the state of patello femoral joint.

II- One leg tests

1) Stair hopple test

The subject jumped up and down 22 steps on a stair case (each step 17-5 cm high) with the uninvolved then, the involved leg and the time difference was measured between them.

2) One-leg hop for a distance

The subject jumped on the same limb (taking off and landing). The quotient between the affected limb and normal limb was recorded and scored. Borsa et al. (1997)[2] stated that there is a positive correlation between proprioceptive input and one leg hop for a distance.

3) One leg hop for time

The time passed to jump a long a straight line of 6 meters was calculated and scored for the uninvolved then the involved leg.

4) Triple hop for distance

The distance hopped for three consecutive hops was measured. The mean values and limb symmetry index were calculated. Both stair hopple and triple hop for distance examined the degree of instability which correlated well with results of the KT-1000 knee arthrometer, also atrophy was better reflected by the triple hop test as it provides an assessment of functional stability of the involved leg.

5) Cross-over hop for distance

The subject hopped three consecutive times on one foot, crossing over the center strip extended 6 meters and consisted of a 15 cm markings. The total distance hopped was calculated as previously described.

6) Sid jump test

The subject jumped on the uninvolved then the involved leg over two straight lines of 6m long and 30cm width in between where ten marks were made on the outside of one line at 60cm intervals. The time in seconds was measured and the difference between the two legs was recorded.

7) Controlled leap

It examined force absorption. Leaping is the projection of the body from one limb onto the other. The controlled leaping distance onto one limb when divided by the maximal hopping distance of the opposite limb, and multiplied by 100, produced the stop to stop ratio. When normal subjects could execute a controlled leap covering a distance equal to 195% of the maximal hopping distance of the contralateral limb, this meant that they had maximal force absorption[9].

Description of Treatment Procedures

The accelerated rehabilitation program was conducted to both groups as they received 6 sessions per week for a period of 12 weeks. The modified Shellbourene program was selected and applied. Therefore, measurements of dynamic knee stability could taken.

Accelerated Physiotherapy Program

The following program was applied to both groups, A and B, as following:

2nd week postoperatively.

- **Full hyperextension exercises**

i- Heel prop exercise.

ii- Prone Hang exercise.

iii- Hamstring stretching exercise.

Flexion to 110 degrees was achieved through:

a- Wall slide exercise.

b- Heel slide exercise.

c- Hamstring curl exercise.

d- Multiple-Angle hamstring isometric exercise.

Quadriceps muscle leg control exercises:

a- Quadriceps setting exercise.

b- Straight leg raising (SLR) exercises (Flextion, abduction, adduction and extension).

I- Flexion leg raising exercise.

II- Abduction leg raising exercise.

III- Adduction leg raising exercise.

IV- Extension leg raising exercise.

c- Short-Arc Quadriceps muscle exercise.

d- Quadriceps isometric exercise with the knee at 90 degrees.

- **Gait Training**

In the first 2 weeks postoperatively, subjects ambulated using two elbow crutches until they could resume a normal gait pattern. Being less stressful to the ACL, heel-to-toe pattern is more preferable than toe-touch gait pattern[12].

Weeks 3-5 post operative

Full knee range of motion was conducted:

a- Continued heel slide exercise.

b- Exercise on a stationary bicycle.

c- Kneeling stretch.

- Normal gait pattern was gradually achieved

Subjects ambulated with one crutch held in the uninvolved side of the reconstructed knee for the 2nd 2 weeks postoperatively till the end of 4th week.

- Muscle strength enhancement

a- Resisted SLR exercises

i- Resisted flexion raising exercise.

ii- Resisted abduction leg raising exercise.

iii- Resisted adduction leg raising exercise.

iv- Resisted extension leg raising exercise.

b- Resisted short arc quadriceps muscle exercise.

c- Resisted hamstring curl exercise.

Just proximal to the ankle, a 1 Lb weight was added to the lower leg as operated in hamstring curl exercise.

Activities of daily living:

Closed kinetic chain (CKC) activities involved in walking running and jumping.

a- Self assisted step up exercise.

b- Double legged mini squat exercise.

c- Double legged calf raise exercise.

Weeks 6-12 post operatively

It included all pervious exercises in addition to:

1) Step up exercise

It was performed as mentioned previously but avoiding pushing of the uninvolved foot.

2) Single legged mini squat exercise
3) Single legged calf raise exercise
4) Exercise on a stationary bicycle
5) Light jogging exercise
6) Agility training

Dynamic Joint control training

a- Foot fists.

b- Anteroposterior rolling movement from sitting.

c- Multidirectional rolling movement from sitting.
d- Double leg standing on the rocking board.
e- Double leg standing on the balance board.
f- Single leg standing on the rocking board.
g- Single leg standing on the balance boar.

RESULTS

Results of the newly designed rating scale

Group A:

The mean value of symptoms score was 46.67±3.9. It was ranged from 40-65. The mean value of "Functional tests" score was 27.73±2.25. It was ranged from 24-30. The mean value of "performance tests" score was 53.73±3.05. It was ranged from 48.2-57. The mean value of "Clinical Examination" score was 17.56±1.56. It was ranged from 14.2-19.7. The mean value of "Isokinetic tests" score was 35.5±2.31. It was ranged from 30.6-38.6. The mean value of "general score" scale was 179.92±11.13. It was ranged from 159.5-192.

Group B:

The mean value of symptoms score was 47.73±3.77. It was ranged from 42-56. The mean value of "Functional tests" score was 27.6±1.72. It was ranged from 24-30. The mean value of "performance tests" score was 53.52±3.43. It was ranged from 48.4-58.3. The mean value of "Clinical Examination" score was 16.94±1.72. It was ranged from 14-18.7. The mean value of "Isokinetic tests" score was 35.54±3.61. It was ranged from 28.6-40. The mean value of "general score" scale was 181.33±12.86. It was ranged from 159.3-196.4.

Comparative analysis of the newly designed rating system applied on studied groups

There is no significant difference between the mean values of "symptoms" score of both studied groups (t= 0.76 and P= 0.45). The mean values of "Functional tests" score show no significant difference (t= 0.18 and P=0.85). The mean values of "performance tests" score show significant difference between the studied groups (t= .17 and P= .86). As sown also, there are no significant differences between the mean values of "Clinical Examination" (t= 1.03 and P= .31)., "Isokinetic tests" (t= .22 and P= .82). and "general score" (t= .32 and P= .75), scale of group "A" and group "B" as shown in table (2) and figure (3).

Table (2): The Newly designed rating system applied on studied groups.

	Symptoms		Functional tests		Performance tests		Clinical examination		Isokinetic testing		General score	
	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
Mean	46.67	47.73	27.73	27.6	53.73	53.52	17.56	16.94	35.3	35.54	179.92	181.33
SD	3.9	3.77	2.25	1.72	3.05	3.43	1.56	1.72	2.31	3.61	11.13	12.86
SEM	1.01	0.97	0.58	0.45	0.79	0.89	0.4	0.44	0.6	0.93	2.87	3.32
Mini	40	42	24	24	48.2	48.4	14.2	14	30.6	28.6	159.5	159.3
Maxi	56	56	30	30	57	58.3	19.7	18.7	38.6	40	192	196.4
t-value		0.76		0.18		0.17		1.03		0.22		0.32
P		0.45		0.85		0.86		0.31		0.82		0.75
Sig.		NS		NS		NS		NS		NS		NS

SD = Standard Deviation SEM = Standard Error of Mean t-value = Student t-test
P = Probability Sig. = Significance

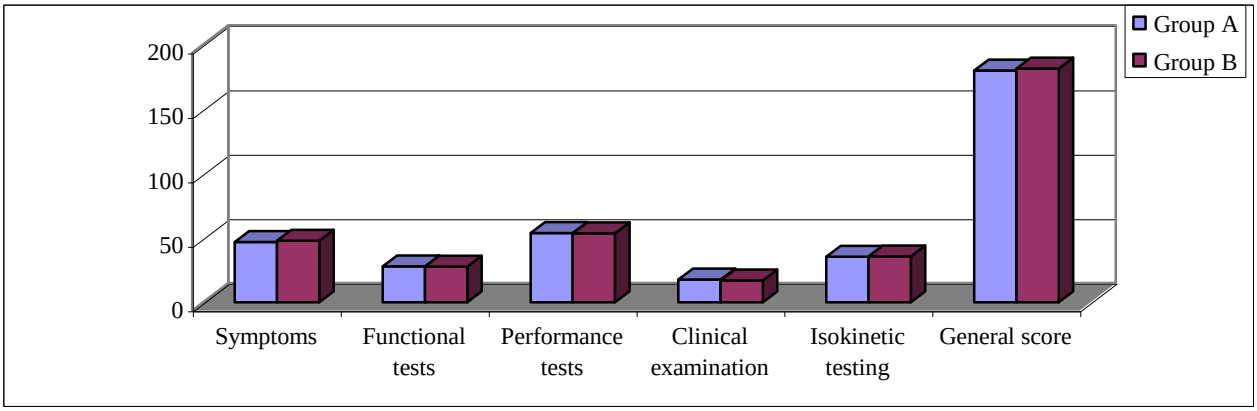

Fig. (3): The Newly designed rating system applied on studied groups.

DISCUSSION

This study was designed to clarify the effect of selected exercise program on dynamic stability of the knee after ACL reconstruction using two different surgical technique. Thirty patients were included in the study according to specific criteria as 15 subjects were reconstructed with BPTB graft, while the others with ST autografts. Both groups have administered the same accelerated physiotherapy program of shellbourne for three months and measurements were taken afterwards. A newly designed rating system of subjective and objective components was designed and at the end, each subject was given a descriptive grade according to the obtained score.

Results of this study substantiate the similarities found in previous literatures that documented presence of good results after ACL reconstruction using either patellar tendon or semitendinosus autografts as generally, the aim of ACL reconstruction is to decrease symptoms, improve function and rapid return of subjects to their pre injury level.

Nine subjects in (group A) were graded "excellent", four subjects as "good" and two subjects as "fair". On the other, ten subjects had "excellent", three had "good" and two had "fair" in (group B).

Thus, more than 83% of subjects in both groups reached the "Athletic level" as described in the newly designed rating system. This agrees with the findings of Anderson AF et al. (2001)[2] that more than 80% in both groups in their study returned to their pre injury level as described by the IKDC scale to be returned to pre injury level where knees function rated normal or nearly normal.

Feagin, J.A. (1985)[5], Marshal, J.F. (1977)[12], Tegner, V. (1985)[19] and Zarines, B. (1986)[20] supported that single findings which may be rated high or low, can distort the overall result. Hence, the need of this study to collect variables from published literatures, weighing them by points and giving a reasonable grade.

Findings supported some authors who contented incidence of knee pain in patients with BPTB or ST grafts as Sgaglion, N.A. (1990)[17].

In our study, stability evaluation with the KT-1000 arthrometer revealed better stability in (group A) than (group B) and better clinical examination., this is supported by the findings of Marder et al., although our study found that some variables may, to less extent, reflect better results than the others as knee laxity in group A is increased, but not significantly, on the other hand rang of motion is better in the same group.

The aim of designing a new rating scale was to achieve objective and comparable results as several scoring systems have been introduced to evaluate knee joint function after ligament injuries. Therefore, assessment of a lot of variables classified to objective and subjective parameters and arranged biomechanically could facilitate the clinical decision making process as many researchers have experienced differing results with the application of various single scoring system. Hence, the need was derived to collect as many variables as we could, and put the suitable score for each.

Moreover, some patients may obtain higher score if anterior laxity isn't considered as in cincinnati score, at the same time, the same patients may obtain poor results with Kamel S or OAK scores for example, the Cincinnati score doesn't take anterior laxity into account and therefore produces better results, especially in subjects who don't suffer subjectively from their anterior laxity. On the other hand, the Zarins and kamel SH scores allow subjects with increased anterior laxity to have fewer points in a scoring system that assesses that defect.

The diversity and differences between patient samples and findings assessed in different scoring systems reduce the credibility of rating like good or poor for a procedure outcome. Furthermore, the question arises as to whether results from scoring systems are reliable enough to make therapeutic decisions.

To minimize the errors in evaluating surgical procedures or treatment modalities according to score systems the aim has to be homogeneity of the patient sample and an agreement about the value of single findings to avoid interference factors, which inevitably lead to wrong results. Consequently patient samples should be selected prospectively.

Among others, the IKDC evaluation form is based on weighing equally all parameters and also, group qualifications are used to determine the overall results, which can't be better than the worst qualification of the first four groups of problems (subjective assessment, symptoms, range of motion and ligament examination), but, on the other hand, basing on the fact that, different patterns of detected defects lead to different result levels. Each variable in the newly designed rating system was given a suitable score depending

on its value of achieving the necessary dynamic knee stability.

Actually functional scales were designed to the athletic and non athletic subjects. So, putting levels for evaluating performance may allow the subject to understand his capabilities and what is needed and to which level he aimed to reach. As, what is needed for the athletic subject with grade "fair", isn't the same as that of the none athletic with the same grade.

From the physiological, biomechanical and functional concepts the isokinetic testing in the new scale depends on the dynamic hamstring quadriceps ratio not on the concentric\ concentric value of peak torque. Generally, sensitivity to other scales is not conducted to evaluate the reliability of that scale.

Conclusion

Dynamic knee stability did not altered after using the same accelerated rehabilitation program as described in this study after ACL reconstruction using two different surgical techniques.

Recommendation

1- Both the BPTP and ST graft proved to have the same results on dynamic stability of the knee using the accelerated rehabilitation program concerning proprioceptive training after ACL reconstruction.
2- A short term and long term follow up evaluation post ACL reconstruction with the newly designed rating system.
3- Sensitivity of the newly designed rating system to other functional rating scales at short term and long term follow up evaluation post ACL reconstruction using the same surgical technique.
4- Further controlled studies using a larger sample of both groups.

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الملخص العربي

دراسة مقارنة بين تأثير برنامج تمرينات علاجية مختار على الثبات الديناميكي لمفصل الركبة بعد عمليتين ذات تقنية مختلفة لإعادة بناء الرباط الصليبي الأمامي

هذه الدراسة قد أجريت لمعرفة ما إذا كان فرق واضح بين تأثير العلاج بالتمرينات على الثبات الديناميكي لمفصل الركبة بعد إعادة بناء الرباط الصليبي الأمامي باستخدام رقعة من الشخص نفسه مأخوذة من الوتر الصابوني للعضلات الرباعية في مجموعة ومن وتر العضلة نصف الوترية في مجموعة أخرى . قد تم باستخدام برنامج علاج طبيعي معجل مراعى فيه تمرينات مستقبلات الحسية العميقة بعد إعادة بناء الرباط الصليبي الأمامي باستخدام هاتين التقنيتين الجراحتين السابقتين وأخذ النتائج بعد ثلاثة أشهر هي مدة البرنامج التأهيلي .

وقد اشتملت هذه الدراسة على عينة مكونة من ثلاثين رياضياً أجريت لهم عملية بناء الرباط الصليبي الأمامي بواسطة جراح واحد وقد تراوحت أعمار الأشخاص المشتركين في هذه الدراسة بين 17-33 عاماً .

وقد تم التأكد من خلو هؤلاء الأشخاص من إصابات من الدرجة الثالثة بالأربطة الجانبية ، أو أي قطع بالغضاريف أو خشونة بمفصل الركبة أو أية مشاكل بمفاصل الفخذ أو الكاحل أو القدم أو أي تاريخ سابق لأية اضطرابات عصبية بالطرفين السفليين .

وقد تم تقسيم الأشخاص عشوائياً إلى مجموعتين (أ ، ب) حيث تلقت المجموعتان برنامج علاجي واحد وبعد الانتهاء تم أخذ النتائج باستخدام نظام قياسي حديث التصميم . وذلك لتقييم وظائف مفصل الركبة المعاد فيها بناء الرباط الصليبي الأمامي بنظريتها السليمة ، ويعتمد هذا النظام على مقياسين أولهما يختص بجمع معلومات القياسية باستخدام أجهزة القياس . وفي النهاية وضع درجات تبعاً للنقاط التي حصل عليها كل شخص .

وقد اتضح بعد تقييم النتائج بأن عدد الأشخاص الذين حصلوا على درجة الامتياز . بالمجموعة الأولى هم تسعة أشخاص نظير عشرة في المجموعة الثانية ، وعدد أربعة أشخاص على تقدير "أفضل" في المجموعة الأولى نظير ثلاثة أشخاص بالمجموعة الثانية ، وشخصان على تقدير "مرضي" بالمجموعة الأولى نظير شخصان أيضاً بالمجموعة الثانية .

وبالتالي فإن نتائج البحث قد أظهرت عدم وجود فروق ذات دلالة إحصائية بين الثبات الديناميكي للركبة في المجموعتين بالرغم من وجود بعض التباين الطفيف في نتائج بعض التغيرات .

والجديد في هذا البحث هو وضع نظام قياسي حديث التصميم يحتوي على متغيرات أكثر من السابق ذكرها في مقاييس أخرى مثل مقياس "ليسهولم" أو "IKDC" أو مقياس "تجنر" ، ذلك بالإضافة إلى تصنيف تلك المتغيرات تبعاً لقواعد الميكانيكا الحيوية .

وأيضاً تم وضع تصنيف لمستوى الأشخاص إلى ثلاثة مستويات وهي :

١ - المستوى الرياضي .

٢ - المستوى الطبيعي .

٣ - المستوى ضعيف الأداء .

والغرض من وضع تلك المستويات هو تحديد الهدف طويل الأمد وأقصى ثبات للركبة حيث لا يستوي ذلك الهدف بين الشخص الرياضي من دونه .