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CORE STABILIZATION EXERCISES AFTER ACL RECONSTRUCTION SURGERY PROVIDES BETTER OUTCOMES: A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Background: Decreased core stability displaces center of gravity away from base of support reducing activity participation of athlete. Present study was conducted to study the effect of core stabilization exercises after reconstruction surgery of ACL on functional outcomes.

Methods: 30 subjects following 5 months of ACL reconstruction were randomly assigned to either group that performed (study group) or did not performed (control group) additional core stabilization exercises in conjugation with standard rehabilitation protocol. Outcome measures were: activity level using Tegner activity level scale and functional performance using triple hop test. Outcome measures were compared at day 1 and day 42 of the treatment.

Result: Significant improvement was seen in the study group for Tegner score with mean difference changing from 4.5 to 1.5 from day 1 to day 42 of treatment ($p=0.039$) while the control group showed improvement in mean difference changing from 3.8 to 1.4 ($p=.045$) from day 1 to day 42 of treatment. Highly significant improvement was seen in the study group for triple hop test with mean difference changing from 25 to 6.7 ($p<.001$) compared to the control group with mean difference changing from 15.2 to 9.7 ($p=.005$) from day 1 to day 42 of treatment.

Conclusions: Both the groups showed improvement for activity level and functional performance but highly significant improvement was seen in the study group for functional performance. Core stabilization exercises in conjugation with the standard ACL rehabilitation protocol results better improvement in the triple hop test.

Keywords: ACL rehabilitation, Core-stabilization, Activity level, Functional performance.

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INTRODUCTION

Return to play following ACL reconstruction is of significant concern amongst athletes following injury.¹ A return to pre-injury level of sport represents most strong assessment of activity level outcome after ACL reconstruction.² Athletes typically receive clearance to return to sport after ACL reconstruction surgery around 6 to 12 months post operatively and most are expected to return to sport within 12 months after surgery.³ It has been proved that 67% of athletes after ACL reconstruction surgery had returned to some form of sports activity participation and 33% of athletes had attempted to play competitive sport at their pre-injury level at a mean of 13 months post-operatively.²

Core stability programs are being increasingly used for sports conditioning. Greater core stability benefits sports performance by providing greater force production in upper and lower extremity. Core exercises increases sensitivity of muscle spindles resulting in higher state of readiness to respond to forces applied to joint resulting in enhanced performance in sports.^{4,5} Rehabilitation protocol for athletes following ACL reconstruction includes routine exercises including range of motion and strengthening exercises with lesser stress placed on core stability exercises.⁶ The present study was conducted to study the effect of core stabilization exercises after reconstruction surgery of ACL on functional outcomes.

MATERIALS AND METHODS

The study was approved by Ethics cum Research committee of Mother Teresa Saket College of Physiotherapy, Panchkula, Haryana, India. A randomized controlled trial was conducted on 30 elite sports persons of level 1 sport for 6 week duration. Both males and females with age group of 15-35 year following 5 months of ACL reconstruction surgery having full knee range of

motion and stable graft on KT1000 arthrometer were included in the study. Subjects with upper motor neuron/ lower motor neuron lesion, prolapsed intervertebral disc, knee osteoarthritis, any pathology of lower extremity, previous knee surgery, history of heart/ lung disease or patellofemoral joint irritation were excluded from study. Subjects were randomly divided into 2 groups with 15 subjects each by convenient random sampling method. The subjects were divided into group A (Control group) and group B (Study group). On the first day of treatment, all the subjects were asked to fill Tegner activity level scale. Assessment for functional performance was done using triple hop test. Final assessment was done on day 42 of treatment.

Group A (Control group): Subjects in this group received conventional rehabilitation protocol. Exercises in this group included active knee range of motion exercises, quadriceps isometrics, hamstring isometrics, straight leg raising exercises, wall slides (0-90⁰), single leg squat and mini squat (0-30⁰) with bars. Each exercise was done with 10 repetitions per set and 3 sets per session for 5 times a week for 6 weeks duration.⁶

Group B (Study group): Subjects in this group received core stabilization exercises in conjugation with standard ACL rehabilitation protocol. Core stabilization exercises were divided into 3 stages with each stage lasting for 2 weeks. Core stabilization exercises consisted of static and dynamic exercises. Table 1 shows performed progressive core stabilization exercises.⁷

Each exercise was done with 10 repetitions per set and 3 sets per session. Dynamic exercises were done with 8 sec hold and 5 sec rest period. Static exercises consisted of 10 sec hold and 5 sec rest period. Abdominal drawing in maneuver was performed in conjunction with each dynamic exercise.

Table 1: Core stabilization exercises for Group B

Stage	Static Exercises	Dynamic Exercises
STAGE 1 (2 WEEKS)	<ol style="list-style-type: none"> 1. Abdominal tuck in in crook lying position 2. Abdominal tuck in in sitting position 3. Abdominal tuck in in quadruped position 	<ol style="list-style-type: none"> 1. Bridging on floor 2. Bird dog exercise in quadruped position 3. Abdominal crunches on floor (hands behind head)
STAGE 2 (2 WEEKS)	Abdominal tuck in in sitting position	<ol style="list-style-type: none"> 1. Bridging on Swiss ball without leg raise 2. Wall squats with Swiss ball 3. Abdominal crunches on Swiss ball(hand over chest)
STAGE 3 (2 WEEKS)	Abdominal tuck in in standing position	<ol style="list-style-type: none"> 1. Bridging on Swiss ball with leg raise 2. Bird dog exercise on Swiss ball 3. Abdominal crunches on Swiss ball. (hands behind head)

Outcome Measures

Activity Level: Tegner activity level scale was used to measure activity level. It is a graduated list of activities of daily living, recreation, and competitive sports. It is a numerical scale ranging from 0 to 10. An activity level of 10 corresponds to participation in competitive sports at national level. Activity level of 6 indicated participation in recreational sports while 0 level was assigned if person was on sick leave because of knee problem. Patient was asked to select the level of participation that best describes their current level of activity and that before injury.⁸

Functional Performance

Triple Hop Test: Patient was made to stand on a marked line and was then asked to take three long hop/ jump on one leg while landing on the same leg. Distance covered was measured and the test was repeated for opposite leg. Patient was made to repeat this test 3 times on each leg alternating sides and the average of all three hops was taken for each leg.⁹

Analysis of data collection of triple hop test and Tegner activity level scale of 30 subjects was done by suitable statistical tests by using SPSS software 17.0 version.

RESULTS

Both the groups were matched for age. There were 20% females in control group and 6.7% females in study group. Table 2 shows gender and mean age of both the groups.

Table 2: Mean age and percentage of males and females in Group A and Group B

Group	N	Mean Age	Female % Within Group	Male % Within Group
A	15	24.33	20%	80%
B	15	23.80	6.7%	93.3%

Changes in Tegner activity level score showed improvement in study group with mean difference improving from 4.5 to 1.5 as compared to control group with mean difference changing from 3.8 to 1.4 from day 1 to day 42 of treatment. Table 4 shows mean change in activity level for both the groups. Significant improvement was seen in study group for activity level at day 42 of treatment with mean change in activity level of 3 ($p=.036$) compared to control group with mean change in activity level of 2.4 ($p=.045$). Table 5 compares the changes in activity level for both the groups.

Table 3: Comparison of mean, standard deviation and p-value for activity level of Group A and Group B from day 1 to day 42 of treatment

MEAN CHANGE IN ACTIVITY LEVEL					
GROUP	N	Mean	Std. deviation	Std. error mean	P value
A	15	2.4000	.82808	.21381	.045
B	15	3.0000	.65465	.16903	.039

Improvement in both the groups in triple hop test for mean difference between day 1 and day 42 of treatment was 5.49 and 18.36 in group A and group B respectively. Highly significant improvement was seen in study group ($p<.001$) and a significant improvement was seen in control group ($p=.005$) at day 42 of the treatment. Table 4 compares mean difference for both the groups.

Table 4: Comparison of mean, standard deviation and p-value for triple hop test of Group A and Group B from day 1 to day 42 of treatment

Mean Change in Distance for Triple Hop Test					
GROUP	N	Mean	Std. deviation	Std. error mean	P value
A	15	5.49	6.36480	1.643	.005
B	15	18.36	8.42681	2.175	<.001

DISCUSSION

Core stability is product of motor control and muscular capacity of lumbo-pelvic hip complex. Ben kibler et al¹⁰ studied the role of core stability in athletic function. It was found that core stability results in proximal stability for distal mobility by creating interactive moments that move and protect distal joints. They observed that core activation results in anticipatory postural adjustments which help the body to withstand balance when forces are created during kicking, throwing or running activities. Thus, core activation was thought to create proximal stability for distal mobility improving performance level of athletes. Their study concluded that rehabilitation programs should not only include restoring core but also include core as base for extremity function. In the current study, functional performance of athletes following ACL reconstruction surgery was improved when standard ACL rehabilitation protocol was applied in conjugation with core stabilization protocol.

Kulandaivelan et al¹¹ found that progressive core stabilization exercises of 6 weeks duration increases strength and endurance of core muscles.

Exercises progressed from training isolated muscles to integrated system of muscles in order to facilitate functional activity. They found that 6 weeks program induces hypertrophy of Transverse Abdominis and Multifidus. This results in 70% of maximum voluntary contraction of core muscles promoting strength in abdominal muscles. Kelly et al¹² found that swiss ball exercises successfully recruit wide range of core musculature including local and global stabilizers and global mobilizers for improving core stability. The present study thus utilizes 6 weeks of core stabilization protocol following ACL reconstruction for improving functional performance in conjugation with the standard ACL rehabilitation protocol.

Nicholas et al⁹ observed that outcome measures utilized following ACL reconstruction surgery currently includes functional performance test namely hop test, jump, sprint and agility test. They further observed that interclass correlation coefficient (ICC) for triple leg hop test was 0.90 making it highly reliable and valid test for measuring functional performance in ACL reconstructed knee. It was concluded that functional performance tests namely single leg hop test, triple hop test and stair hop test has the potential to yield valuable information to clinician regarding athlete's status following knee ligament injury. The present study utilizes triple hop test for measuring functional performance in athletes following ACL reconstruction surgery.

Activity participation is important for establishing outcome for ACL reconstructed subjects. Nick Caplan et al¹³ found that many activity scales such as Lysholm scale and Function Elements of Knee Society Rating Scale evaluates patients ability to perform typical activity of daily living without any indication of patient's prior involvement in more demanding recreational and competitive sports. They found that tagnar activity scale allows clinician to evaluate success of clinical intervention in terms of whether patient is able to return to its pre-injury activity level. Tagnar activity rating scale was designed to complement other functional scores for patients with ligament injuries. Brigg et al¹⁴ found that tagnar scale have accepted test-retest reliability and did not show floor or ceiling effects. The present study utilizes tagnar activity level scale for assessing activity level in patients who performed or did not performed additional core stabilization exercises following ACL reconstruction.

The limitation of the present study is small sample size. Furthermore, the duration of this study is short. Final follow up was at 6th week due to logistic

reason as the study was part of a dissertation. However, the advantage of the present study is that it gives a clue that adding core stabilization exercises in ACL reconstruction rehabilitation protocol can result in better functional performance. Future studies should be performed with larger sample size and long follow up to further strengthen our observations.

CONCLUSION

The present study concluded that the core stabilization exercises in conjugation with standard ACL rehabilitation protocol results better improvement in triple hop test as well as Tagnar activity level score. Performance of players with ACL reconstructed knee can thus be increased by adding core stabilization exercise in standard rehabilitation protocol.

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Appendix: Master chart

SUBJECT CODE	AGE	GENDER	TEGNAR ACTIVITY LEVEL SCORE						TRIPLE HOP TEST					
			DAY 1			DAY 2			DAY 1			DAY 2		
			BEFORE	AFTER	DIFFERENCE	BEFORE	AFTER	DIFFERENCE	INVOLVED	UNINVOLVED	DIFFERENCE	INVOLVED	UNINVOLVED	DIFFERENCE
A1	30	M	6	4	2	6	5	1	42	69	27	78	98	20
B1	28	M	6	2	4	6	5	1	59	80	21	88	99	11
A2	19	M	7	4	3	7	6	1	34	62	28	55	70	15
B2	20	M	7	4	3	7	6	1	103	130	27	129.1	133	3.9
A3	21	M	6	2	4	6	5	1	40	56.1	16.1	54	68	14
B3	22	M	9	4	5	9	8	1	157	207	50	191.5	209.5	18
A4	32	M	7	4	3	7	6	1	94	102.5	8.5	105	112	7
B4	24	M	9	4	5	9	6	3	132	146	14	150	152	2
A5	35	M	7	3	4	7	6	1	64	84.5	20.5	70	89	19
B5	29	M	10	4	6	10	8	2	128	142	14	151	152	1
A6	24	M	7	4	3	7	6	1	48	60	12	62	72	10
B6	21	M	10	4	6	10	7	3	98	109	11	129.8	132	2.2
A7	25	M	8	4	4	8	5	3	101	115	14	111	118	7
B7	23	M	6	2	4	6	5	1	99.8	138	38.2	126	139	13
A8	21	M	6	4	2	6	5	1	126	138	12	141	150	9
B8	24	M	7	3	4	7	6	1	88	110	22	100.2	111.2	11
A9	28	M	6	2	4	6	5	1	97	112	15	120	128	8
B9	24	M	10	6	4	10	9	1	82	114	32	106.9	115.8	8.9
A10	26	M	6	2	4	6	5	1	61	85	24	90	89	1
B10	25	M	10	5	5	10	8	2	88	128	40	112	128	16
A11	16	F	6	4	2	6	7	1	92	100	8	121	128	7
B11	22	M	9	5	4	9	8	1	123	151.9	28.9	149.5	153	3.5
A12	20	M	10	2	8	10	5	5	126	138	12	139	148	9
B12	21	M	9	4	5	9	7	2	132	146	14	151	152	1
A13	21	F	6	4	2	6	7	1	82	92	10	91	100.2	9.2
B13	31	M	10	4	6	10	8	2	102.5	107.5	5	117	115	2
A14	32	F	9	5	4	9	8	1	98	109	11	109.5	118.5	9
B14	26	M	9	6	3	9	8	1	108	142	34	148	150	2
A15	24	M	10	5	5	10	8	2	148	158	10	235	238.5	3.5
B15	17	F	6	2	4	6	5	1	21	46	25	45.8	55	9.2

	MEAN AGE	TEGNAR ACTIVITY LEVEL MEAN DIFFERENCE DAY 1	TEGNAR ACTIVITY LEVEL MEAN DIFFERENCE DAY 2	TRIPLE HOP TEST MEAN DIFFERENCE DAY 1	TRIPLE HOP TEST MEAN DIFFERENCE DAY 2
Group A	24.33	3.80	1.40	15.20	9.71
Group B	23.80	4.53	1.53	25.07	6.71

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