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THE EFFECT OF 4 WEEKS CORE STABILITY EXERCISE ON THE DYNAMIC BALANCE AMONG CRICKET PLAYERS

Sports Science

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ABSTRACT

Objective: Dynamic balance is an integral part of any sports especially cricket, which is least, utilized. Core stability training is considered to improve dynamic balance and this study aims to determine the effects of core stability exercise on dynamic balance using by Star Excursion Balance Test (SEBT) and abdominal muscle performance by Double Leg Lowering Test (DLLT) among cricket players.

Methods: This repeated measure study was conducted on 66 cricket players in the study aged 18 to 25 years who were randomized in to two groups: experimental (n=33) and control group (n=33). The experimental group participants were given progressive core stability training which was progressed every week for duration of 4 weeks. Both the experimental and control groups were allowed to follow their normal playing and training schedule. Dynamic Balance and core muscle performance outcomes were measured pre on day 1 and post intervention on day 7, day 14, day 21 and day 28, using Star Excursion Balance Test (SEBT) and Double Limb Lowering Test (DLLT). Repeated measures ANOVA was used to compare the means of SEBT and DLLT measures at five time periods –baseline, end of 1st week, end of 2nd Week, end of 3rd week and end of 4th Week between the groups. Post hoc analysis with Bonferroni correction was used if ANOVA results were statistically significant. Results were considered to be significant at $p<0.05$ and confidence interval was set at 95 %.

Results: Statistically significant results were observed between groups for DLLT ($p<0.01$), Right Anterior ($p=0.02$) and Left Medial ($p=0.01$) directions in SEBT.

Conclusion: From the results of the present study, it can be concluded that core stability exercises for 4 weeks duration progressed every week improves core muscle performance as compared to the regular training as measured using DLLT in University level cricket players. However, dynamic balance did not show improvements as hypothesized in the core stability group in all directions. Hence, it can be concluded that core exercise can be of significance in improving core muscle performance which in turn can prevent injury and improve athletic performance.

KEYWORDS

Core stability, Dynamic balance, Star Excursion Balance Test, Double Limb Lowering Test, Cricket

INTRODUCTION

There are five skills in cricket i.e. batting, fast bowling, spin bowling, wicket keeping, and fielding and their movement patterns involve walking, jogging, running, and sprinting (Petersen CJ et al 2010). It has been known that there is a direct correlation of lower limb injuries to dynamic balance but the relation of core muscle activation, stabilization and strength with dynamic balance is not known. In fact, core strength training aims to target all the muscles groups that stabilize the spine and pelvis. It's these muscle groups that are critical for the transfer of energy from large to small body parts during many sporting activities (Faries M D, Greenwood M 2007). The local system is responsible for segmental spine stability while the global system is responsible for isometric and isotonic contraction in the spine. Both of these regions play a role not only in daily and athletic movement but also potentially in injury prevention. The strength, endurance and neuromuscular control of these muscles is important for stability of the spine (Akuthota et al 2008). Implementation of core stability also increased control of center of mass. As the center of mass moves away from the base of support, there is an increased potential for biomechanical deviations to occur in the lower extremity (Kibler WB et al 2006, Kreighbaum, E., & Barthels, K. M. 1985, Bliss LS, Teeple P. 2005, Barr et al. 2007). Training the core muscles especially has been hypothesized as an improvement program, further investigation on a core stability program's effect on balance is therefore needed in an effort to provide a balance maintenance program (Faries M D, Greenwood M 2007). Dynamic balance is the ability to maintain stability while in motion or in movement of the body or part of the body from one point to another and in maintaining stability (Bressel et al. 2007). It has been said that "Proximal stability is important for distal mobility"; weak Trunk muscles lead to overcompensation by pelvic or lower limb which will predispose to chronic injuries (Akuthota et al. 2008, Panjabi M et al. 1989). So, the core stability can be important in the balance, physical activity and performance. Unstable or weak core can also lead to lower body injuries and weak of the balance during the performance. "Balance comes from core; strong core equals good balance" (Faries M D, Greenwood M 2007). Due to scanty literature on the effects of core stability training in cricket players, this present study aims to determine how core stability can be of significance in improving dynamic balance among university level cricket players.

METHODS

The list of cricket players from Veer Narmad South Gujarat University were obtained from the respective coaches. Only male participants in the age group of 18 to 25 years and who have represented University level at least once were included in the study. Participants with any history of musculoskeletal injuries, any neurological conditions in the past three months, abdominal, spinal or any surgeries in the past six months and already involved in core, abdominal exercises were excluded from the study. A total of 66 cricket players were randomly assigned (n=33) to either of two groups (Control group and Core Exercise group) by Opaque envelope method. Data collection procedure was started after obtaining Ethical approval from Institutional Ethical Committee of the Sarvajanik College of Physiotherapy. All participants gave a written consent as per Helsinki's declaration and participation in the study was voluntary.

Players were allocated to two groups: Control and Core exercise group for pretest and posttest assessments of dynamic balance using Star Excursion Balance Test (SEBT) and Core muscle performance using the Double Leg Lowering Test (DLLT) at the end of every week (pre-measurements on 1st day and post measurements on day 7, day 14, Day 21 and day 28).

Fig 1: SEBT measurements in participants

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Fig 2: DLLT measurements in participants

The protocol for core stability training in experimental group is progressive as follows: (Beginner, Intermediate in that Cognitive, Associative and Autonomous Stage)

Table 1: Protocol for Core exercise group

		Week 1	Week 2	Week 3	Week 4
Frequency	3 Days/ Week				
Intensity*	Set	1	1	1	1
	Repetition	10	10	10	10
Time	30 to 45 Min				
Type	Core Stability exercise				

* 5 Sec Hold time, 10 Sec Rest in each set of repetition and a 1 min rest in between each set

Table 2: Week wise Progression of core exercise (Hopkins N et al. 2009)

Week	Exercise	Repetition
1	**Transversus abdominus (TA) activation** TA Supine TA Marching TA Prone TA 4 Point Knee lift Knee and Foot lift	1 Set -10 Repetition
	Bridge Pelvic lift Segmental Bridge Bridge with pelvic tilt Single leg bridge Single leg bridge with pelvic tilt	1 Set -10 Repetition
2	**Fall out** Fall out with feet up	1 Set -10 Repetition
	Back Extension Exercise Back Extension Exercise1 Back Extension Exercise 2 Back Extension Exercise 3 Kneeling Back Extension Exercise 1 Kneeling Back Extension Exercise 2	1 Set -10 Repetition
3	**Abdominals** Modified crunch 1 Modified crunch 2 Modified cross over crunch Crunch with feet up Cross over crunch with feet up Decline curl 1 Decline curl 2	1 Set -10 Repetition
	Opposite arm and leg Supine Opposite arm and leg Prone Opposite arm and leg 4 Point Opposite arm and leg	1 Set -10 Repetition
	Plank Exercise Knee plank Knee plank with arm lift Plank Plank with arm lift Knee side plank Side plank Leg lengthen 1 Leg lengthen 2 Reverse Crunch 1	1 Set -10 Repetition
4	**Push up Exercise** Single leg push up Push up with twist Decline push up	1 Set -10 Repetition
	Cat Curl Cat stretch	1 Set -10 Repetition
	Lunges	3 Sets -10 Repetition

Fig 3: Transversus Abdominus marching

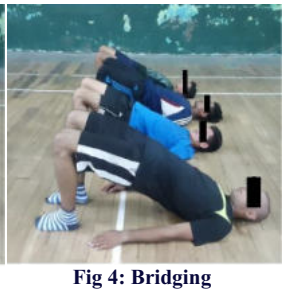

Fig 4: Bridging

Fig 5: Back Extension Exercise

Fig 6: Kneeling Back

Fig 7: Push Up twist

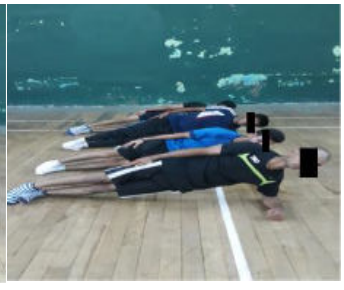

Fig 8: Side Plank

Fig 9: Leg lengthen

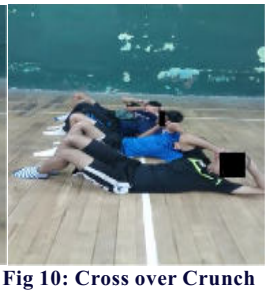

Fig 10: Cross over Crunch

Fig 11: Cat Stretch and Curl

RESULTS

Table 3: Descriptive Statistics of demographics in Core and Control Group

	Core Group Mean ± SD	Control Group Mean ± SD	t	Sig.*
Age (in years)	20.36 ± 1.16	20.79 ± 1.29	-1.399	0.167
Height (in cm)	164.33 ± 4.49	165.52 ± 4.65	-1.049	0.298
Weight (in kg)	58.88 ± 6.47	61.79 ± 5.36	-1.988	0.06

*Significance at p<0.05
SD: Standard Deviation

Table 4: Mean comparison of DLLT and SEBT between groups

Source	Sum of squares	df	F	Sig.*
DLLT	8706.13	1	74.27	**0.00**
Rt Ant	269.1	1	5.7	**0.02**
Rt AM	61.96		1.05	0.30
Rt Med	112.876		2.42	0.125
Rt PM	117.6		2.14	0.14
Rt Post	230.83		3.44	0.06
Rt PL	160.3		2.14	0.14
Rt Lat	189.39		2.31	0.13
Rt AL	167.34		2.24	0.13
Lt Ant	180.41		3.12	0.08
Lt AM	2.20		0.04	0.84
Lt Med	426.13		6.94	**0.01**
Lt PM	224.19		3.38	0.07
Lt Post	178.93		2.18	0.14
Lt PL	44.36		0.47	0.49
Lt Lat	132.36		1.94	0.16
Lt AL	137.48		2.04	0.15

*Significance at p<0.05

DLLT: Double Leg Lowering Test; Rt Ant: Right Anterior; Rt AM: Right Anteromedial; Rt Med: Right Medial; Rt PM: Right Posteromedial; Rt Post: Right Posterior; Rt PL: Right Posterolateral; Rt Lat: Right Lateral; Rt AL: Right Anterolateral; Lt Ant: Left Anterior; Lt AM: Left Anteromedial; Lt Med: Left Medial; Lt PM: Left Posteromedial; Lt Post: Left Posterior; Lt PL: Left Posterolateral; Lt Lat: Left Lateral; Lt AL: Left Anterolateral

Test of between subject effects for DLLT showed significant differences (p<0.05) (Table 4). Post hoc analysis showed significant improvement in core group as compared to control group at the end of second, third and fourth week with a mean improvement of -5.30, -13.48 and -30.75 degrees respectively (p<0.01) (Table 5).

Table 5: Pairwise comparison using Post Hoc analysis of DLLT between groups

Time Week	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.*
Pre	Core	Control	-0.75	1.37	0.58
1st Week			-1.06	1.30	0.41
2nd Week			-5.30	1.19	0.00
3rd Week			-13.48	1.35	0.00
4th Week			-30.75	1.46	0.00

*Significance at p<0.05

DLLT: Double Leg Lowering Test; Rt Ant: Right Anterior; Rt AM: Right Anteromedial; Rt Med: Right Medial; Rt PM: Right Posteromedial; Rt Post: Right Posterior; Rt PL: Right Posterolateral; Rt Lat: Right Lateral; Rt AL: Right Anterolateral; Lt Ant: Left Anterior; Lt AM: Left Anteromedial; Lt Med: Left Medial; Lt PM: Left Posteromedial; Lt Post: Left Posterior; Lt PL: Left Posterolateral; Lt Lat: Left Lateral; Lt AL: Left Anterolateral

Table 6: Pairwise comparison using Post Hoc analysis of Rt Ant SEBT between groups

Time Week	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.*
Pre	Core	Control	0.39	0.76	0.60
1st Week			0.75	0.81	0.35
2nd Week			1.57	0.81	0.05
3rd Week			3.03	0.76	0.00
4th Week			3.27	0.70	0.00

*Significance at p<0.05

DLLT: Double Leg Lowering Test; Rt Ant: Right Anterior; Rt AM: Right Anteromedial; Rt Med: Right Medial; Rt PM: Right Posteromedial; Rt Post: Right Posterior; Rt PL: Right Posterolateral; Rt Lat: Right Lateral; Rt AL: Right Anterolateral; Lt Ant: Left Anterior; Lt AM: Left Anteromedial; Lt Med: Left Medial; Lt PM: Left Posteromedial; Lt Post: Left Posterior; Lt PL: Left Posterolateral; Lt Lat: Left Lateral; Lt AL: Left Anterolateral

Test of between subject effects for Rt Ant direction (Table 4) showed significant difference between the two groups (p<0.05). Post hoc analysis showed significant improvements in balance in the anterior direction of the right limb at the end of second, third and fourth week with a mean improvement of 1.57 (p≤0.05), 3.03 (p<0.01) and 3.27 (p<0.01) respectively (Table 6).

Table 7: Pairwise comparison using Post Hoc analysis of Lt Med SEBT between groups

Time Week	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Pre	Core	Control	0.84	0.88	0.34
1st Week			1.51	0.88	0.09
2nd Week			1.75	0.92	0.06
3rd Week			2.90	0.83	0.00
4th Week			4.33	0.80	0.00

*Significance at p<0.05

DLLT: Double Leg Lowering Test; Rt Ant: Right Anterior; Rt AM: Right Anteromedial; Rt Med: Right Medial; Rt PM: Right Posteromedial; Rt Post: Right Posterior; Rt PL: Right Posterolateral; Rt Lat: Right Lateral; Rt AL: Right Anterolateral; Lt Ant: Left Anterior; Lt AM: Left Anteromedial; Lt Med: Left Medial; Lt PM: Left Posteromedial; Lt Post: Left Posterior; Lt PL: Left Posterolateral; Lt Lat: Left Lateral; Lt AL: Left Anterolateral

Test of between subject effects for Lt Med direction (Table 4) showed significant difference between the two groups (p<0.01). Post hoc analysis showed significant improvements in balance in the medial direction of the left limb at the end of third and fourth week with a mean improvement of 2.90 (p≤0.01) and 4.33 (p<0.01) respectively (Table 7).

Test of between subject effects for Rt AM, Rt Med, Rt PM, Rt Post, Rt PL, Rt Lat, Rt AL, Lt Ant, Lt AM, Lt PM, Lt Post, Lt PL, Lt Lat and Lt AL direction showed no significant difference between the two groups (p>0.05) (Table 2).

DISCUSSION

The present study focused on the effects of 4 weeks of core stability exercise on the dynamic balance among cricket players in which dynamic balance was assessed using Star excursion balance test and abdominal muscle performance was assessed using Double leg lowering test. It also compared the effects within groups as well as Repeated measure ANOVA for between Core and Control groups for above mentioned outcome measures.

Since normative data on the SEBT outcome measure has not been materialized, composite score of SEBT was not calculated. Analysis and discussion was made on comparing the means for each direction on each side of the limb.

Results from the study conducted by Sadeghi H et al did study on the effects of core stability exercise on the dynamic balance of volleyball players and found that there were significance differences in all the direction of SEBT in the core experimental group. This result justified that core stability exercise can improve dynamic postural control during landing of volleyball players significantly. Similar to this study, in our study we found the effects of 4-week core stability exercise on the dynamic balance among cricket players with results showing improvements in dynamic balance measured using SEBT, but only in Rt Ant and Lt Med directions. Our study results did not show improvements in other directions of SEBT measurements.

Results from the study conducted by Abdi J and Sadeghi H showed high levels of improvement in dynamic balance in Medial lateral, anterior –Posterior directions after 8 weeks of core exercises, which were similar to the results obtained from the present study showing improvements in dynamic balance measured using SEBT, but only in

Rt Ant and Lt Med directions.

Results from the study conducted by Mohammadi V et al examined the effects of six weeks of core strength training on static and dynamic balance in young male athletes. Result of this study showed a significant increase in static and dynamic balance in the experimental group and statically significance in all direction of SEBT. Present study conducted by us showed improvements in dynamic balance measured using SEBT, but only in Rt Ant and Lt Med directions.

Results from the study conducted by Wirth K et al did a critical analysis core stability in athletes and concluded that there is no proof found for special training exercises for deeper core or segmental stabilizing muscles. According to the authors of this critical analysis, studies inspecting EMG recordings of several core muscles have shown simultaneous activity that varied in extent and on- and offset depending on the motor task. They concluded that this is why stressing the importance of a few single muscles is not justified and classification into 'local' and 'global' muscle groups is inappropriate. Hence, they recommended the use of classical strength training exercises as these provide the necessary stimuli to induce the desired adaptations. The comments from the critical analysis is in contrast to the results obtained from our study which showed clinically significant improvements in DLLT which is considered as a reliable objective method to measure core muscle performance. However, we could not justify our findings as we have not used EMG recordings to consolidate the results. Since, it is out of scope of our present study, we conclude that the results obtained in our study supports the fact that core exercises can improve muscle performance.

From the results of the present study and discussion above, it can be concluded that core stability exercises for 4 weeks' duration progressed every week improves core muscle performance as compared to the regular training which was measured using DLLT in University level cricket players. However, dynamic balance did not show improvements as expected in the core stability group. Improvements were observed only in two directions out of the 16 directions measured (8 on right lower limb and 8 on left lower limb). Further studies to determine the core effects on other functional performances would help in devising protocols to players which will be instrumental in improving their performances. Since core effects on cricket players have not been explored, we conducted this study only on cricket players. Future studies can compare the core exercise effects on different sports groups and its outcome on various other functional tests can be tested.

CONFLICT OF INTEREST: Author agree that there was no source of Conflict of Interest.

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