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Harish S Krishna
Professor, Laxmi Memorial College of Physiotherapy, Mangalore, Karnataka, India

Sudeep Shetty
Professor and HOD, Department of Orthopedics, AJ Institute of Medical Sciences, Mangalore, Karnataka, India

Akshay S Raj
Post Graduate Student, Laxmi Memorial College of Physiotherapy, Mangalore, Karnataka, India

Corresponding Author:
Harish S Krishna
Professor, Laxmi Memorial College of Physiotherapy, Mangalore, Karnataka, India

Relationship between core endurance and dynamic balance in college level football players: A pilot study

Harish S Krishna, Sudeep Shetty and Akshay S Raj

Abstract
As a game of fast and varied movements maintaining dynamic balance is integral in football. The objective of the study is to find out the relationship between core endurance and dynamic balance in college level football players.
Methodology: 20 college level football players between 18-25 years of age was included in this study. Core endurance was assessed using McGill core endurance test and dynamic balance was assessed using modified star excursion balance test.
Result: There was no significant correlation between core endurance and dynamic balance in college level football players.
Conclusion: Core endurance training alone will not be enough to improve dynamic balance. Proprioceptive training and other strengthening domains should be included in order to improve the dynamic balance in football players.

Keywords: Core endurance, dynamic balance, college level players

1. Introduction
Football is one of the most popular sports in the world, engaging people worldwide as players, spectators and TV viewers. The world of football is following the increasing trends of global access to culture, economy, knowledge, labor and faster transport, which means that football as labor, entertainment and leisure activity is more accessible across borders than ever before [1]. The last report from FIFA in 2007 shows that as many as 265 million people worldwide regularly play football, an increase of about 20 million from the previous report in 2001 (FIFA, 2001, 2007a). This means that approximately 4.1% of the world's total population regularly plays football. It seems that football is especially popular among the male population, which represents approximately 90% of all worldwide participants.
About 265 million people regularly play football, of which only 0.04% play in a professional league. This suggests that reaching expertise specifically in football is difficult and highly competitive. Participation in football imposes high demand on the neuromuscular control agility eccentric and concentric muscle activity. Football performance is composed of technical, tactical, physiological and mental area. Physical fitness one of the most important elements that affect football performance because of the high physical demand in the real match situations [2].
As an impact collision sport, with injuries occurring in both contact and non-contact situations football is one of the sports with greater potential injuries. It has been demonstrated that the overall risk of injury to professional football players is approximately 1000 times higher than for industrial occupations generally regarded as high risk [3]. The major mechanisms of traumatic football injuries are tackling/being tackled, jumping, landing, turning, falling and collisions with other players/opponents. Running, shooting, turning, overuse, and jumping are the major contributing factors for injury without player to player contact. The prevalence of football injuries is larger compared to other sporting activities due to its aggressive nature and time bound framework. The frequent alteration of activities, numerous accelerations and decelerations, change of direction, unorthodox movement patterns and execution of various technical skills during the play time contribute to the higher injury rate in elite football players [4].

On comparison with injury awareness of European elite football players and Indian players suggest that elite and division I Indian players share similar injury awareness but division II and amateur players showed reduced awareness on injury prevention. Outfield players (e.g., wing-back, central midfield, striker) require high levels of aerobic capacity, speed, agility, and maximal as well as explosive strength. It is reported that a sprint bout occurs approximately every 90 s during a top-level soccer game, each lasting on average for 2–4 s [5]. It is well known athletic performance in soccer players can be improved by means of strength training [6]. The performance level of football players depends upon the ability to maintain the optimum level of muscular activity of the lower limb and the upper limb in multidirectional task for long duration of time. Strength training has the potential to induce strength gains and to improve sport specific performances in youth soccer players [7]. More recently, the importance of trunk muscle strength and trunk stability has been described for performance enhancements in sport-specific activities.

By definition, the core is considered a box with the abdominals as the front, paraspinalis and gluteal in the back, the diaphragm as the roof, oblique's as the sides and the pelvic and hip girdle musculature serving as the bottom. Research suggests an athlete's core must function efficiently to enhance performance, prevent injuries, rehabilitate from injuries. It is believed that a strong core will efficiently transfer energy to the upper and lower limbs thus allowing one to perform difficult and powerful maneuvers in aggressive actions. The core musculature's purpose is to provide stabilization to one's torso allowing optimal production, transfer, and control of forces proximal to distal in the human body [8, 9]. A strong core will perform these actions more efficiently hence resulting in increased athletic performance and decreased incidence of injury.

Performance in football often occurs on relatively unstable surfaces (e.g., jumping and landing on uneven natural turf, kicking a ball while being impeded by an opponent) and the challenge to the balance of the players is more compared to other sporting games [10]. This is suggestive that football players require to have more dynamic balance compared to other games. Balance during sports activities requires proper neuromuscular control, which is a unique integration of inputs from the periphery into the central nervous system and back, with the aim of maintaining the posture in non-constant, external environment [11]. This occurs unconsciously and skeletal muscles surrounding a joint are automatically activated in response to sensory stimuli. To maintain upright stance, the central and peripheral components of the nervous system are constantly interacting to control body alignment and the center of gravity over the base of support where peripheral components in balance include the somatosensory, visual, and vestibular systems and via central nervous system these peripheral inputs selects the most appropriate muscular responses to control body position and posture over the base of support [12]. Furthermore, balance ability is essential for top athletes, in order to reach peak performance in sport competitions and balance is also a very important factor for athlete talent identification since only in dynamic balance during human movement, can muscle create adequate power and strength [13].

Dynamic balance refers to maintaining equilibrium during motion or re-establishing equilibrium through rapid and successively changing positions. Both static and dynamic balance require integrating sensory information from the visual, vestibular, and somatosensory systems. In a game player often perform single-leg reaching movements outside their base of support during passing, receiving, and shooting in intermittent actions, usually with a change of activity every 4–6 seconds [14]. It has been suggested that soccer game activities may be directly related to the player's position on the field. Athletes may develop certain physical characteristics based on the demands of their specific positions.

Star Excursion Balance Test (SEBT) as a highly representative dynamic postural stability test for physically active individuals [15]. The SEBT requires the individual to move from a double to single-legged stance position while maximally reaching along set multidirectional lines with the opposite leg and touching down lightly on a tape measure with the distal end of the reach foot, without compromising equilibrium and may be useful in predicting future athletic injury [16].

Sprinting, running and field events require controlled posture sustained for extended periods of time and dynamic postural controls during single-limb events as well as quick and explosive movements [17]. The rectus abdominis, external oblique, and erector spinae control trunk position relative to its base of support. Core musculature transfers forces between the upper extremity and lower extremity of the postural control system which is permanently required to maintain or relocate the center of mass over the base of support and thus maintain balance. Balance is an integral part in core stability. The early dominant activation of the trunk muscle and delayed activation of the synergistic muscle is the reason behind the major neuromuscular imbalances in the core region. This faulty movement can also lead to excessive abnormal accessory gliding, thereby increasing trauma to the joint and increasing the causing increased risk for dysfunction and pain Hence the need is to find the relationship between core endurance and dynamic balance in football players and there by improve the performance of football players by specific training programs.

2. Materials and Methods

This cross-sectional study was conducted in college level football players with age between 18 to 25 years to find the correlation between core endurance and dynamic balance. Study protocol was approved by institution Ethics Committee. The study population was selected by convenient sampling method. The study was conducted in the course of 1 year. The subjects were enrolled according to the inclusion and exclusion criteria. The inclusion criteria were male football players, age between 18 to 25, member of college football team, participants who were free from injury, participants who are involved in at least 2 hours of training per week. The exclusion criteria were participants who had an injury in the previous six months, participants who underwent any surgery with in last one year, participants were excluded if they reported any current injury that limited daily activity or if they answered "yes" to any question on the Physical Activities Readiness Questionnaire (PAR-Q). This study involved minimal equipment such as table, exercise mat, a stopwatch, pen/pencil and paper.

2.1 Outcome Measures

2.1.1 Modified Star Excursion Balance Test (SEBT).

The Star Excursion Balance Test (SEBT) is a clinical test of dynamic postural control that involves unilateral stance while attempting maximal reach with the opposite leg in 3 different

directions anterior posterolateral and posteromedial. Star excursion balance test in the earlier days include 8 reach directions. Participants reported for a single testing session. The dominant leg was determined as the leg used by the participant for kicking The length of both the legs were measured from the anterior superior iliac spine to the middle of the medial malleolus using a standard tape measure while participants lay supine on a plinth. The task goal and performance constraints of the SEBT were explained to the participants. Reach directions were evaluated by affixing three tape measures to the floor, one orientated anterior to the apex (A) and two aligned at 135 to this in the PM and PL directions [18]. Intra-tester reliability (ICC) in these directions has been reported to range from 0.84 to 0.87 and test retest reliability from 0.89 to 0.93[19]. The order of the test leg and reach direction were randomized for each participant.

2.1.2 MCGILLS Core Endurance

McGill's Core Endurance Tests McGill's tests were used to examine participants' core endurance. These tests consisted of four positions: the trunk anterior flexor test, the right and left lateral plank, and trunk posterior extensor test [20]. Participants performed one practice trial. The maximum time (seconds) participants could hold a static position in each position was measured. For the trunk anterior flexor test, participants sat with their backs flat against a wooden wedge angled at 60o with hands across their chest and their knees both flexed to a 90-degree. Time recording started when the wedge was moved back and stopped when the trunk deviated either forward or backward from the 60o angle. For the left lateral musculature plank test, participants' feet were placed one on top of the other, the right arm was perpendicular to the floor, elbow resting on the mat, with the left arm across the chest and the left hand on the right shoulder. A similar position for the right lateral musculature plank test, but with the left arm perpendicular to the floor. Time was stopped when the line between the participants' trunk or lower body segments (thigh or lower leg) was not maintained. For the trunk posterior extensor test, participants lay prone on an examination table with both their ASIS's on the edge of the table, their hands on the seat of a chair placed in front of them at the edge of the table. Straps were held above and below their knees to secure participants' lower body. Time was started when participants assumed a horizontal position of the trunk, removing their hands off of the chair and crossed them across their chest, and stopped when participants were unable to remain in that position.

3. Result

The study comprised of a total of 20 college level male football players. The mean age of the subjects was 22.20±1.44. The mean score of height, weight and BMI were 171.90±3.99, 62.80±5.51 and 21.27±1.82 respectively. The mean limb length of right leg was 94.45±2.42 and left leg it was 94.50±2.54. The mean practicing hours per day was 2.05±0.76. The mean value of McGill core endurance test scores (in seconds) was anterior 50.58±21.55, left plank 37.76±11.62, right plank 39.50±9.80 and in extension score was 59.66±22.15. The mean values of SEBT composite scores for right side was 90.97±4.86 and left side it was 86.78±5.59. The result of the present study suggested that very weak correlation was present between four components of McGill core endurance test and both right and left composite scores of SEBT and which was not statistically significant (p >0.05).

Table 3.1: Descriptive table of demographic data, SEBT score and McGill test scores

N = 20		Mean	Std. Deviation
Age		22.20	1.44
Height		171.90	3.99
Weight		62.80	5.51
BMI		21.27	1.82
Limb length (right)		94.45	2.42
Limb length (left)		94.50	2.54
Practicing hours/ day		2.05	0.76
McGill core endurance test	Anterior	50.5893	21.55650
	Left	37.7679	11.62598
	Right	39.5000	9.80909
	Extension	59.6607	22.15177
SEBT	Composite score (right)	90.9716	4.86839
	Composite score (left)	89.7869	5.59505

Table 3.2: Correlation between core endurance and dynamic balance

N = 20		McGill Core Endurance Test			
		Anterior	Left plank	Right Plank	Extension
Composite score (right)	'r' value	-0.06	-0.35	-0.35	-0.38
	'p' value	0.79	0.11	0.13	0.10
Composite score (left)	'r' value	-0.01	-0.10	-0.07	-0.17
	'p' value	0.96	0.66	0.78	0.48

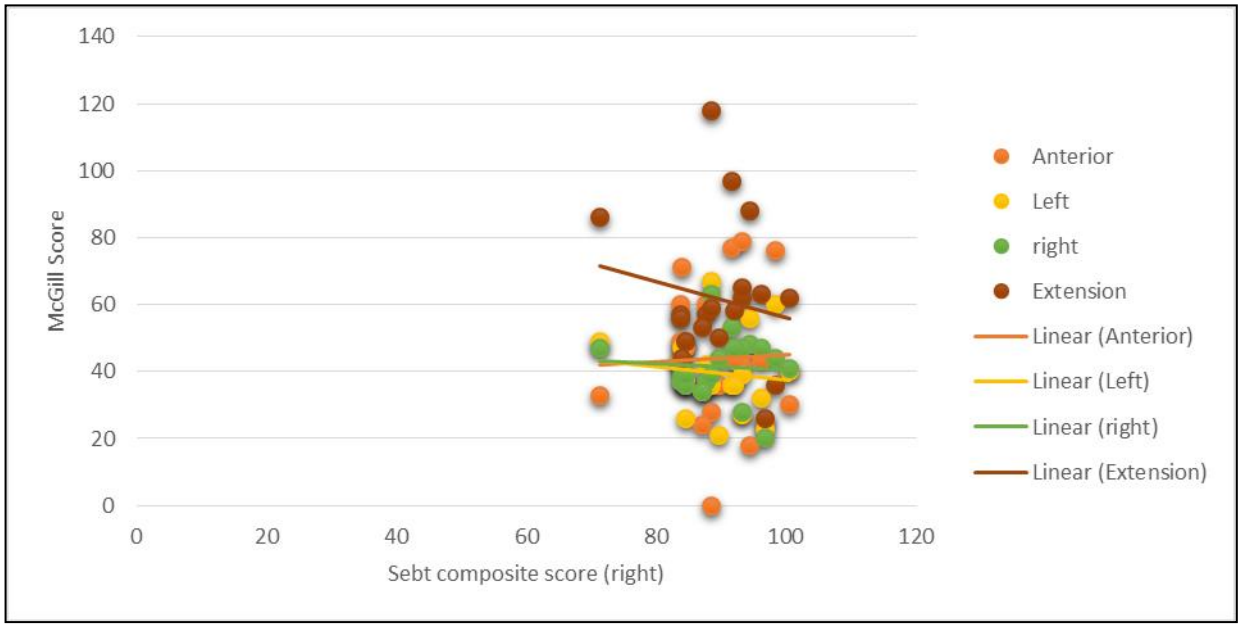

Fig 3.1: Correlation between McGill core endurance and SEBT (right).

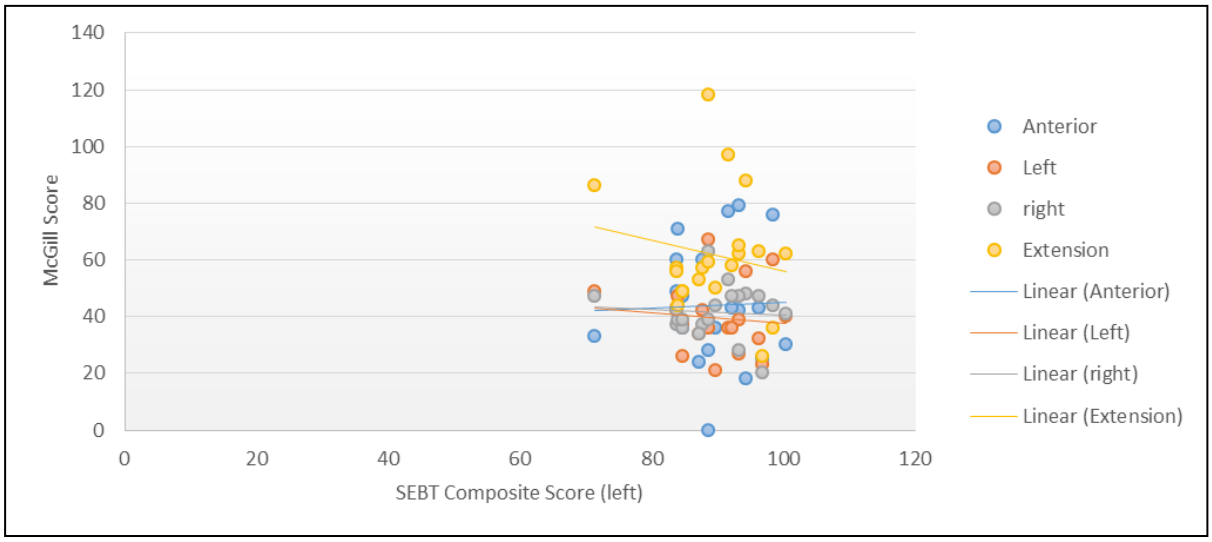

Fig 3.2: Correlation between McGill core endurance and SEBT (left)

3.1 Discussion

Football is a sport which require a good postural control during efforts such as kick, dribble, pass and to recover quickly after sprints, jumps, and cutting maneuvers [21]. The performance level of the football players depends upon the ability to maintain the optimum level of muscular activity of the lower and upper limb in multidimensional tasks for long duration of time. Moreover, players are exposed to situations where their balance is dynamically challenged, each time they step, run or jump.

McGill's core endurance test consisted of four positions: the trunk anterior flexor test, the right and left plank, and trunk posterior extension. These four tests measure all aspect of torso strength via isometric. The maximum time (seconds) participants could hold a static position was measured [22]. The psychometric properties including reliability and validity of the scale have been well demonstrated. The mean value of McGill test was, anterior:50.58±21.55, left 37.76±11.62, right 39.50±9.80 and in extension 59.66±22.15.

An improved ability to control movement has the potential to decrease excessive forces on the lower extremity. The rectus abdominis, external oblique, and erector spinae control trunk position relative to its base of support. Core musculature transfers forces between the upper extremity and lower extremity in the postural control system which is permanently required to maintain or relocate the center of mass over the base of support and thus maintain balance. Previous studies suggested that there is a very low rate of significance or no significance in the relationship between core endurance and dynamic balance.

This can be in other words be explained as the core play a vital and stabilizing role in the movement pattern of the lower limb but the endurance of the core muscular alone does not account much in dynamic stability domain. (reaching to different directions in unilateral limb stance).

During reaching in these directions, the leg extends backward, which causes the trunk to slightly flex to maintain balance. This causes gravity to act on the trunk by causing a hip flexion movement at the hip joint. It requires a mechanism to stabilize the spine against flexion moment at the hip joint. In contrast to the current study this indicates that the hip kinetics and kinematics has greater influence in dynamic balance along with core musculature.

A major limitation of this study was that the participants were recruited from a single university. Only male players were included in our study and their current playing status was not

taken into account. Muscle flexibility which might have an influence in reaching ability was not recorded in our study.

4. Conclusion

There is no relation between core endurance and dynamic balance in college level football players. Core endurance training in football players has proven to have improvement in lower limb performance and strength variables. So dynamic balance specific training should be added in training protocols along with strength training to enhance the performance of college level football players. Proprioceptive training regimes may improve the overall performance level of college level players.

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