Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XIII, ISSUE 2 supplement, 2013, Romania
The journal is indexed in: Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST, DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengace Learning, Cabell's Directories

Science, Movement and Health, Vol. XIII, ISSUE 2 supplement, 2013
September 2013, 13 (2), 137-143

EFFECTS OF CIRCULAR STRENGTH TRAINING SYSTEM ON BONE MINERAL DENSITY AND KICKS PERFORMANCE FOR YOUNG SOCCER PLAYERS

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Abstract
Purpose. Circular strength training (CST) was pioneered by Scott Sonnon, and continues to build on his insights to evolve an ever more refined, coherent, cohesive and comprehensive approach to becoming a movement specialist. CST has rapidly emerged as a leader among the premier training modalities in the health / fitness and strength / conditioning arenas. The purpose of this study was to investigate the effects of circular strength training system on bone mineral density and kicks performance for young soccer players
*Methods.*Twenty young soccer players were randomly allocated to receive either a 10-week intervention of the Circular strength training system which contain (intuitive flow, Prasara Flow Yoga and Clubbell swinging) (n = 10) and a control group receiving 10-week of normal training only (n = 10). The data collected from (DEXA instrument, physical tests and Performance level tests of kicking) before and after the program for the two groups.
*Results.*Statistical analyses showed that there was a significant difference between the two groups in BMD and BMC of the lumbar spine (L2, L3, L4), the femoral regions of the kicking leg, neck (F.N), Trochanter (TROCH), Strength and power tests and kicking distance kicking accurate for the experimental group.
Conclusions. Finally, circular strength training, for 10 weeks, resulted in an increase in bone mineral density and kicks performance for young soccer players. These results have to be taken into account by coaches in order to better understand and implicated of these concepts for technical effects of training.
Key words: Circular strength training, bone mineral density, young soccer players.

Introduction

Soccer is possibly the most widely practiced sport in the world by children. Few sports are played on as large a playing field, lasting as long and without regular rest periods. It involves several sprints, which evoke high mechanical stress on lower-limb bones, particularly due to the high ground-reaction forces elicited during sprinting (Freychat, et al. 1996). The latter combined with the forces generated during jumping and kicking may confer excellent osteogenic properties to soccer, as suggested by some cross sectional studies carried out with adult soccer players (Mohammed, 1992).

Quality and health of bone depend on the regularity in practicing physical activities as well as a type of this activity; so that the study of biological responses of regular sport training on health and quality of the skeleton in athletes is one of topic contribute in raising the levels of sport achievement. The importance of bones comes in as it is the general structure of body surfaces of the muscle fusion areas in the body, in addition to its important role in protecting the soft tissues and it is a big store of calcium and phosphorus. Bones are a life tissue needs food which receives rich blood vessels as need exercise especially strength training to help good growth process although the exercises are not related to bones length, the width and bones increasing by precipitation of more salts to be more strong as bones affected by stress and pressure (Mufti, 1998).

Weight-bearing physical activity has beneficial effects on bone health across the age spectrum. Physical activities that generate relatively high intensity loading forces, such as plyometric, gymnastics, and high-intensity resistance training, augment bone mineral accrual in children and adolescents. Further, there is some evidence that exercise-induced gains in bone mass in children are maintained into adulthood, suggesting that physical activity habits during childhood may have long-lasting benefits on bone health. It is not yet possible to describe in detail an exercise program for children and adolescents that will optimize peak bone mass, because quantitative dose-response studies are lacking. However, evidence from multiple small randomized, controlled trials suggests that the following exercise prescription will augment bone mineral accrual in children and adolescents:

In soccer, strength training plays a major role. It requires a balance of explosive power and muscular endurance. Some players may benefit from increasing their lean mass but even they should focus on converting much of their strength into a soccer-specific power.

Strength training for soccer also helps to correct muscle imbalances. Soccer players in particular are prone to developing overly strong quadriceps in relation to their hamstrings and a well-formed strength plan can address this and prevent future injury

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(Gioftsidou, et al. 2006).

(Mohammed, 1992; Abul Ela; 1984) indicated that muscle strength is one of the physical attributes important for sports and special games friction such as football and develop longer need to access the individual with a high level and muscle strength is not only a physical attributes but are the most important physical attributes upon which to develop other qualities such as speeding, endurance, agility and flexibility. (Mufti, 1998) adds that muscle strength and one of the dynamic factors of motor performance and importance lies in that it greatly influential on the speed of motor performance and motor skill proficiency required and is an important cause of progress performance. And also (Aweys, 2000) explain that muscle strength is a physical attributes that contribute to a prominent role in the mastery and development of tactical skill and performance and have a significant role in highlighting the emergence of some other physical attributes. In soccer, good maximal strength is beneficial for holding off opponents and shielding the ball. More importantly it also forms the foundation of muscular speed and power.

Finally, at the very heart of becoming the great soccer athlete that can run fast, cut quickly, jump high and reduce the likely hood of injury is strength training and power training. Old school thinking like, we cannot strength train because it will slow my athletes down or get my soccer athletes too big is flawed and outdated.

The soccer players need the lower body strength is required for kicking, jumping, and tackling, twisting and turning and also forms the foundation for explosive speed. And the Upper body strength is required for shielding the ball, holding off opponents, throw-ins and also contributes to the overall power and explosiveness.

One of the methods which used to improve the muscular endurance is circular strength training (CST) which pioneered by Scott Sonnon, and further developed by his elite Faculty Coaching Staff, CST is the cutting edge of health, fitness and sports performance enhancement. It's unique among fitness systems in offering a complete "health first" approach. Other systems place function (attributes like strength, endurance or speed) first, valuing those things over and often at the expense of health.

Circular Strength Training is made up of three "wings" or sub-disciplines. Though they can and are practiced independently, the three wings of CST integrate seamlessly into a stand-alone health and fitness system.

Intu-Flow is an incrementally progressive system of dynamic joint mobility exercises designed to feed and lubricate your joints and connective tissues and restore all of your joints to their full, healthy range of motion. Beginning CST athletes start with the Intu - Flow, and long term athletes use it to release stored tension, speed recovery from training, and to maintain the health and longevity of their bodies.

Prasara yoga takes the range of motion and co-ordination that you recovered with the Intu - Flow to the next level. It transforms physical performance by teaching one how to re-integrate the breath, movement and structure—the key to accessing flow state in any activity. Prasara specifically focuses on the releasing of chains of tension throughout the body. Tension caused by fear, anxiety, trauma, habit, and even exercise are pulped and released through the practice of Prasara yoga. Prasara works in the opposite and teaches you to release this habitual tension. Paired with the Intu-Flow, Prasara will give the ability to strut around the stage and contort yourself in a freakish display of athleticism while holding a note and making it look easy.

Clubbell Athletics is the third weighted wing of CST. Unlike machines, free weights, and Kettlebells, the Clubbell was specifically designed to be moved in three dimensions, just as people move in the real world. Clubbell allow one to develop the rotary and angular strength of the prime movers (translating directly to athletic performance in any activity), to develop selective tension (the ability to apply exactly the right amount of force for the task at hand, rather than the "full on/full off" approach of traditional strength training), and to develop incredible grip strength and stamina. Clubbell Athletics is simply the most sophisticated, fun and creative vehicle for strength and conditioning ever conceived. (Ryan, 2011)

CST provides a technique to cover every factor of an individual's remedial, fitness, and sports performance.

According to the above, and from believe of the researcher that, strong muscles should carry on strong bone. Hence, The purpose of this study was to investigate the effects of circular strength training system on bone mineral density and kicks performance for young soccer players.

Material and Methods

Experimental approach

Two groups (control and experimental) performed a pre- and post-training designed intervention in which the (power: vertical jump test (VJ), standing long jump test (SLJ), seated medicine ball throw (SMBT), (Static strength: leg and back strength (LS-BS) by Dynamometer), (Dynamic strength: A barbell and free weights were used to measure dynamic strength to the legs and arms), kicking tests (KT) was recorded. And Bone mineral density (BMD) in g/cm2 of the 2nd 3rd and 4th lumbar vertebral bodies (LS) and the left hip (neck of femur, FN and Trochanteric region, FT) was measured in each subject by dual energy X-ray Absorptiometry (DEXA) using a Norland Densitometer (Norland Inc.,. USA). Scan analysis was performed by technicians with daily experience in DXA analysis. The experimental group completed a CST program (10) weeks, 3 times a week, to see whether this type of training modality would have a positive, negative, or no effect on VJ, SLJ, SMBT, and SS. Validity and reliability were assessed using a coefficient of variation on pretest measures. A good level of validity reliability was observed.

Participants

Twenty elite young tennis athletes (13.95 ± 1.87 years old; 161 ± 6 cm height; and 60 ± 5.1 kg weight) were randomly allocated to receive either a 10-week intervention of CST (n = 10) or a control group receiving 10-week of normal training only (n = 10). The training experience of all the participants ranged from 3 to 5 years. Subjects and coaches were required to read and complete a health questionnaire that collected detailed that confirmed that there was no history of injuries, diabetes or recent surgery.

Training Protocol

A 10-week in-season training program consisted of a set of Intu-Flow movements followed by a series of Prasara yoga and Clubbell exercises. All sets of the exercise were with a recovery of 60 seconds/set. This was followed by a 1-minute rest before performing all set of the matched exercise.

Procedures

Subjects were assessed before and after an 10-week training program Tests followed a general warm-up that consisted of running, calisthenics, and stretching.

Vertical Jump Test: The subject stands by their side touching a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. This is called the standing reach height. The athlete then stands away from the wall, and leaps vertically as high as possible using both arms and legs to assist in projecting the body upwards. They attempt to touch the wall at the highest point of the jump. The difference in distance between the standing reach height and the jump height is the score. The best of three attempts is recorded.

Standing Long Jump Test (SLJT): The subject stands behind a line marked on the ground with their feet slightly apart. A two-foot take-off and landing is used, with the swinging of the arms and bending of the knees to provide forward drive. The subject attempts to jump as far as possible, landing on both feet without falling backwards. Three attempts are allowed.

Seated Medicine Ball Throw (SMBT): The subject sits with their back to a wall on a mat facing the area to which the ball is to be thrown with their feet extended and slightly apart. The ball is held with the hands on the side and slightly behind the center. The ball is brought to the chest, and then thrown vigorously out as far as possible. The back should remain in contact with the wall at all times. Three attempts are allowed. The distance from the wall to where the ball land is recorded. The measurement is recorded to the nearest 10 cm. The best result of three throws is used.

Static strength test (LS) (BS)

Leg and back Dynamometer was used to measure the static leg strength. The subjects stood on the Dynamometer platform and crouched to the desired leg bend position, while strapped around the waist to the Dynamometer. At a prescribed time they exerted a maximum force straight upward by extending their legs. They kept their backs straight, head erect and chest high. 3 trials were allowed to the subjects and the best score was taken. Subjects had a rest between the trials (Jensen & Fisher).

Dynamic strength test (DST)

A barbell and free weights were used to measure dynamic strength. A suitable starting weight, close to, but below the subject's estimated maximum lifting capacity was selected. If one repetition was completed, the experimenter added weight to the barbell until the subject reached his maximum capacity. Both legs were tested.

The weight increments have been usually 5, 2 and 1kg during the period of measurement (Mcardle / Katch / Katch 1981).

The performance levels of kicking

- Kicking distance.
- Kicking accurate.

Statistical Analysis

All statistical analyses were calculated by the SPSS statistical package. The results are reported as means and standard deviations (SD). Differences between two groups were reported as mean difference ±95% confidence intervals (mean diff ± 95% CI). Student's t-test for independent samples was used to determine the differences in fitness parameters between the two groups. The $P<0.05$ was considered as statistically significant.

Results

Table 1. The differences in physical- skill tests and Measurements of bone density in the experimental group.

Variables	Experimental			T sign
	Pre	post	change%	
Power				
Vertical Jump Test (VJ) (cm)	25.25 ±2.31	29.16 ± 2.12	31.06	Sign
Seated Medicine Ball Throw Test (SMB)(m)	5.23 ± 0.16	5.92 ± 0.24	13.19	Sign
Standing Long Jump Test (SLJ)(m)	1.70 ± 0.11	1.79 ± 0.1	5.29	Sign
Static Strength				
Leg strength (LS) (kg)	43.53 ± 4.1	50.11 ± 4.3	12.12	Sign
Back strength (BS) (kg)	38.53 ± 4.3	44.11 ± 4.7	14.48	Sign
Dynamic Strength				
Biceps Curl Test (BC)(kg)	21.31 ±2.17	26.12 ± 3.11	22.57	Sign
Bench Press Test (BP) (kg)	30.44 ± 4.52	38.02 ± 5.12	24.90	Sign
Dynamic Knee Extension Test (DKE) (kg)	29.63 ± 3.12	33.39 ± 4.02	12.69	Sign
Leg Press Test (LP) (kg)	50.78 ±2.91	59.67 ± 3.94	17.51	Sign
Level performance of kicking				
Instep Kicking distance (IKD) (m)	17.99±2.14	22.03 ± 2.67	22.46	Sign
Instep Kicking accurate (IKA) (d)	4.11 ± 0.68	5.02 ± 0.94	22.14	Sign
Measurements of bone mineral				
BMD. F.N (g/cm^2)	0.945± 0.04	0.989± 0.03	4.66	Sign
BMD. TROCH o (g/cm^2)	0.866± 0.05	0.881± 0.06	1.73	Sign
BMC. F.N (g/cm)	5.73± 0.55	6.41± 0.89	11.87	Sign
BMC. TROCH (g/cm)	5.67± 0.77	6.03± 0.93	6.35	Sign
BMD (L2-L4)	0.821± 0.08	0.909± 0.1	10.72	Sign
BMC (L2-L4)	25.07± 2.77	28.42± 3.15	13.36	Sign

(Cm = centimetre, m = meter, kg = kilogram, d = degree, g/cm^2 = gram/ $centimeter^2$, g/cm = gram/ centimetre)

The T score showed significant differences between the pre-and post-training for all variables in the experimental group. ($P \leq 0.05$). Improves ranged between 1.73% to 24.90%

Table 2. The differences in physical- skill tests and Measurements of bone density in the control group.

Variables	Control			T sign
	Pre	Post	change%	
Power				
Vertical Jump Test (VJ) (cm)	23.99 ±2.43	24.97 ± 2.73	4.09	Sign
Seated Medicine Ball Throw Test (SMB) (m)	5.25 ± 0.18	5.35 ± 0.32	1.90	Not Sign
Standing Long Jump Test (SLJ) (m)	1.72 ± 0.09	1.74 ± 0.1	1.16	Not Sign
Static Strength				
Leg strength (LS) (kg)	44.09 ± 4.21	45.11 ± 4.41	2.31	Not Sign
Back strength (BS) (kg)	38.68 ± 3.97	40.39 ± 4.1	4.42	Sign
Dynamic Strength				
Biceps Curl Test (BC)(kg)	20.88 ±2.17	22.55 ± 2.75	8.00	Sign
Bench Press Test (BP) (kg)	31.11 ± 3.74	32.15 ± 4.07	3.34	Sign
Dynamic Knee Extension Test (DKE) (kg)	29.72 ± 2.85	30.25 ± 3.11	1.78	Not Sign
Leg Press Test (LP) (kg)	51.11 ±3.04	52.36 ± 3.12	2.45	Not Sign
Level performance of kicking				
Instep Kicking distance (IKD) (m)	18.11±2.17	19.22 ± 2.19	6.13	Sign
Instep Kicking accurate (IKA) (d)	4.36 ± 0.54	4.88 ± 0.61	11.93	Sign
Measurements of bone mineral				
BMD. F.N (g/cm^2)	0.941± 0.06	0.947± 0.07	0.64	Not Sign

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BMD. TROCH (g/cm^2)	0.867± 0.07	0.869± 0.08	0.23	Not Sign
BMC. F.N (g/cm)	5.68± 0.85	5.80± 0.89	2.11	Not Sign
BMC. TROCH (g/cm)	5.83± 0.91	5.92± 0.97	1.54	Not Sign
BMD (L2-L4)	0.822± 0.08	0.829± 0.1	0.85	Not Sign
BMC (L2-L4)	25.15± 2.34	25.87± 3.02	2.86	Not Sign

The T score showed significant differences between the pre-and post-training in (VJ) , (BS) , (BC) , (BP) , (IKD) , (IKA) for the post-training. (P≤ 0.05) , and no significant differences between the other variables , Improves ranged between 0.23% to 11.93%

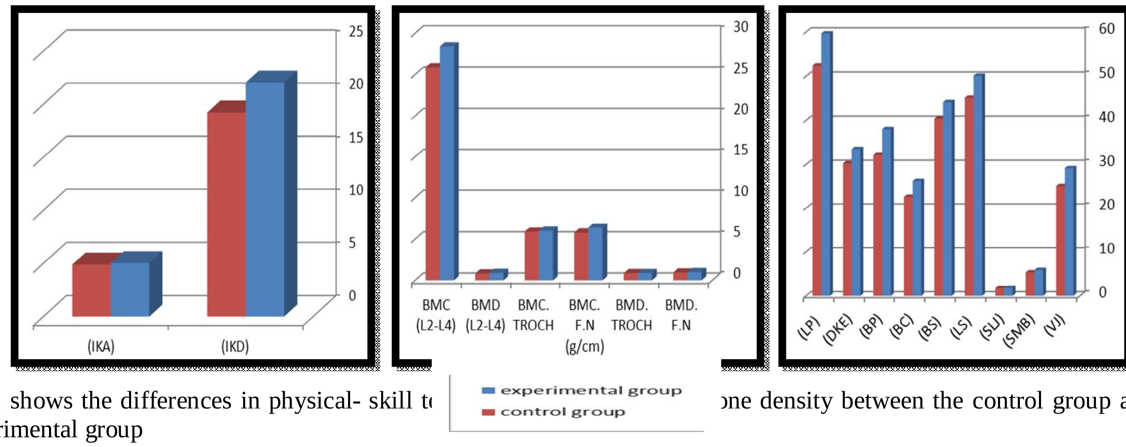

Fig 1 shows the differences in physical- skill t ... one density between the control group and experimental group

Table 3. The differences in physical tests in the experimental group.

Variables	Experimental	Control	T sign
Power			
Vertical Jump Test (VJ) (cm)	29.16 ± 2.12	24.97 ± 2.73	Sign
Seated Medicine Ball Throw Test (SMB) (m)	5.92 ± 0.24	5.35 ± 0.32	Sign
Standing Long Jump Test (SLJ) (m)	1.79 ± 0.1	1.74 ± 0.1	Sign
Static Strength			
Leg strength (LS) (kg)	50.11 ± 4.3	45.11 ± 4.41	Sign
Back strength (BS) (kg)	44.11 ± 4.7	40.39 ± 4.1	Sign
Dynamic Strength			
Biceps Curl Test (kg)	26.12 ± 3.11	22.55 ± 2.75	Sign
Bench Press Test (kg)	38.02 ± 5.12	32.15 ± 4.07	Sign
Dynamic Knee Extension Test (kg)	33.39 ± 4.02	30.25 ± 3.11	Sign
Leg Press Test (kg)	59.67 ± 3.94	52.36 ± 3.12	Sign
Level performance of kicking			
Instep Kicking distance (m)	22.03 ± 2.67	19.22 ± 2.19	Sign
Instep Kicking accurate (d)	5.02 ± 0.94	4.88 ± 0.61	Sign
Measurements of bone mineral			
BMD. F.N (g/cm^2)	0.989± 0.03	0.947± 0.07	Sign
BMD. Tro (g/cm^2)	0.881± 0.06	0.869± 0.08	Sign
BMC. F.N (g/cm)	6.41± 0.89	5.80± 0.89	Sign
BMC. Tro (g/cm)	6.03± 0.93	5.92± 0.97	Sign
BMD (L2-L4)	0.909± 0.1	0.829± 0.1	Sign
BMD (L2-L4)	28.42± 3.15	25.87± 3.02	Sign

The T score showed significant differences in all variables between the post-training in the two groups (experimental and control) to the experimental group. (P≤ 0.05)

Discussion

This study aimed to explore the effects of circular strength training (CST) on muscle strength , muscle power , Level performance of kicking and bone mineral in young soccer players. Compared to control group, young soccer players in the experimental group performed better in all tests.

The results of the present study showed that the experimental group in general, have more muscle strength , muscle power than the control group, Previous studies in female and male soccer players showed similar results. Indeed, in a previous study it was found that young female soccer players had significantly higher concentric and eccentric peak torque of the thigh muscles than controls (Soderman , et al. 2000). In another study, while young male soccer players conventionally or resistance-trained showed higher values of isokinetic concentric and eccentric strength of the lower limb extensor and flexor muscles of the knee joint of the dominant and non-dominant limb than non-soccer players (Iga , et al. 2009).

Intu-Flow is indeed one of the most revolutionary exercises. In fact, it's one of the best exercise programs that medical professionals refer out to their clients constantly . It's because an adaptation of strength training program, a Cardio program, a stretching exercise program . And thousands of men and women of all ages are regaining pain-free range of motion and healthy joints – and they're doing it naturally, without supplements, pills, "magic potions," gadgets, gizmos, or outrageous gurus. And Clubbell exercises are a new form of training designed around the concept of centre of mass (COM). Therefore, it seems that the Clubbell exercises are a way to increase strength over a particular range of motion (ROM) exercise. The concept behind Clubbell exercises is circular strength. Supposedly, the ancient Persians used to have strong men's competitions using heavy clubs. Circular strength is also described as a full range of motion strength training using multiple joint movements. Now the theory behind this has some significance for soccer players. Clubbell exercises seem to increase some of the following aspects of soccer players training:

- Increased wrist strength
- Increased upper body strength
- Increasing muscular endurance
- Increasing strength in a particular ROM
- Increasing core body strengths

Clubbell exercises can help soccer players in a whole array of ROM type activities, such as kicking power (especially through the hips), stronger arms, shoulders, ABS , parks and back for a greater throwing distance. Stronger wrist strength can help with catching the ball etc.

Moreover, our results showed that the experimental group in general, has more bone mineral density (BMD) , and bone mineral content (BMC) than the control group

Cross-sectional studies suggest that physical activity promotes greater bone deposition in children than in adults (Cooper, et al. 1995; Kannus, et al. 1995; Vuori, et al. 1994). Weight-bearing activities increase bone mass more than nonweight-bearing activities in weight-loaded skeletal regions (Calbet, et al. 2001; Nordstrom, et al. 1998). Most of the studies relating to bone mass enhancement in pre- and peripubertal children have been carried out with female gymnasts, but there are some dealing also with boys (Daly, et al. 1999; Lima, et al. 2001). Ground reaction forces during gymnastic participations are close to 10 times body mass in prepubescent gymnast boys (Daly, et al. 1999). This high-impact loading during gymnastic training has been associated with significantly greater bone mineral density (BMD) for the whole body (Cassell, et al. 1996), spine, and legs (Nickols, et al. 2000). Also, longitudinal case-control studies support the view that exercise increases bone mass (Nickols, et al. 2000).

Conclusions

Finally, circular strength training, for 10 weeks, resulted in an increase in bone mineral density and kicks performance for young soccer players .These results have to be taken into account by coaches in order to better understand and implicated of these concepts for technical effects of training.

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