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Effectiveness of Shock Plyometric Training of Bone Density and Protection from Fractures Injury in Athletes

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Abstract: Shock trainings are one of best trainings which contribute to maintain strength of muscles and bone and that bone motivation for growth be throughout physical activities are represented in shock trainings that characterized by plyometric training. This study aims to use shock plyometric training and identify its effects on bone mineral density and protection of injuries of bone bruises and fractures.This study was conducted on 30 players of football in Zamelek club aged between 16-18 years old. They were divided into two groups (15 players as control group-15 players as study group) the experiment was performed in three steps; first step was doing pre-measurement for bone mineral density (BMD). Second step was applying a program of shock training for six weeks during preparation three times / week for 30min and on the study group only. The third step was doing post-measurements of BMD that follow the injuries that occur during training or matches within the season and recorded. The regularity of plyometric shock training has positive effect on increasing BMD by 13.08 % to 19.2 % as well as it protect from bone injuries by 42%. Researcher recommends using plyometric shock trainings for increasing BMD because they protect from bone injuries.

Key words: Plyometric shock · Bone Density · Minerals BMD

INTRODUCTION

Quality and health of bone depends on regularity in practicing physical activities as well as type of this activity, so that the study of biological responses of regular sport training on health and quality of 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 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 [1].

Shock trainings are the best training contribute to maintain strength of muscle and bones as well as mechanic stress on bones cells, thus the amount of bone building depends upon the degree of force and frequency of performance [2]. The stimulation of bones for growth is through physical activities represents in shock training which characterized by plyometric training on skeleton as it is a way of stimulating bones growth [3]. The Physical activities to be performed need collision and friction to land such as activities of jumping and loping play a major and effective role on skeletal system and increasing mineral and bones density, while there are some of the physical activities have not little positive effect on health of bones [4].

Hence, researcher thought that increase attention to strength and density of bones in the activities of friction and cohesion such as football, thereby reducing injuries from broken bones and bruises through applying training program using shock plyometric training. Shock training is one of plyometric trainings depends on the face of muscle outside strong and surprise resistance such as weight or body weight against gravity through the process of collision where the muscle works in a way leads to long them firstly and then rapid central contraction. This study aims to use shock plyometric training and identify its effects on bone mineral density and protection of injuries of bone bruises and fractures.

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MATERIALS AND METHODS

This study was conducted in the Faculty of Medicine, Kasr AL Aini, department of radiology and Zamelek Club, Egypt. The experiment was performed in three steps; first step was doing pre-measurement for bone density in the faculty of medicine, Kaser AL Aini at the beginning of preparation period and before the start of league matches 1-2/7/2008, second step was applying program of shock training for six weeks 5/7/2008 to 16/8/2008, during preparation three times / week for 30 min on the study group only (Appendix 1,2) and the third step is post-measurements in 18-19-8/2008, then follow the injuries that occur during training or matches within the season and recorded then to study the effect of plyometric shock training none mineral density and protection from bone bruises and fractures.

The sample of this study was players from Zamalek club, aged between 16-18 years old. They were 30 divided into two groups (15 players as control group-15 players as study group) and the equivalence among them was performed in variables age, length, weight, bone density and content of minerals.

Appendix 1: Examples of exercises used in the plyometric training program

1. [Stand on the front of the horizontal lines dawn on the floor with appropriate distances] forward jump up with feet together between lines.
2. [Stand]. forward annexed jump up with foot, land inside collar then high forward opened jump an land each foot inside jump an land each foot inside collar and so on.
3. [Stand at the beginning of ladder] push land with feet, jump up and take forward distance and land with feet together.
4. [Opened standing and put the Swedish seat between feet] jump up and touch feet of each other at the top of Swedish seat and land in same place.
5. Stand] side on front of Swedish seat, high forward jump up with feet over Swedish seat and land to the other side then direct return to the other side in addition to fallback from position of motivatio.
6. [Stand on low box-arms side body] slip from the low box then jump the light box speed and fast feet together with up swing arms.
7. [Stand]. ..jump with small step over cones in horizontal position with small distance and land on the floor with right foot then left respectively.
8. [Stand half squatting-in front of box at distance 2-3 steps] speed and fast jump with feet over the box, land for away as possible then ascend the next box.
9. [Stand a little bending knees] jump up and forward with feet ends together to land on the edge of box then direct jump to back and down in the same place he started.
9. [Stand on front of slope rope a side the low end] sequence partridge a side rope and attempt to access to high end of rope.
10. [Stand on front of drawn horizontal lines on the floor with appropriate distances] forward jump up with feet together between lines in addition to forward move with jump.
11. [Stand on the beginning of ladder] push the floor with feet and jump up, take forward distance and land with feet together in addition to land with jump down.
12. [Stand on box at a height of 50 cm] lope to the floor with legs then ascend again over the box and repeat.
13. [Run and jump up box at a height 30 cm] lope to the floor with legs then ascend again over the box and repeat.
14. [Stand half squatting] forward and side jump up a highest possible distance and side with bending knees to the top and feet down back then land with feet together.
15. [Stand on front of boxes placed at appropriate distances and different height] forward jump up to ascend over the first box then land on the floor with feet together, then forward jump up to another box successively.
16. [Stand half squatting] jump over the barriers in a row with appropriate distances with feet together.
17. [Stand half squatting] forward and side jump up a highest possible distance side with bending knees for up and down the back and sequence landing with left foot.
18. [Stand] jump over three barriers and direct rotation.
19. [Stand] jump over two barriers with middle distances, land on the floor then jump at the place of beginning again.
20. [Stand] run to ascend the ladder and descend again.
21. [Stand] jump with feet to ascend the ladder and descend again.
22. [Stand] jump with a foot to ascend the ladder and descend again.
23. [Stand catching ball] push up a medical ball with hands and snap it.
24. [Forward stand between two players] exchange to pass a medical ball throughout hand pushing.
25. [Stand with forward arms] body fall to access the position of slope lie.
26. [Slope lie]. .. push the floor, hand clapping and arms clashing with the floor.
27. [Slope lie and feet on Swedish seat] push the floor, hand clapping.
28. [Stand with forward arms] body flight forward and down as body accesses the position of slope lie and arms clashing with the floor.
29. [Reverse lie on the floor] push the floor with arms and clashing with the floor.

Appendix 2: Model for a training unit (No.3)

Week	Days	Stress	Sections	Content	Groups	Frequencies	In between rest: between exercises	In between rest: between groups
(3) Weeks	*Saturday*	*85%*	*preparatory Part (5 min)*	Forward run and do exercise of stretching muscles, joints flexibility and some exercises of simple strength such as slope lie, bend arms and jump in the same place.	*(4 g)*	*(8 f)*	*(45 sec)*	*2 min)*
			Main Sections (15 min)	[Stand]. ..jump with small step over cones in horizontal position with small distance and land on the floor with right foot then left respectively in addition to advance forward step from position of motivation. [Stand]. ..side on front of Swedish seat, high forward jump up with feet over Swedish seat and land to the other side then direct return to the other side in addition to fallback from position of motivation . [Stand]. jump over two barriers with right foot in appropriate distance, land on the floor then jump at the place of beginning again. [Stand]. .. run to ascend the ladder and descend again. [Stand]. .. jump with feet to ascend the ladder and descend again. [Slope lie]. .push the floor, hand clapping and arms clashing with the floor. [Slope lie and feet on Swedish seat]. .. push the floor, hand clapping.				
			Final Section (5 min)	Calm exercises and stretch muscles				

Measurement of Bone Density: The measurements of bone density were conducted under the supervision of specialist doctors in radiology and bones in the Faculty of Medicine Kasr AL Aini, departments of Radiology and Orthopedics using-Energy-x-ray absorptiometry (DEXA) method.

Statistical Analysis: The results in this study were analyzed by using SPSS program (medium). Sp., P value and program rate was used to interpret the result.

RESULTS AND DISCUSSION

The results showed no statistical significant difference between the control and study group in growth rates (age-length-weight) bone mineral density (BMD) which refers to their equivalence (Table 1) and there are statistical significant difference between pre and post measurements of experimental group in BMD for post measurement. Hence this illustrates the program effect of plyometric shock exercises (Table 2). There are no statistical significant differences between pre and post measurements of control group in BMD (Table 3) and there are statistical differences between control and study groups in post measurements for study group in BMD (Table 4). This illustrates the effect of plyometric shock training was 28.5% while control group was 71.4%, the decrease was 42% for experimental group as well as the rate of fracture, break age and bruise was decreased for study group (Table 5).

The results of Table 2 showed pre and post measurements of study group in BMD for post measurement, increasing rate was between 20.2% and 25.9%. This showed the exercises effect of polymetric program, which contain shock training beside training program of football, on quality and health of bone because exercises of jump and strike to land lead to direct loading on bone during myospasia which have helped in increasing their strength and solidity and was evident in increasing BMD.

Results of research confirm that all types of bone need more stress to be developed according to Wolff's law, which expresses that using leads to rebuild bone structure and such using is result from loading and varied strike, so that practice of physical activities is one of the important issues in access to the maximum of bone mass[5].

These results agree with results of other researches which showed that sport training develops muscular strength leading to increasing bone density as a result of stress on the bone [6, 7]. Also, the study agrees with results of other studies stating that football sport is one of physical activities of essential effect on bone density of the body [8]. Results in Table 3 of studying differences between pre and post measurements of control group in BMD showed that there are no statistical differences between the two measurements of this group. The researcher attributes this result that traditional training programs in most sports in many clubs do not contain regulated plyometric training, therefore most of coaches suggest developing the skillful side to develop the physical side, thus there were no statistical significant changes on control group in variables BMD which ensures that progress and improvement of study group as a result of regulated plyometric training.

Table 1: Significant differences between study and control groups in (age-length-weight) and BMD

Group		Control		Study			
Test	Measurements	M	±SD	M	±SD	P value	Significance
Age	Year	16.33	0.40	16.37	0.41	0.82	Not significant
Length	Cm	175.3	0.88	167.90	10.89	0.08	Not significant
Weight	Kg	70.40	11.08	73.60	10.48	0.17	Not significant
Bone density	Body /cm^2	0.682	0.105	0.672	0.121	0.82	Not significant
Minerals content	Gm	1.52	1.52	17.31	1.84	0.77	Not significant

Table 2: Significant differences between pre and post measurements or study group in BMD

Measurement		Pre		Post				
Test	Measurements units	M	±SD	M	±SD	Progress rate	P value	Significance
Bone density	Body /cm^2	0.68	0.105	0.921	0.125	%25.9	0.0	Significant
Minerals content	Gm	17.4	1.52	21.91	2.26	% 20.2	0.00	Significant

Table 3: Significant difference between Pre and post measurements of control group in BMD

Measurement		Pre		Post				
Test	Measurements units	M	±SD	M	±SD	Progress rate	P value	Significance
Bone density	Body /cm^2	0.672	0.121	0.744	0.133	% 9.6	0.11	Not significant
Minerals content	Gm	17.31	1.84	19.02	2.77	% 8.9	0.60	Not significant

Table 4: Significant differences between study group and control group in post-measurement in BMD

Measurement		Study group		Control group				
Test	Measurements units	M	±SD	M	±SD	Progress rate	Pvalue	Significance
Bone density	Body /Cm^2	0.921	0.125	0.744	0.133	%19.2	0.01	Significant
Minerals content	Gm	21.91	2.26	19.04	2.77	%13.08	0.04	Significant

Table 5: Incidence rate of bone injury (fracture-breakage-bruise)

		Type of injury			
Place of injury	Group	Bruise	Breakage	Fracture	Total
Foot and leg	Control	2	2	1	5
	Study	1	1	-	2
Thigh and pelvis	Control	1	-	-	1
	Study	1	-	-	1
Upper limp	Control	2	1	1	4
	Study	1	-	-	1
Total	Control	5	3	2	10
	Study	3	1	-	4
Percentage	Control	35.7%	21.4%	14.2%	71.4%
	Study	21.4%	7.14%	5%	28.5%

Results in Table 4 of studying differences between control and study groups in post measurements of BMD showed that there are statistical significant differences ranged from 13.08 % to 19.2 % among these two groups in post measurements for the study group. Researcher attributes level increasing of BMD of study group (football players) to their regularity in programs of plyometric shock training which have positive effect on quality and health of bone compared to control group, as it requires load on the bone and shock of legs and arms movement whether land or wall which is reflected in increasing the quality and health of bone of upper and lower limbs.

Researcher interprets this change in bone density that plyometric training have especial mechanic in the performance where the process of shocking during training work on bone precipitation, this is what confirmed that the mechanical stress on bone is creating a sliding collagen fibers one after the another and followed efforts inside bone which work on increasing the activity of osteoblastic bone cells, consequently bone sliding increases in areas of stress [9]. Results agree with what was indicated that exercise practice especially exercise of muscles strength and high shocking necessary to growth and density of bone by sliding more minerals which increase strength [1,10]. This agrees with what was reported that sport training especially shocks training, resistance training and bear weight training are one of the best training contribute in maintaining strength of bone and muscles as well as mechanical stress on bone as a result of motor activity lead to calcium sliding on bone, thus the amount of bone building depends on degree of strength and frequency of using[11].

It is clear from Table (5) the decreasing of injury as a result of increasing BMD as injuries decreased during the sport season which applied the suggested program of plyometric shock training at the beginning to 42% as the percentage of injuries of study group players which applied the program of plyometric shock exercises was 28.5 % while control group was 71.4 % by decrease of 42 % for the study group as well as the rate of fracture, bruise and breakage injuries was decreased for study group by up to almost half. The researcher finds that the decline of injuries due to regularity in training and using different methods with a focus on plyomrtric shock training with loading and stress leading to bone solidity and protection from injuries of fracture, breakages and bruises [12]. Asserts that practice of sports and physical exercises increase bone health, so that it should be emphasize on the importance to start sport practice at the beginning of adolescence to reach the maximum bone mass and reduce the occurrence of bone injuries. These results of the study agree with results of other studies which indicated that there is a strong correlation between regulated training programs that contain training of muscular strength that contribute to increase mechanical stress on bone and further improvement of bone density [6,13,14].

CONCLUSION

The regularity in polymeric shock training has a positive effect on increasing bone density BMD. As well as the program of polymeric shock training lead to protection from bone injuries of the research sample by 41 %. Researcher recommends using polymeric shock training to increase BMD due to this important in protection from bone injuries such as fractures, breakages and bruise.

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