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The effect of 6–week plyometrics exercize on hydroxyproline serum of adult and young volleyball men

Omid Reza Arash*, Mohammad Islam Far, Yadullah Edalat Panah

Department of Educution, University of Applied Sciences Dehdasht, Dehdasht, Iran

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ABSTRACT

Objective: Hydroxiproline is the main bio-chemical criterion which shows the ruin of the collage tissue. It is a kind of amino acid which increases the resistance of the collage tissue of tendons, because the Hydroxiproline contains inter-molecule heterogenic connections in its own poly peptide chains. Plyometrics exercises are those kinds of exercises in which occurs a severe shortening contraction and then a long contraction will follow. The purpose of this study is to investigate the rate of changes of hydroxiproline serum in young and adult volleyball men in 6-week Plyometrics exercise. **Methodology**: The method of this study is quasi-experimental. The participants of this study were chosen among the volleyball players of Kohgiluyehand Bouyerahmad province, Iran. 12 young men volleyball players and 12 adult volleyball players were chosen. The sampling process was random. The players were divided into two groups namely, young and adult. Before performing the exercises, the players were asked to fill the questionnaire and testimonial form. **Results**: The Plyometrics exercise decreased the rate of serum Hydroxiproline in young and adult men volleyball players after 6-week exercise, and this decrease was equal between the two groups. It can be said that performing the 6-week Plyometrics exercise make the tendon tissue more adaptable which can prevent the ruin of the other tissues by using regular physical exercises and keep them in a very high condition for a long time. **Conclusion**: By this method the tissue will not be exposed to arthritis and will continue maintaining their natural biosynthesis and gin a kind of adaptability by performing the Plyometrics exercises which include inside and outside contractions.

1. Introduction

Plyometrics exercises improve explosive power, strength, speed and agility, physical fitness which are important factor in sports such as volleyball, handball, football, athletics, and so on. In Plyometrics exercises, the force of muscle contraction is so great which is transmitted via tendons involved in the contraction of muscles to bones and cause the movement of the body. Muscle tendon is always subject to corruption due to pressure (it means that the cells and tissues, including strong links between molecules, are lost due to the pressure of high training in the passage of time) damage and tear (Radcliffe & Farentinos, 2015). Hydroxyproline, an amino acid that increases the resistance of collagenous tendons tissue, this is due to fact that the hydroxyproline has intermolecular hydrogen bonds in their polypeptide chains (Maffulli et al., 2005). Recent researches have shown that collagen and muscle tissues are corrupt after intense exercises which have eccentric contractions, (such as Plyometrics exercises). Research also expressed that the most important biochemical marker of collagenous tissues corruption hydroxyproline (Jordaan, 2004). One of the indicators and determinants of tendon tissue injury is hydroxyproline levels (Jordaan, 2004). Researches showed that collagen hydroxyproline exists only in humans and mammals. Severe contractions are able to produce a lot of power, which in turn transmits this force to the tendon tissue, and cause tiny tears in collagen tissue. Since athletes, so they are considered the main part professional exercises of volleyball players and the other athletes or sports (da Rocha Mafra et al., 2010).

But if the recovery time for this type of training is low, the possibility of the phenomenon of overtraining or injury in athletes is created (Tofas et al., 2008). If the injury occurs during this type of exercise due to short and inadequate exercise muscle tendon and muscle recovery, it may cause an athlete to retire, which subsequently led to a sharp drop in athlete fitness. On the contrary, if the recovery period is completely, it will not only damage an athlete but

* *Corresponding author:* omidrezaarash@gmaill.com
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also an improvement in athlete performance can be observed (Jordaan, 2004). Contusion is not associated with muscle damage and probably refers to fatigue. So, if we recognize the recovery period after this type of exercise we can do better and athletes and coaches can get better results from their exercises. If we can determine that the implementation of a Plyometrics exercises cause compatibility in tendon tissue and increases collagen tissue resistance, we can suggest that corruption c of collagenous tissue due to subsequent implementation of a Plyometrics training session (or performing Plyometrics training period) would reduce the probability of injury of tendon tissues in volleyball players. Because little research has been done regarding the amount and intensity (volume of work) to make Plyometrics adaptation of tendon tissue and compared between young athletes and adults, studies conducted by (Tofas et al., 2008).didn't gain the similar results, On the other hand, because the volleyball players their need to increase their jump, and jumping exercises are considered Plyometrics activities (Radcliffe & Farentinos, 2015). Plyometrics exercises are capable in exerting of extremely high force in tendon collagen tissue to create injury and tear (Virtanen et al., 1993). So, if tissue is able to be adapted to the kind of intense exercise, the possibility of injury during practice and competition will be reduced. Therefore, the present study attempts to answer the question whether through subsequent six-week Plyometrics training, will the serum hydroxyproline levels in young and adult male volleyball players change or not.

2. Materials and methods

The study is a quasi-experimental in nature. The population of this research included volleyball players of Kohgiluyeh and Bouyerahmad province in which the sample included 12 male young volleyball player (16 to 18 years) and 12 male adult volleyball players (above 19 years. The study was stratified random sampling, which means that we divided the volleyball players of the province into two groups (young and adults) and then 12 people were selected for each group randomly. The method of data collection was based on the library research and field study.

In this study the young volleyball players, those who have begun playing volleyball recently are not a member of the first class teams. The adult volleyball players are those who have a background of high training in volleyball premier league of the province and also members of national teams. Before performing Plyometrics exercises, the participants were asked to complete a consent form, then, a week before Plyometrics training (exercises), subjects' test weight, height and BRUCE test were taken. Finally, to measure the amount of hydroxyproline in the pre-test (immediately after the first session) and after test (immediately after the last session) of the sample, to be able to evaluate whether the subsequent six-week Plyometrics training sessions similar to the hydroxyproline content of equal intensity and duration will change or not. Following six weeks Plyometrics a sample was sent to the laboratory of Yasuj medical university. It should be noted that in the first session and the last session duration and intensity Plyometrics exercises are quite similar and at the same time (9 am) at the beginning and end of a six-week course the Plyometrics exercises were performed respectively. In the six-week program two sessions of Plyometrics exercises were performed per week. Statistical methods for research including a paired t-test was used to assess changes in serum hydroxyproline between pretest and posttest for both groups separately, corresponding to the first and second hypotheses and an independent t-test was used to assess changes in serum hydroxyproline of two young adult groups regarding the third hypothesis is done by using version 19 of SPSS software. Graphs of descriptive statistics were calculated by using 2010 version of the Microsoft Office Excel software.

3. Discussion and results

To describe collected data from measurements taken in this study, tables1-2-3-4-5 are used as the following:

Table 1. Mean profile of young and adult men volleyball players

young		adult		
mean	SD	mean	SD	Including
17.65	1.02	26.20	3.12	Age(years)
188.40	8.14	191.82	5.42	height(cm)
78.72	6.42	81.14	7.13	Weight(kg)
245.45	11.09	235.18	17.17	long jump(cm)
50.13	7.52	48.53	2.44	jump height (cm)
50.18	2.8	53.44	9.17	Vo2max (ml/kg/min)

In table 1, the mean and SD of players including age of adult men volleyball players (12/3 ± 20/26 years), height (42/5 ± 82/191 cm), weight (13/7 ± 14/81 kg), long jump (17/17 ± 18/235 cm), jump height (44/2 ± 53/48 cm),maximal oxygen uptake, or VO2max (17/9 ± 44/53 ml per kg per min) and mean (SD) age profile of the young men ¬volleyball (02/1 ± 65/17 years), height (14/8 ± 40/188 cm), weight (42/6 ± 72/78 kg), long jump (09/11 ± 45/245 cm), high jump (52/7 ± 13/50 cm m) and maximal oxygen uptake, or VO2max (88/2 ± 18/50 ml per kg per minute) is given.

Table 2. Mean and SD of serum hydroxyproline(µg/dl) in young and adult men volleyball player.

post-test		pre-test		test
SD	Mean	SD	Mean	
8.84	56.41	8.11	174.16	young
8.77	58.08	14.28	174.58	adult

In table 2 the Mean and SD serum hydroxyproline of young and adult men volleyball players in the pre-test (immediately after the first session) and after test (immediately after the last training session) is given, to see whether the level of serum hydroxyproline in young and adult males volleyball players in the post-test compared to the pre-test of has changed significantly or not, Should be subjected to the test of the hypothesis test can be determined because through the statistical tests can we judge that these differences between the post-test and the pre-test are significant or not.

Table 3. Paired t-test to compare pre-test and post-test serum hydroxyproline in young men volleyball player.

Significant level.	T-statistics	Degrees of freedom	DifferenceMean	Variable
0.05	- 42.27	11	- 117.75	serum hydroxyproline

As Table 3 shows that compared to the pre-test and post-test, the amount of serum hydroxyproline in young men volleyball players following a six-week Plyometric straining shows a significant change (t=-42/27, p=0.05) and a decrease. Therefore, the null hypothesis is rejected and the research hypothesis is confirmed.

In general, it can be concluded that the results of the six-week Plyometric straining can reduce the hydroxyproline content of the serum in both groups of young and adult men volleyball players. According to the test obtained results there is no difference between young and adult men volleyball players at levels of hydroxyproline content compared to the pre-test and post-test.

Table 4. Paired t-test to compare pre-test and post-test hydroxyproline volleyball players in adult men.

Significant level.	T-statistics	Degrees of freedom	DifferenceMean	Variable
0.05	- 21.55	11	- 116.50	Serum hydroxyproline

As Table 4 shows the levels of hydroxyproline in adult men volleyball players post-test compared to pre-test following six-week Plyometric straining has a significant change (t=-21/55, p=0.05) and show a decrease. Therefore, the null hypothesis is rejected and the research hypothesis is confirmed.

Table 5. T-test to compare the amount of hydroxyproline between the young and adult men volleyball player

Significant level.	T-statistics	Degrees of freedom	DifferenceMean	Variable
0.05	-0.206	22	- 1.25	serum ydroxyproline

As table 5 shows the amount of hydroxyproline levels among young and an adult men volleyball player does not show significant difference in the posttest compared to the pretest, followed by six weeks of Plyometrics exercises (t=-0.206, p=0.05). Therefore, the null hypothesis is confirmed and the research hypothesis is confirmed.

4. Conclusion

Researchers who were in agreement with the present study: Chatzinikolaou et al. (2010). They investigated the period of inflammatory responses change following by Plyometrics exercises. In this study, a recovery period (recovery) after prolonged heavy Plyometrics exercise, inflammatory responses and exercise performance of experimental and control groups of 12 men (mean age 34/25 years) were studied. They found that intense Plyometrics exercise can cause muscle damage and may cause temporary inflammatory response (Ducomps et al., 2003).

This study suggests that a necessary and sufficient recovery time should be considered to a Plyometrics sessions. Choi et al. (2010) conducted a research to answer the question of whether a period of 12 weeks of exercise, long-term can be effective on the corruption of young and old male rats' cardiac muscle or not. About 344 young and old male rats were divided into four groups: they were divided into two control groups (young and old) and two experimental groups (young and old). The results showed that the hydroxyproline (HP) and creatine kinase (ck) in both young and older groups compared with control groups other than following to a long-term exercise training period was not significantly different, but in the two control groups the rate of compared to the other two groups of hydroxyproline (HP) and creatine kinase (ck) in male old rats did not differ compared to young male rats. This study suggests that long-term regular physical activity can help prevent heart muscle gradual decay. It was studied that the comparable effect of three model of Plyometrics training on male university students muscle leg strength, and the amount of perishable tissue, tendon collagen (hydroxyproline measurement index) (Abass, 2009). In this study, forty students, with the age ranged between 18-27 were randomly selected according to four groups (a control group and three experimental groups with three different Plyometrics performances). The exercises lasted12 weeks in which Plyometrics exercise training was performed 3 sessions per a week periodically. The results showed that the Plyometrics exercises in which the jump was deep and rebound, had a greater impact muscle strength compared to cross jumps, and the level of hydroxyproline content was reduced after a 12-week training period which is the sign of tendon compatibility with the pressure of exercises (Abass, 2009). Ducomps et al. (2003) conducted a study entitled: the effects of jump training on

passive mechanical stress and limb stiffness in rabbit (the collagen tissue). In this study, the effect of 15 weeks of jump training on collagen concentration in rabbit muscle types 50, 90 and 140 days was investigated. The results showed that jumping exercises, strength and stiffness increase fast contracted muscles, which this increase depends on link collagen (elasticity improves resistance power against) and a reduction in collagen solution. All of the above-mentioned researchers concluded that the maximum intensity exercise, especially in combination with Plyometrics is a combination of extroverted and introverted contraction changes the amount of hydroxyproline levels and reduces it subsequent to implementation of Plyometric straining.(Ducomps et al., 2003) As mentioned, the amount of hydroxyproline as a determinant of the amount of collagen or gelatin, collagen tissue, which is the resistance factor of this tissue. The Plyometrics exercise is formed based on severe inside contraction immediately after outside contraction which is able to exert a high elastic force on collagen tissue which it is responsible for tendon tissue resistance. And possibly damage the tissue and increases catabolism of collagen tissue that may increase serum levels of hydroxyproline in young volleyball players significantly after performing this type of exercise. So, it can be said that after Six weeks Plyometrics exercise in young and adult men volleyball players have probably been affected tendon collagen tissue, and somehow achieve the adaptability to the pressure exerted by Plyometrics exercises that involve sever inside and outside contractions. After six weeks of Plyometrics exercises, this adaptability reduces the level of corruptibility in collagen tissue, tendons, and muscles young men volleyball players (Maffulli et al., 2005).

Consequently, it can be said that the level of serum hydroxyproline following Plyometrics exercises after six weeks of regular exercises show a significant reduction compared to a one Plyometrics training session. Scholars whose results were not in harmony with these findings were: Carroll et al. (2008) in their study investigated the effect of exercise on bone properties and bone collagen network in growing and adult rats.

The results showed that in adult mice, weight training and, running improves mechanical properties of the collagen network without changing the amount of collagen, and also increases the mineral density in adult mice. Thomas et al. (2000) conducted a research titled with a collagen gene expression in rat left ventricle: interactive effect of age and performing exercise, in order to answer the question whether the exercise with sufficient intensity and duration can produce an increase in muscle mass of the left ventricle (LV) and also deposition of collagen crosslinks in the surface, intermediate and in pre transitional level or not. Thus, the effects of exercise training on gene expression of collagen fibrils in both the original LV, Type I and Type III, in young adult mice (5 months old), middle-aged (15 months) and old mice (26 months old) were measured. We also estimated potential interactions for precollege mRNA changes with changes in material properties by simultaneous measurement of the concentration of extracellular collagen (hydroxyproline (HP)) and the level of mature collagen cross-links (hydroxy-lysine, Pried Yelunin HP). Ten weeks of treadmill running made the LV muscle bulk and increased uptake in all three age groups trained mice compared to sedentary mice of control group. Percentage of collagen in the LV of mice from 5-26 months almost doubled and this increase was unchanged by exercise. With aging, a significant reduction in the incidence of both collagen mRNA ($P < 0.005$) I and III ($p < 0.001$) in the cutoff wall (LVF) LV and not in the LV layer (LVS) was observed. Performing exercise prevented LVF-mRNA in both collagen fibrils decline middle-aged rats while the loss in aging animals decreased. Several studies have shown that collagen fibers require all of crosslinks that have them shortly after synthesis. Crosslinks are Maximum at early stage of life after birth and appear at least at physical maturity stage (Thomas et al., 2000).

Newly synthesized collagen molecules are strong with reducible crosslinks, but their number is reduced during maturation. Uneducable loss of mature collagen crosslinks can be found on the tissue, which is stronger tougher and more stable. Reduction of crosslinks causes extremely weak and frail collagen fiber (Thomas et al., 2000). Collagen cross-link communication is one of the most marked biological aging. Crosslink communication substances are produced in pregnant groups, and removed by means of metabolic processes in early life. But accumulate in aging, for example, hydroxyproline in young animals is released quickly and in large quantities while in older animals it is released slowly with small amount. However, another study has stated that Biosynthesis of collagen decreases with maturation and endurance training increases keeps the higher the level of biosynthesis of the muscles in the lifetime. Therefore, with regular exercise in the lifetime one can have a high biosynthesis of collagen tissue and muscle (Koyama et al., 1993). For this reason, it probably be stated: because The two groups were athletes and had a similar amount of collagen tissue synthesis regarding the high-intensity training (Plyometrics exercise) showed the same response. In this study, Bruce test was used to determine the maximum oxygen consumption (Tofas et al., 2008). Based on all mentioned in the above, it can be said that based on theories of tissue tearing and damage in young and adult men volleyball players participated in this study, following the Plyometrics exercises which were performed with intensity, were exposed to small damage in the cell membrane of the muscle tissue and cross-linked collagen tendon tissues which after the six-week of performing Plyometrics training it is likely to create more compatibility in tendon tissues. It has been observed that after performing Polymeric, compared to pre-exercise values in both groups the serum hydroxyproline levels decreased significantly in young and adult men's volleyball players. This study suggests that the coaches and athletes should consider recovery time needed between Plyometrics exercises.

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