ORIGINAL ARTICLE

Comparison between depth jump and counter-movement jump for increasing vertical jump height in male Badminton players

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ABSTRACT:

Background: Many controversies exist between effects of jump training programs. Hence the objective of this study was to study the effectiveness of jump training in male Badminton players and to compare depth jump training and counter movement jump training for increasing vertical jump height.

Material and Methods: 30 Male Badminton players undergoing training, aged 20-25 years and playing Badminton for at least 1 year were selected by simple random sampling method. Amateur and professional badminton players, those with history of musculoskeletal disorders within 6 months, cardiovascular disorders, neurological disorders and body weight more than 220 lbs were excluded from the study. The players were randomly divided into two groups: - countermovement jump group and depth jump group. Their static vertical jump was assessed and they were given a separate training program for 6 weeks (two sessions/week). Outcome was assessed as improvement in vertical jump score at the end of 6 weeks. Analysis was done using paired and unpaired t test.

Results: The mean pre training vertical jump score in the Counter movement jump group was 38.5 which increased to 39.1 at 3 weeks of training and further increased to 39.7 at 6 weeks of training. The mean pre training vertical jump score in the depth jump group was 39.6 which increased to 40.4 at 3 weeks of training and further increased to 41.4 at 6 weeks of training. There was a significant increase in the vertical jump height post-training in both the groups at 3 and 6 weeks (<0.01). The increase in depth jump group was significantly more than the increase in counter-movement jump group at 6 weeks (<0.01).

Conclusion: Jump training program is effective to increase vertical jump height in male Badminton players. However, depth jump training program is significantly more effective for improving vertical jump height as compared to countermovement jump training program.

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INTRODUCTION

Badminton was included into the Olympics Games in 1992.[1] Badminton is one of the most popular racket sports in the world. In badminton, the most commonly used stroke is the overhead smash. [2] It requires much greater explosive athleticism with players required to jump for height or distance.[3]So, strength, explosive power, agility and flexibility conditioning are necessary to maximize speed about the court and powerful overhead smashes.[4, 5] However; there is still a lack of scientific research done on this sport as compared to other sports such as swimming or soccer. 3

Jumping and landing movements are fundamental features of many sporting activities.[6]Many athletes seek to jump higher.[7] Several studies used plyometric training and have shown that it improves power output by training the muscles to do more work in a shorter amount of time.[8] Vertical jumps (VJ) are most common sport movements in a large number of sports.9 So, coaches and athletes are interested in the improvement of VJ in sports[10].

Numerous training techniques have been used to increase vertical jump. The two commonly used techniques are Depth jumps and Countermovement jumps. Depth jumps (DJ) use the athlete's body weight and gravity to exert force against the ground. They are performed by stepping out from a box and dropping to the ground, then attempting to jump back up to the height of the box. One should attempt to step out into space before dropping to the ground. Upon making contact with the ground, the athlete directs the body up as fast as possible.

Countermovement jump (CMJ) is simply flexing the hips, knees, and ankles, allowing for a rapid descent of the body's center of gravity before using concentric muscle activity to jump vertically. A countermovement jump is where the jumper starts from an upright standing position, makes a preliminary downward movement by flexing at the knees 90 degrees, then immediately extends the knees and hips again to jump vertically up off the ground. [11]

Very less number of researches has directly compared the effects of CMJ vs. DJ training for improving vertical jump ability, the primary purpose of this study was to determine

whether DJ training was superior to CMJ training for improving vertical jump ability.

METHODOLOGY

30 Male Badminton players undergoing training, aged 20-25 years and playing Badminton for at least 1 year from the nearby Badminton clubs approved by the guide and college were selected by simple random sampling method. Amateur and professional badminton players, those with history of musculoskeletal disorders within 6 months, cardiovascular disorders, neurological disorders and body weight more than 220 lbs were excluded from the study. The players were randomly divided into two groups: - countermovement jump group and depth jump group.

Method of random allocation – chits were made and kept in box, in which 15 chits of each group countermovement and depth jump group were made (total 30) and mixed thoroughly and then the subject was asked to pick one chit randomly & according to that he was allocated into respective group. Then that chit was removed from that box.

If the subject picked up countermovement jump group chit then he had been given a countermovement jump protocol two times a week for six weeks. If the subject picked up depth jump group chit then he had been given a depth jump protocol two times a week for six weeks.

All procedure was adequately explained to the subjects and an informed consent was obtained from each of them. Then consenting subjects agreed that they would not engage in any other lower limb exercise.

PROCEDURE:-

Before taking measurements each subject wore loose and cotton clothing for comfortable movements.

30 male Badminton players were randomly selected from various badminton clubs and their static vertical jump was assessed and recorded by static vertical jump test.

The static vertical jump test consisted of a person to jump as high as he or she possibly could. The test began with the participant standing 6 inches (15.2cm) to the side of the wall. Some chalk was put on player's finger tips on hand which was near the wall. An initial measurement was taken with the participant reaching as high as possible with his or her feet flat on the ground. A mark was made at this point with the chalk on finger tips. The participant then bent down, swinging his both arms down and backward quickly forward and up, and jumped as high as possible. At the highest point a chalk mark was left on the wall. 3 trials were performed and the highest jump was recorded. A brief recovery of 30 seconds was given between each trial. The distance between the initial standing mark and maximum jump reach was recorded. [20,21] .The purpose of the study and procedure was explained to the subjects.

The study utilized 6-weeks of program duration, with two sessions per week (twelve sessions in total)[22]. Subjects were then randomly assigned to 1 of 2 groups. During the first 2 weeks the subjects performed 2 sets of 8 reps to familiarize themselves with the training. For the remaining 4 weeks, both training groups completed 4 sets of 8 reps. To isolate the contribution from the leg muscles, subjects were asked to place their hands on their hips throughout each jump for both depth jump and countermovement jump groups. The subjects were asked and motivated to give their maximum effort to perform highest jumps while training. [18]

TRAINING PROTOCOL:-

Countermovement jump

Photograph 1a: Starting position of CMJ

Photograph 1b: Countermovement squat before jump in CMJ

Depth jump

Photograph 2a: Starting position of DJ

Photograph 2b: Dropping off from the box in DJ

15 players were assigned countermovement jump program (photograph 1a and 1b) consisting of a standardized 10-minute warm-up consisting of light jogging and lower limb muscle stretching.[22]. The players were advised to start from a standing position. Next, rapidly dip down to a knee angle of

Photograph 2c: Squat before the jump in DJ

90 degrees4, and jump as high as possible. The hands were held on the hips during the jump to avoid any effect of arm-swing. 5 sec rest was given between each repetition. Additionally, 1 min of rest between each set was provided.[2] Focusing gaze straight ahead was instructed.[18]

15 players were assigned depth jump program (photograph 2a,2b,2c) consisting of a standardized 10-minute warm-up consisting of light jogging and lower limb muscle stretching.[22] Each participant was instructed to jump in the proper box drop technique and given the opportunity to practice while receiving feedback. The standardized technique was used requiring the athletes to step off the drop box platform, land both feet simultaneously on the floor, flex knees to 900 and immediately rebound upward with a maximal effort, as high as possible was explained to each player. Focusing gaze straight ahead will be instructed. A rest of 5 sec between each repetition upon returning to the 40cm step was given to each player. Additionally, 1 min of rest between each set was provided. A height of 40cm was chosen because of the reported high levels of Achilles tendon tension when jumping from greater heights.[18]

Static Vertical jump was again assessed after 3 weeks and then after 6 weeks and results were recorded and analyzed.

OUTCOME MEASURE :

Static Vertical jump test [20, 21] - The static vertical jump test consists of a person to jump as high as he or she possibly can. The test begins with the participant standing 6 inches (15.2cm) to the side of the wall. Some chalk is put on player's finger tips on hand which is near the wall. An initial measurement is taken with the participant reaching as high as

possible with his or her feet flat on the ground. A mark is made at this point with the chalk on finger tips. The participant then bends down, swings his both arms down and back, quickly swings both arms forward and up, and jumps as high as possible. At the highest point a chalk mark is left on the wall. Perform 3 trials, recording the highest jump. A brief recovery of 30 seconds is given between each trial. The distance between the initial standing mark and maximum jump reach is recorded.

High reliability a coefficients between 0.93 and 0.96 for static vertical jump test is recorded. Since jumping test has high correlation coefficients with the principal component (r = 0.76-0.87), it is interpreted as the explosive power factor. Reliability will depend upon how strict the test is conducted and the individual's level of motivation to perform the test. This test provides a means to monitor the effect of training on the athlete's physical development.[23] Since only one of the kinesiology professors could accurately and consistently rate range of motion compared to the majority of the students, professional experience did not affect the ability to rate range of motion in the vertical jump in these subjects.[24]

Mean standard deviation and standard error was carried out for all the groups in this study[25]. Within group analysis was done using paired t test and between group analyses was done using unpaired t test.

RESULT

By applying paired t-test for countermovement jump group:-

Highly significant increase in vertical jump was observed after 6th week as compared to 3rd week ($p<0.01$) (table1)

Table 1: Vertical jump score pre-training, after 3 weeks and after 6 weeks in countermovement jump group

CMJ	VJ Pre-training	VJ after 3wks	VJ after 6 wks
Mean	38.56667	39.1	39.7
P value	<0.01	<0.01	<0.01

By applying paired t-test for depth jump group:-

Highly significant increase in vertical jump was observed after 6th week as compared to 3rd week ($p<0.01$) (table2)

Table 2: Vertical jump score pre-training, after 3 weeks and after 6 weeks in depth jump group

DJ	VJ pre-training	VJ after 3 weeks	VJ after 6 weeks
Mean	39.63333	40.44667	41.46667
P value	>0.01	<0.01	<0.01

By applying unpaired t-test for comparison between countermovement jump group and depth jump group:-

Same amount of significant increase in vertical jump was observed in both the groups on 3rd week as p-value was greater than 0.01 (0.068808) ($p>0.01$). Significant increase in vertical jump at 6th week was observed in depth jump group with p-value 0.000815 ($p<0.01$). (table3)

Table 3: Comparison between countermovement and depth jump groups from 3rd week to 6th week

	Mean			p value		
	VJ 1 to 3 wks	VJ 3 to 6 wks	VJ 3 to 6 wks	VJ 2 to 3s wk	VJ 3 to 6 wks	VJ at 6 wk
CMJ	0.533333	1.133333	0.6	<0.01	<0.01	<0.01
DJ	0.813333	1.833333	1.02			

DISCUSSION

The main principle behind increase in the vertical jump height after plyometric jump training is the principle of stretch-shorten cycle. During a stretch-shorten cycle (SSC), muscles are actively lengthened prior to a subsequent shortening phase that is muscles are activated eccentrically immediately prior to shortening. The stretched components of the muscle-tendon unit store elastic recoil potential energy (or elastic strain energy), a portion of which may be subsequently recovered. The storage and recovery of elastic strain energy during a SSC is an important determinant of performance, as the energy stored during a lengthening cycle can substantially amplify force and power production in the subsequent shortening cycle Many changes occur in the muscle-tendon unit after plyometric jump training, like the muscle adapts to demands placed on it and there better neuro-motor recruitment.

According to some authors [16, 23] DJ training proved superior to CMJ training. However several other authors [24,12,29,26] have shown negative influences of depth jump training in their studies. Whereas, others Authors [25] have observed that both countermovement jump training and depth jump training program are equally worthwhile training programs. The present study supports the findings that depth jump training is better training program than Countermovement jump training program.

Depth jumps use the athlete's body weight and gravity to exert force against the ground. Depth jumps are performed by stepping out from a box and dropping to the ground, then attempting to jump back up to the height of the box. This activity requires the athlete to time the drop and be prepared to reverse the descent (eccentric to concentric muscle action) at the time the stimulus is perceived (when the feet make contact with the ground).Controlling the height dropped helps not only to accurately measure intensity but also to reduce overuse problems.

Holcomb et al. have examined the differences between training with the depth jump (DJ) versus the countermovement jump (CMJ). The mechanical distinction between these two activities is that the CMJ is simply flexing the hips, knees, and ankles, allowing for a rapid descent of the body's center of gravity before using concentric muscle

activity to jump vertically, while the DJ requires the use of body weight to eccentrically load the muscles via a vertical drop from a prescribed height.

Stepping off a box to the ground is similar to landing from a jump in any sport based on assumption that touch down velocity of the center of mass from a certain height is always the same.[26]

The relative simplicity of performing the depth jump has made it an easy task to study.[11]

Thus Depth jump training is superior because it improves the mechanical output of knee extensors and plantar flexors.[27]DJ training proved superior to CMJ training due to neuromuscular specificity.[18] DJ allows the athlete to time the drop and be prepared to reverse the descent. This helps to decrease the Amortization phase by stressing on touch and go action as the athlete can time and control the procedure.

CONCLUSION

The clinical implication of this study suggests that depth jump training program is effective training program for improving the vertical jump height in male Badminton players as compared to countermovement jump training program. So it is possible that male Badminton players may be able to experience gains in vertical jump ability through depth jump training program.

LIMITATIONS:

Static vertical jump test is not as accurate as a commercial devices like jump mat. A commercial device will usually give slightly more accurate and objective result, because testing conditions will always remain uniform for each trial. Also, the effect of vertical jump improvements is not compared to the performance improvement in Badminton players.

SCOPE OF FURTHER STUDY:

The further studies can be done using more accurate commercial devices like jump mats. Studies can also be done to see the effect on the performance of the athlete after increasing the jump height.

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