LOW VOLUME PLYOMETRIC TRAINING IMPROVED POSTURAL STABILITY IN BASKETBALL PLAYERS

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SUMMARY
The purpose of this study was to evaluate the effects of six weeks of low-volume PT on dynamic PS. 24 male collegiate basketball players volunteered to participate in the study and were randomly assigned to the experimental or control groups. The experimental group underwent low volume PT exercises (80-120 jumps) twice a week for six weeks. Dynamic PS was evaluated by the 8-direction limits of stability (LOS) test using the Biodex Balance System. Repeated measures analyses of variance (ANOVA) were conducted to determine if any differences existed between groups and time of testing in any of these parameters. Results showed that LOS performances in the total, forward, left, forward-left, and forward-right directions were significantly improved after six weeks of low-volume PT. This study demonstrates that low-volume PT can improve dynamic PS in collegiate basketball players.

METHODS
Twenty-four collegiate male basketball players volunteered to participate in this study. Subjects were at least 18 years of age and free of lower extremity injuries, and randomly assigned to the experimental or control group (12 in each group). All the participants were right-leg dominant for kicking and performed the same basketball training exercises, but the PT experimental group performed an additional low-volume PT exercise program with the same supervisors for six weeks. The mean ± SD age, body weight, and height of the subjects in the experimental group were 20.3 years, 75.3 kg, and 178.5 cm, respectively. In the control group, the mean ± SD age, body weight, and height were 20.4 years, 75.3 kg, and 178.9 cm, respectively. The study was approved by the ethics committee of the university, and informed consent was obtained from all the participants.

This study was conducted during the off-season, when the players attended general basic basketball training exercises (i.e., straight line dribble, crossover dribble, turn around dribble, stop step dribble, cross leg dribble, behind the back dribble, slide step, cross steps, slide and arch run, two and five man fast break, three man weave, three point shooting, etc.) twice a week for 60 minutes. The PT group also performed the same basketball training exercises as the control group, but the control group did not participate in the PT intervention or other training outside of their basic basketball training and normal daily activities. All participants had been involved in similar levels of basketball training for more than 2 years before the study.

A 6-week low-volume PT program was developed consisting of two training sessions per week, and was incorporated into the subjects’ usual twice-weekly basketball training regime. The training program was based on recommendations of intensity and volume from previous studies, using similar exercises, sets, and repetitions for the beginning and intermediate workouts. Training volume started at 80 foot contacts per session in the first three weeks (6 sessions), and was then increased to 120 foot contacts per session in the fourth and fifth weeks (6 sessions) during week 6. The intensity of training was tapered so that fatigue would not be a factor during post-exercise testing. Throughout the study, all subjects trained at the same time of the day, two days a week for twenty minutes each. During the training, all subjects were under direct supervision by the same trainers including...
certified basketball coach and fitness instructor and were instructed on how to perform each exercise.

Dynamic PS was measured by the Biodex Balance SD (BBS, Biodex Medical Systems, Shirley, NY, US), which comprised of a multi-axial foot platform connected to a computer and a screen located in front of the subject. In this study, the subjects performed the dynamic limit-of-stability (LOS) protocol, a task requiring them to control the cursor by moving the platform, such that the cursor moves back and forth from a central box to eight peripheral boxes appearing successively in a random order on the screen. Subjects were bare footed and tested on a bipedal stance at levels 3 twice representing unstable situations.

Nine $2 \times 2$ (trained/untrained groups × pre/post tests) analyses of variance (ANOVAs) with repeated measures were conducted to determine if any significant difference existed between groups (experimental versus control groups) or time of testing (pre-training versus post-training) for overall LOS score at level 3 and the eight individual directions LOS scores. An alpha level of .05 was used to determine the significance level for all analyses. Statistical analyses were conducted in Statistical Package for Social Science for Microsoft Windows, version 12.0 (SPSS Inc, Chicago, Ill, US).

RESULTS AND DISCUSSION

The overall LOS scores for the PT group at levels 3 pre- and post-training changed from 17.2±6.3% to 23.9±7.1%. The overall LOS score for the control group at levels 3 in pre- and post-training changed from 17.2±6.3% to 23.9±7.1%. The overall LOS scores for the PT group at levels 3 pre- and post-training changed from 17.2±6.3% to 23.9±7.1%. The overall LOS scores for the control group at levels 3 in pre- and post-training changed from 17.2±6.3% to 23.9±7.1%.

significant main effect of training between groups ($F=4.62$, $p < .05$). In addition, the results of the ANOVA for each direction of the LOS score at level 3 also indicated a significant interaction between the groups × pre/post repeated measures with post-training scores higher than pre-training scores in the PT trained group ($F=8.16$, $p < .05$), forward-right ($F=5.27$, $p < .05$), forward-left ($F=8.16$, $p < .05$) directions with post-training performance being better than pre-training in the PT group.

PT refers to exercises that are designed to enhance muscle strength and power, mainly through the use of jumping, bounding, and hopping, including the countermovement jump, the drop jump, and the squat jump. The main findings of this study suggest that this kind of PT can significantly improve dynamic PS performance, as shown by the improvement in the dynamic LOS test, especially in the forward, left, and forward-left directions during unstable situations.

Significant improvement in the overall performance on the unstable, level 3 LOS test indicates that a 6-week period of low-intensity PT can improve dynamic PS (figure 1). This improvement could be due to enhanced neuromuscular coordination and neural adaptations between the CNS signal and proprioceptive feedback, or to better facilitation of neural impulses to the spinal cord. It is commonly assumed that core strengthening, PT, and jumping exercises can alter the movement patterns of athletes and lower the incidence of injury. Our study provided further support for this hypothesis, since it showed that PT could facilitate voluntary active postural and lower extremity corrections during the unstable LOS test.

Furthermore, this is the first study to demonstrate the effectiveness of low-intensity PT as a component of a training program during the pre-season or in-season. The training protocol used in this study for PT was based on traditional recommendations offered in the literature. As regards athletic trainer and conditioning coaches, the benefits associated with low-intensity PT on dynamic PS and/or injury prevention may be highly valuable to teams that have limited time for training in the weight room. Maximizing the benefits of any training program within the limited time available for training is an important objective of most strength coaches in high school, college, and professional environments.

CONCLUSIONS

Implementing a 6-week low-intensity PT program had positive effects on dynamic PS, not only improving the total performance in the LOS test, but also improving the performance in the forward, left, and forward-left directions with only 20 minutes of extra training twice a week. Specifically, such a program might facilitate voluntary active postural and lower extremity corrections, therefore improving performance in dynamic PS and LOS measures.

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REFERENCES