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EFFECTIVENESS OF PROPRIOCEPTIVE TRAINING VERSUS PLYOMETRIC TRAINING TO IMPROVE BALANCE, AGILITY AND POWER IN ADOLESCENT SOCCER PLAYERS

Physiotherapy

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ABSTRACT

Background Scientific literature reports conflicted results on effectiveness of plyometric and proprioceptive training on balance, agility and power of an athlete. Also certain literature reveals lesser balance and agility in adolescent players, as they are subjected to maturation process. Thus this study aims to assess and compare the effect of proprioceptive training and plyometric training on balance, agility and power of adolescent soccer players. **Methods** A pre-test post-test comparative study with six weeks training was designed. Forty five subjects who fulfilled inclusion exclusion criteria were recruited, and allocated to 3 groups for proprioceptive training (Group A n=15), plyometric training (Group B n=15) and conventional training (Group C n=15) using convenient sampling method. Outcome measures used were stork balance test for static balance, t test for agility and triple hop jump test for power. The data was analysed with paired t test and ANOVA. **Result** Analysis revealed significant improvement in static balance in Group A. Group B expressed significant improvement in agility and power compared to other groups.**Conclusion** Current study concluded that proprioceptive training is effective in improving static balance of adolescent soccer players, whereas plyometric training is effective in improving agility, and power of adolescent soccer athletes.

KEYWORDS

Proprioceptive training, Plyometric training, Static balance, Agility, Power

Background

Soccer is a dynamic sport where the players adapt their movement patterns based on changes in environment and dynamic profile of the play.[1]Soccer players require explosive power, strength, speed, agility, balance, flexibility and endurance, as the game demands bursts of explosive activity. Sprints in soccer are mainly performed short distance with maximal velocity or intensity, thus speed or quickness is another important component in soccer.[3] The environmental imposition and expertise requirements of the game provoke sensorimotor systems, which cumulatively influence the balance abilities of trained soccer players.[4] Coordinative abilities play a vital and fundamental role in sports, as they allow athletes to easily control theirmovements.[5]

Proprioceptive training which is progressed in terms of skill and complexity has effect on balance of unstable ankles, postural control, and diminishes ankle sprains. It aimsto perform gradually more challenging actions while maintaining movement accuracy. The emphasis therefore is on quality of motion rather than quantity of musclework.[23]Plyometric training employs explosive movements such as bounding, hopping, and jumping to develop muscular power. It helps an individual to react to the ground surface in such a way that they develop larger than normal ground forces that can then be used to project the body with greater velocity or speed of movement.[27] Plyometrics has positive effects on sport performance, including distance running, jumping, sprinting, and leg- extension force.[31,32,33]

Literature review revealed controversial results on the effect of proprioceptive and plyometric training on various parameters of physical fitness like balance, agility and power among athletes which lead to the design of current study.

Aim and objectives

The aim of the study was to compare effect of proprioceptive training and plyometric training on balance, agility, and power in adolescent soccerplayers. The objectives were to find out the effect of proprioceptive and plyometric training on balance, agility, and power in adolescent soccerplayers.

Methodology

Three group pretest posttest comparative design was employed with a convenient sampling method. Ethical approval was obtained from the Institutional ethics committee. The independent variables were proprioceptive exercises, plyometric exercises and conventional exercises whereas the dependent variables were balance, agility and power. Forty five male subjects in the age group 11- 17 years were recruited for the study. All of them were active players in football team or academy for past one year with routine physical training. Athletes with any musculoskeletal or neurological deficits reported in past two years were excluded from study. Informed consent was taken from participants and their parents. Subjects were divided randomly to group A for proprioceptive training, group B for plyometric training and group C for conventional training with 15 subjects in each group.

Before commencing intervention, outcomes were measured using Stork test for static balance, T test for agility and Triple Hop Jump Test for power. A six week training was given to each group and evaluation was conductedafter 6 weeks intervention.The data was analyzed statistically using SPSS 16 version.

Group A received proprioceptive training for 1 hour per day, 3 days/week for 6 weeks along with conventional training. This consisted of 18 set of exercises with 4 sets in single leg stance on floor, 5 sets of exercise with another player in single leg stance, 4 sets of exercise on balance board and 5 sets of exercise on balance board with pair of players.[23]Group B received plyometric training for 1 hour per day, 3 days per week for 6 week along with conventionaltraining. This consisted of squat jump, ankle jump, forward zigzag jump, lateral saw tooth jump, jump upon steps, split squat jumps, hop for a distance, tuck jump, diagonal hops and agility ladder with maximum 10 repetitions.[40]Group C received conventional training only which included warn up, stretching, strengthening exercises, endurance training and game oriented skill training like target passing drills, dribbling and juggling.

Results

The age group considered for the study was between 11-17 years and the mean age for the group A was 14.80 (±1.32), mean age of group B was 14.20 (±1.47) and for the group C was 13.93(± 1.38).The mean BMI for the group A was 20.08 (±2.82), group B was20.55 ((±4.08) and for the group C was 21.66 (±4.19)

The pre-test & post-test mean value for static balance in group A for the left extremity was 11.69 (±5.99) &17.86 (±6.33) respectively and for right extremity was 11.02 (±5.29) &17.60 (±5.77) respectively. The mean difference on left and right side was -6.17 and -6.13 and t value-10.59 and -6.13 respectively withp < 0.001. The analysis suggested significant effect of proprioceptive training on static balance on both lower extremities among adolescent soccerplayers.

The pre-test & post-test mean value for static balance in group B for the left extremity was 8.33 (±4.49) &9.43 (±3.84) respectively and for right extremity was 8.75 (±3.81) &8.35 (±3.11) respectively. The mean difference on left and right side was -0.048 and 0.306 and t value -0.12 and0.97 respectively withp > 0.05.Theanalysis suggested no significant effect of plyometric training on static balance on both lower

extremities among adolescent soccerplayers.

The pre-test & post-test mean value for static balance in group C for the left extremity was 7.54 (±6.18) &7.27 (±5.97) respectively and for right extremity was 7.13 (±5.63) &6.85 (±5.29) respectively. The mean difference on left and right side was 0.26 and 0.28 and t value1.23 and 1.27 respectively with p > 0.05.The analysis suggested no significant effect of conventional training on static balance on both lower extremities among adolescent soccerplayers.

While analyzing the result, group Aonly expressed a significant improvement in static balanceleading to the conclusion that proprioceptive training is effective to improve static balance in adolescent soccer athletes compared to plyometric and conventional training.

The pre-test & post-test mean value for agilityin group A was 12.17 (±0.569) &11.32 (±0.692) respectively. The mean difference was -0.011 and t valuewas -0.11 with p>0.05. The analysis suggested no significant effect of proprioceptive training on agility among adolescent soccerplayers.The pre-test & post-test mean value for agility in group B was 11.00 (±1.27) &13.04 (±0. 1.06) respectively. The mean difference was 1.86 and t value was 11.79 with p > 0.001. The analysis suggested significant effect of plyometric training on agility among adolescent soccerplayers.The pre-test & post-test mean value for agility in group C was 12.35 (±0.84) &12.36 (±0.78) respectively. The mean difference was -0.012 and t value was -0.14 with p > 0.05. The analysis suggested no significant effect of conventional training on agility among adolescent soccerplayers.

Group B who received plyometric training only revealed significant improvement in paired t test for agility. This lead to the conclusion that plyometric training is effective in improving agility among adolescent soccer athletes compared to proprioceptive and conventional training.
The pre-test & post-test mean value for power in group A for the left extremity was 591.66 (±48.14) &591.40 (±48.75) respectively and for right extremity was601.73 (±56.12) &598.06 (±50.93) respectively. The mean difference for left and right side was 0.26 and 3.66 and t value was 0.068 and 1.105 respectively. Analysis expressed p >0.05 on left side indicating no significant improvement with proprioceptive training on the lower extremity power in adolescent soccerplayers. Whereas, the right extremity expressed p < 0.05 indicating significant improvement with proprioceptive training on the lower extremity power in adolescent soccerplayers.

The pre-test & post-test mean value for lower extremity power in group B for theleft extremity was 490.93 (±88.20) &521.66 (±90.86) respectively and for right extremity was 495.26 (±79.64) &526.93 (±83.48) respectively. The mean difference for left and right side was -30.73 and -31.66 and t value was -7.54 and -5.92 respectively. As p < 0.001on both extremities, it suggestedsignificant improvement with plyometric training on the lower extremity power in adolescent soccerplayers.

The pre-test & post-test mean value for the left lower extremity power in group C was 528.20 (±100.10) &529.06 (±100.66) respectively and for the right extremity was 531.26 (±90.16) &532.26 (±87.59) respectively. The mean difference for left and right side was-0.86 and -1.00 and t value was -0.31 and -0.28 respectively. As p >0.05 on both extremities,the result suggested no significant improvement in lower extremity power with conventional training among adolescent soccer players.

Group B who received plyometric training only expressed significant improvementin lower extremity power in paired t test. Therefore it can be concluded that plyometric training is the better option for muscle power compared to proprioceptive or conventional training among adolescent soccerathletes.

Discussion

Results revealed that proprioceptive training is effective in improving static balance and plyometric training is effective in improving agility and power among adolescent soccer players whereas conventional training do not have significant effect on balance, agility and power.

According to Huihuiwang et al, proprioceptive training provokes both fast and slow proprioceptive receptors, periodically resulting in adaptation of imposed demands. Fast receptors response to quick adaptation of postural demands and generate maximal impulses on external stimuli whereas slow fibers adapt slowly.[50] Hence 6 week of proprioceptive training might have imposed an adaptation to these receptors in the adolescent soccer players. According to Distefano et al, nine weeks progressive plyometric training will be required in pediatric population to provide sufficient exercise load to cause change in balance ability.[35] As the present study conducted only 6 weeks plyometric training which may not affected the balance. As Group B and Group C didn't reveal any significant improvement in static balance in paired t test, ANOVA was not conducted to compare the groups.

According to Johnson. B et al, plyometric training induces stretch shortening cycles in the target muscle, which leads to reduction in amortization phase. This allows greater power production from the target muscle that in turn increases speed of movement or explosiveness.[13]Plyometric training can optimize stretch shortening cycle in lower limb muscles and in turn can produce improvements in agility test time. According to Simeksalaj, proprioceptive training improves strength of flexors and extensors of foot rather than invertors and evertors. This study also states that to improve agility in athlete lateral movements should be incorporated in training programs,[26] which was lacking in proprioceptive and conventional training. As Group A and Group C didn't reveal any significant improvement in agility in paired t test, ANOVA was not conducted to compare the groups.

Significant improvement in power could be due to neuromuscular adaptations like excitability in stretch reflex, increased agonist neural drive, changes in musculo-tendinous mechanical stiffness characteristics, and inter-muscular coordination.[26] According to Liu Ambrose, power can be assessed in both horizontal and vertical jump tests where the muscle contributors of vertical jump without arm-swingare leg extensors followed by hip extensors whereas for horizontal jumps,hip extensors have greater involvement.[25]As triple jump hope testis a horizontal jump test, more activation generated on hip extensors to achieve better score. Proprioceptive and conventional training lack activation of hip extensors which could have affected the results.

Conclusion

The present study revealed that proprioceptive training is effective in improving static balance and plyometric training is effective on improving agility and power among adolescent soccer players.

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