Effects of static and dynamic stretching during Warm-up on vertical jump in Soccer players

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Abstract

The purpose of this study was to examine the effects of different stretching methods during warm-up on the power in soccer players. Therefore, nineteen professional soccer players (height: 173.37 ± 7.64 cm; mass: 68.12 ± 8.69 kg; age: 25.00 ± 4.56 years) were tested for power using vertical jump test after different warm-ups protocols consisting of static stretching, dynamic stretching, dynamic exercise, and no stretching. All data variables from the dynamic stretching, static stretching and static stretching trials were normalized to no stretching data and then analyzed at significance level of p ≤ 0.05. There was significant increase in power after dynamic stretching (1.62 ± 5.36 m) vs. static stretching (-1.43 ± 5.58 m) at p < 0.002, but there were no significant differences between dynamic stretching vs. dynamic exercise (0.12 ± 4.45 m) and dynamic exercise vs. static stretching. We concluded that soccer players probably perform better power after dynamic stretching and could be with more training on dynamic exercise; they can adapt their body with this stretching condition to perform better performances.

Keywords: Soccer, Dynamic Stretching, Static Stretching, Power, Warm-up

Introduction

Power is a fundamental determining factor of many types of athletic performance, and its improvement of efficiency during training and competition can be improved with proper warm-up (Faigenbaum et al., 2006). It is believed that the use of stretching as part of a warm-up routine may improve performance and decline the risk of injuries and postponed onset muscle soreness (Knudson et al., 2001). However, recent researchers have reported reduces in different strength and power output tests when they are followed by static stretching (Fowles et al., 2000; Nelson et al., 2001; Young and Behm, 2003; Yamaguchi et al., 2006; Bacurau et al., 2009). Therefore, some researchers suggested that players should not use static stretching before activities that depend of high levels of strength and power (Fowles et al., 2000; Bacurau et al., 2009). On the other hand, investigators suggested that dynamic stretching is more helpful than static stretching to improve explosive performance. Dynamic stretching has been reported to either facilitate power and jump performance or have no adverse effects (Dalrymple et al., 2010). Thus, the use of dynamic stretching rather than static stretching for the warm-up would tend to be a more prudent option.

According to previous studies, there were conflicting findings in acute effects of stretching on vertical jump. It appears that an important gap is yet to be filled by sport scientists: determine the response of vertical jump after different stretching methods in soccer players. Thus, the purpose of this study was to examine the acute effects of static stretching, dynamic stretching, dynamic exercise and no stretching methods on vertical jump. Established upon previous studies suggesting a decrease in vertical jump height after static stretching, it is hypothesized that there will be an acute decrease in vertical jump after static stretching, whereas performing dynamic stretching will enhance the vertical jump.
Materials and Methods

Participants

Twenty male soccer players (height: 173.37 ± 7.64 m; mass: 68.12 ± 8.69 kg; age: 25.00 ± 4.56 years) were tested as part of their athletic training program. All subjects who had no history of major lower limb injury or disease, volunteered to participate in this study. Finally, just 19 participants accomplished the protocol. The university institutional review board gave approval for all procedures. Subjects were required to report to our research laboratory to read and sign a medical questionnaire and an informed consent.

Procedure

Subjects were divided into four groups, that is, each group included five subjects. Each group performed four different warm-up protocols on four non-consecutive days. The warm-up protocol used for each group was performed in a randomized manner, which is displayed in Table 1. Subjects performed four minutes jogging, one of the stretching programs (except for NS protocol), rest for 2 minutes, and then the vertical jump test for one day.

Static stretching was conducted on the principle lower extremity muscle groups used: gastrocnemius, hamstrings, quadriceps, hip flexors, gluteals, and the adductors, according to Amiri-Khorasani et al. (2010 and 2011). For each muscle group, subjects held the static stretching for 30 seconds on one leg before changing to the contralateral side. Subjects were instructed to stretch in a slow, deliberate manner with proper body alignment.

| Table 1: Different warm up protocols and testing program during four non-continuous days |
|-----------------------------------------------|-----------------------------------------------|
| Days 1 | Days 2 | Days 3 | Days 4 |
| 4 min jogging | 4 min jogging | 4 min jogging | 4 min jogging | 4 min jogging |
| Stretching | Stretching | Stretching | Stretching | Stretching |
| (+) denotes activity included; (NS) No stretching; (SS) Static stretching; (DSS) Dynamic stretching on standing position; (DSG) Dynamic stretching combined with galloping motions. |

The procedures for performing dynamic stretching on the same muscle groups that were stretched in the static stretching protocol were adopted from Amiri-Khorasani et al. (2010 and 2011); subjects were instructed to attempt maximal range of motion during each repetition. Each subject intentionally contracted the antagonist of the target muscle in a standing position once every second so that the target muscle was stretched. This stretching was performed five times without any bouncing at each of the three different speed protocols, which were prescribed in the order of slow, moderate, and ‘fast-as-possible’. The order of target muscles and the rest periods were the same as those in the static stretching.

In the dynamic exercise protocol, subjects performed the same movements, therefore stretching the same muscles, as the dynamic stretching protocol, but they performed two steps and then one leg stretching during 10 meters. In the no stretching protocol, subjects rested for two minutes after the general warm-up before performing the vertical jump test.

Power evaluated using the vertical jump test. Standardized protocols for fitness testing were followed according to methods previously described (Little and Williams, 2006). The vertical jump was measured using the Vertical Jump Training System (MTAK21, KER, IR). The best score of 3 trials was recorded for each fitness test. The same researchers tested the same participants after each warm-up treatment. At end, all data variables from the static stretching, dynamic stretching, and dynamic exercise trials were normalized to no stretching data.
Statistical Analyses

The effect of different stretching methods on power in all players was determined using one-way analysis of variance for repeated-measures. When justified, paired t-tests were performed to confirm significant changes within each condition. The Bonferroni adjustment was then carried out to confirm the significant differences. A significance level of \( p \leq 0.05 \) was considered statistically significant for this analysis.

Results

![Graph showing power after static stretching (SS), dynamic stretching (DS), and dynamic exercise (DE) relative to no stretching (NS) in all players. * is significant difference after DS against SS relative to NS (p < 0.002).]

As illustrated in Figure 1, there was significant increase in vertical jump height after relative dynamic stretching (1.62 ± 5.36 cm) vs. relative static stretching (-1.43 ± 5.58 cm) at \( p < 0.002 \), but there were no significant differences between relative dynamic stretching (1.62 ± 5.36 cm) vs. relative dynamic exercise (0.12 ± 4.45 cm) and also between relative dynamic exercise (0.12 ± 4.45 cm) vs. relative static stretching (-1.43 ± 5.58 cm).

Discussion and Conclusion

The purpose of current study was to investigate acute effect of static stretching, dynamic stretching, and dynamic exercise methods on power in soccer players. Present finding showed significant differences after dynamic stretching compared to the static stretching (Figures 1). On the other hand, dynamic exercise did not produce a higher record to complete the vertical jump test (Figure 1) compared to dynamic stretching. In addition, there were no significant differences between dynamic exercise and static stretching on power, but dynamic exercise showed better record than static stretching.

Recent evidence has suggested that a bout of static stretching may actually cause acute decreases in vertical jumping ability (Church et al., 2001; Cornwell et al., 2002; McNeal and Sands, 2003). Therefore, two hypotheses suggested by previous researchers for the static stretching-induced
decrease in performances: (1) mechanical factors involving the viscoelastic properties of the muscle that may affect the muscle’s length-tension relationship, and (2) neural factors such as decreased muscle activation or altered reflex sensitivity (Herda et al., 2008; Amiri-Khorasani et al., 2011). In addition, there are two hypotheses which suggested for positive effect of dynamic stretching: (1) some level of post-activation potentiation (PAP) and (2) increasing muscle temperature. PAP may be a contributing factor to the faster sprint times with the control condition as well as the lack of stretch-induced deficits in the other conditions (Herda et al., 2008; Amiri-Khorasani et al., 2011).

Therefore, it seems that dynamic stretching by PAP and optimal muscle temperature cause better power performance and in contrast, static stretching cause less power due to less muscle stiffness and decreased muscle activation. However, there is no significant increase after dynamic exercise; it could be that players did not respond to dynamic exercise better than dynamic stretching because of their amateur level. According to their training and exercise level, it seems that dynamic exercise was strange and no familiar motions for them; therefore they did not able to respond better records in power and agility.

In summary, power reductions after static stretching have been explained by a combination of mechanical and neural factors. Mechanically, static stretching results in a longer and more compliant musculotendinous unit, resulting in reduced peak torque and a slower rate of force development. Neurologically, static stretching may cause a decrease in motor unit activation (Fowles et al., 2000; Fletcher and Anness, 2007). On the other hand, the improvement in power after dynamic stretching has been associated with increased motor unit excitability, enhanced motor unit recruitment and synchronization, declined presynaptic inhibition, or greater central activation of the motor neuron (Hamada et al., 2000; Aagaard et al., 2002).

In conclusion, dynamic stretching during warm-ups, as compare to static stretching, is probably most effective technique as preparation for the required power in soccer. Our results suggest that soccer players should be use dynamic stretching instead of static stretching and dynamic exercise during warm up to perform higher power during training sessions and competitions.

Acknowledgment

The authors would like to thank football players for their kind participation. This study in title of "Effects of Static and Dynamic Stretching during Warm-up on Vertical Jump in Soccer Players" was supported by Research Grant from The Research Deputy of Bafrgh Branch, Islamic Azad University, Bafrgh, Iran. Therefore, the authors would like to thanks its staffs.

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