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Original Research Article

Static Stretching and Proprioceptive Neuromuscular Facilitation Stretching within Collegiate Athletes

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Abstract

Introduction: Stretching before and after practice or a work out is common among athletes. Stretching serves a variety of purposes such as improving joint range of motion. Two popular forms of stretching are static stretching (SS) and proprioceptive neuromuscular facilitation (PNF). Research on static and PNF stretching (compared to no stretching) increasing range of motion (ROM) in athletes is recommended to confirm previous study findings. Therefore, the purpose of this study was to determine if static and PNF stretching (compared to no stretching) improves flexibility within college athletes. **Methods:** Participants (N = 45) were from the Huntington University's baseball, softball, and cheerleading teams and ranged in age from 18 to 23 years. Participants were excluded from the study if any injury occurred within 6 months of testing. The sit and reach and shoulder flexibility tests were used to measure flexibility. Testing was performed over a two-day period. Day one included no stretching followed by testing. Day one also included SS followed by testing. Day two included PNF stretching followed by testing. **Results:** For the sit and reach test, no stretching resulted in significantly ($p \leq 0.05$) lower scores compared to static and PNF stretching (Mean \pm SD; 25cm \pm 9.6 vs. 29cm \pm 9.7 vs. 30.1cm \pm 9.6). For right shoulder flexibility, no stretching resulted in significantly ($p \leq 0.05$) lower scores than static and PNF (0.1 \pm 8.2 cm vs. 2.9 \pm 6.7cm vs 3.81 \pm 7.0 cm, respectively). For left shoulder flexibility, PNF stretching was significantly ($p \leq 0.05$) higher than no stretching (M = 0.04 \pm 8.2 cm vs. -4.2 \pm 9.6 cm). **Conclusions:** Our findings support our hypotheses that static and PNF stretching improve flexibility compared to no stretching within an athletic population. It is suggested future studies compare whether different "time delays" between the last stretch and the range of motion assessment, has on the increase in range of motion.

Key Words: Flexibility, ROM, Sports, Sit-N-Reach, Non-Athletes

Introduction

Improvements in flexibility have been linked to injury prevention and sports performance¹. Stretching is one of the most used techniques that have been demonstrated to improve flexibility in athletes². Two common stretching techniques to increase flexibility are proprioceptive neuromuscular facilitation (PNF) and static stretching (SS)³.

PNF stretching is defined as the use of body weight including a hold, relax, and repeat technique³. PNF stretching has been demonstrated to improve flexibility significantly within hamstring muscles⁴. It is commonly used to enhance both active and passive range of motion to optimize performance and rehabilitation⁶. Flexibility improved the greatest with a hold and relax PNF technique for a total of 30 seconds¹. Flexibility was also tested previously in the biceps femoris muscle and it was found PNF and SS improved flexibility significantly³.

SS is the most common stretching method due to its simplicity, and has been shown to significantly improve flexibility². SS has been defined as stretching a particular muscle to the furthest possible point and holding the position for a period of time². A Study showed SS increases flexibility, with the best hold-time of 40 seconds⁴. Static stretches have often been used in specific active warm-ups to enhance performance. SS has been reported to increase flexibility by 2.8 percent in certain populations⁵.

Although previous studies indicate that PNF increases flexibility more than SS⁶, it is important to assess the increase in flexibility in athletes using both techniques (i.e, PNF and SS). Furthermore, given that SS is easier to perform, assessing whether increases in flexibility using SS are comparable to PNF stretching in athletes compared to no stretching, is important. Therefore, the purpose of this study was to assess if PNF and SS increase flexibility in college athletes and if yes, how much more compared to no stretching. Our first hypothesis was PNF stretching compared to no stretching will increase flexibility. Our second hypothesis was SS compared to no stretching will increase flexibility.

Methods

Participants

This study included 45 college athletes participating in either baseball (22 males), softball (16 females), or cheerleading (1 male, 6 females). All participants were between the ages of 18 to 23 years. Each participant was explained the experimental procedure along with the possible risk of participation. A health questionnaire was completed by each participant to assess for any potential health risks and previous injuries. Participants were excluded if any injury had occurred within 6 months of testing. An informed consent was also given to each participant. The consent was explained including telling each participant that their information would be kept confidential. After answering any questions

the participant had about the study, the participant then signed the consent form. This study was approved by the IRB (Institutional Review Board) prior to any testing.

Experimental Design

The participants performed two tests over a series of three times. Testing was completed over a two day time period in which all participants performed SS on day one, then two days later all participants performed PNF stretching. The two day separation helped assure one stretching technique did not affect the other. Participants' flexibility was assessed using a sit and reach and a shoulder flexibility tests. On day one, a baseline (a.k.a. no stretching) measurement was performed prior to any stretching. After baseline testing, participants performed SS (30 second hold time with 1 minute rest between stretches). Stretches included shoulder, hamstring, calf, and quadriceps stretches, each performed one time. These stretches include the main muscles utilized in majority of sports and physical activity. After the SS, flexibility was immediately assessed using the sit and reach and shoulder flexibility test. Two days later, participants returned to the lab and performed the same baseline testing, but then after baseline testing, participants performed PNF stretches (40 second hold time with 1 minute rest between stretches). Stretches included shoulder, hamstring, calf, and quadriceps stretches, each

performed one time. After PNF stretching, participants flexibility was immediately assessed using the sit and reach and shoulder flexibility tests.

The sit and reach test was measured in centimeters using the sit and reach box (ACCUFLEX I). A positive distance was recorded if the participant reached past their toes while in a sitting position. A negative distance was recorded if the participant could not reach past their toes. The shoulder flexibility test was measured in centimeters using a measuring tape. Each participant placed one hand above their head to the middle of their back and the other hand underneath their shoulder while trying to get both hands to reach touch. If their hands overlapped this was recorded as a positive distance in centimeters. If their hands did not touch, then the distance between their hands was recorded as a negative distance.

Statistical analyses

All data was recorded in Excel, where statistical analyses were performed. Descriptive statistics included mean and standard deviations. Inferential statistics included performing two t-tests, one t-test to compare PNF stretching with no stretching and the second t-test to compare SS with no stretching. Statistical significance was set at $p \leq 0.05$ for both t-tests.

Table 1. Means (\pm SD) for no stretching, SS, and PNF stretching.

Test	No stretching	Static	PNF
Sit and Reach (cm)	25 \pm 9.6	29 \pm 9.7	30.1 \pm 9.6
Right Shoulder (cm)	0.1 \pm 8.2	2.9 \pm 6.7	3.8 \pm 7.0
Left Shoulder (cm)	-4.2 \pm 9.6	-1.6 \pm 8.5	0.04 \pm 8.2

Results

The means (\pm SD) for the sit and reach and shoulder flexibility tests are presented in Table 1. SS significantly increased flexibility in the sit and reach test ($p = 0.040$) and the right shoulder flexibility ($p = 0.049$) compared to no stretching. There were no significant increases in the left shoulder flexibility with SS ($p = 0.083$). Compared to no stretching, PNF stretching resulted in significant increases in all three tests; sit and reach test ($p = 0.012$), right shoulder flexibility ($p = 0.013$) and left shoulder flexibility ($p = 0.013$).

Discussion

The purpose of this study was to assess whether PNF and SS increases flexibility among baseball players, softball players, and cheerleaders. It was hypothesized that both PNF and SS would increase flexibility compared to no stretching. Results showed a significant improvement in flexibility with the sit and reach test and both shoulder flexibility tests following PNF stretching. SS also had significant improvements in both the sit and reach test and right shoulder flexibility. However, SS did not increase left shoulder flexibility.

A previous study found similar results to this study in that PNF and SS improved flexibility⁶, however this study also showed that PNF and SS improved flexibility greatest compared to dynamic stretching in a one session stretching period⁶. This study also showed improvements in youth agility following PNF stretching⁶. Another study conducted by Dastmanesh and colleagues indicated a significant improvement in hamstring flexibility in athletes utilizing PNF stretching⁷. Both studies support the current study findings of PNF stretching increasing flexibility.

Methodological considerations

This study had a few limitations. First, the participants consisted of young college athletes; thus findings may not be generalized to all populations. Second, flexibility improvements were during a 30-minute time frame and therefore, flexibility improvements beyond this time are unknown. Third, this study did not assess if flexibility positively or negatively affect performance in the athletes that participated in this study, which is important to consider; however, it is beyond the scope of this study.

There were two major strengths of this study. First, this study included athletes that already had required stretching incorporated in their sport and thus already familiar with the stretching requirements, and therefore could incorporate the results of this study, and other notable research study findings, in their sports to assure the greatest improvement in flexibility. Second, this study compared two common stretching techniques (i.e., static and PNF) within the same study providing more information than studies only addressing one stretching technique.

Implications

There are two implications from this study. First, it has been thought that athletic performance may improve due to greater range of motion following stretching⁸. Thus, coaches of basketball, baseball and cheerleading may consider having their athletes perform PNF and SS if their goal is to increase range of motion since the current study results support increased range of motion with both static and PNF stretching. These stretches can be performed from 30-40 second hold durations for maximum improvements according to previous research² and from the results of this study. However, this stretching time may need to be different for different age groups and athletes. Second, more research should be conducted to support implications of increased flexibility being beneficial on a long-term basis. A longitudinal study on how PNF and SS affects flexibility, athletic performance, and

injury prevention within college athletes should be conducted to better assess the benefits of both stretching techniques.

Conclusions

SS and PNF stretching compared to no stretching increased sit and reach and right shoulder flexibility. PNF also increased left shoulder flexibility. SS did not increase left shoulder flexibility, which could have been a result of most participants (42 of 45) being right arm dominant and thus SS may not be sufficient for increasing left shoulder flexibility. However, this should be explored further. For athletes wanting to increase range of motion, either static or PNF stretching may be used. For athletes wanting a simple stretching method, then SS would be best. The findings of this study are important because athletes and coaches now have more evidence that static and PNF stretching increases range of motion and also a choice in two methods of stretching. The researchers of this study propose that future studies be conducted comparing static, PNF, and dynamic stretching on flexibility in similar athletes and in athletes in other sports like football, basketball, and track.

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