EFFECTS OF PNF STRETCHING ON FLEXIBILITY IN DIVISION 3 FEMALE COLLEGIATE SOCCER PLAYERS

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ABSTRACT

Mayer, JM, Pederson, AJ, Simons, KM. Effects of PNF stretching on flexibility in division 3 female collegiate soccer player. *J. Undergrad. Kin. Res.* 2005; 1(1): 1-8. This study compares the effects of PNF stretching to a control group during a three week stretching program. Subjects were 20 female collegiate division 3 soccer players between the ages of 18-22. The participants were separated into the groups based on a convenience sample. The control group (n = 10) performed self-stretching, the stretching group (n = 10) performed PNF stretching. Participants in the stretching group received the same stretching treatment of PNF 3 times per week for 3 weeks. There were significant differences ($p < 0.05$) in the mean change in flexibility from baseline to post-program between the control group (m = -1.1 cm) and stretching group (m = 1.3 cm), $t(19) = -2.233$, $p = 0.038$. The data suggests that PNF stretching for 3 repetitions 3 days a week is sufficient to significantly increase hamstring length in this population. More research should be done involving this type of stretching regimen possibly looking at the different variables such as intensity, duration, and frequency.

Key Words: PNF, flexibility, stretching, hamstrings, proprioception, contract-relax

INTRODUCTION

Stretching has been shown to have significant effects on flexibility, which in turn could promote enhanced performance (1). There is much debate on the effectiveness of certain stretching techniques. A study conducted by Feland and Marin concluded that there is a significant difference in flexibility using PNF stretching (2). Our study will look at the effects of the contract-relax technique of proprioceptive neuromuscular facilitation (PNF) on the hamstrings muscle group.

PNF is an approach using the body's nerve physiology and the stretch reflexes to increase flexibility. There are several different patterns used during stretching. In our study, we will be using the contract-relax technique, which is a passive stretch followed by a contraction of the antagonist muscle, followed by another passive stretch (3). PNF stretching uses proprioceptors to relay messages from the nerves to the brain, causing the muscles to perform coordinated movements. These sensory receptors are found in tendons, muscles, and joints.

One author concluded that stretching at the end of a workout is more efficient in increasing flexibility (4). PNF stretching is often compared to static stretching, in terms

of effectiveness. Studies conducted by Funk and Swank et al. conclude that combining exercise and PNF stretching enhances hamstring flexibility (5). There have also been conflicting reports in the effectiveness of PNF stretching. In one study, the authors concluded that PNF stretching is likely to decrease activity in the muscle spindle, which in turn could lead to an increased risk of muscle or tendon injury (1). A study conducted by Rowlands et al. conducted a study to assess the effect of two isometric contractions during PNF to increase hip flexion. The study concluded that flexibility was significantly lower in the control group after 6 weeks of stretching (6).

The purpose of this study is to determine if PNF stretching shows increases in flexibility measurements vs. a control group. We planned to do this by conducting a 3-week PNF stretching program. We hypothesized that PNF stretching will increase flexibility in comparison to a control group.

METHODS

Subjects

20 division 3 female collegiate soccer players (age = 19.2 ± 1.1 years) volunteered to participate in our study. Participants were randomly selected, seemingly healthy active individuals. They were selected through the use of a questionnaire, and assigned to either group based on a convenience sample. Ten subjects were placed in a control group, another 10 subjects in an experimental group. Each participant signed a consent form to participate in this study. The study and consent form were approved by the University Human Subjects IRB.

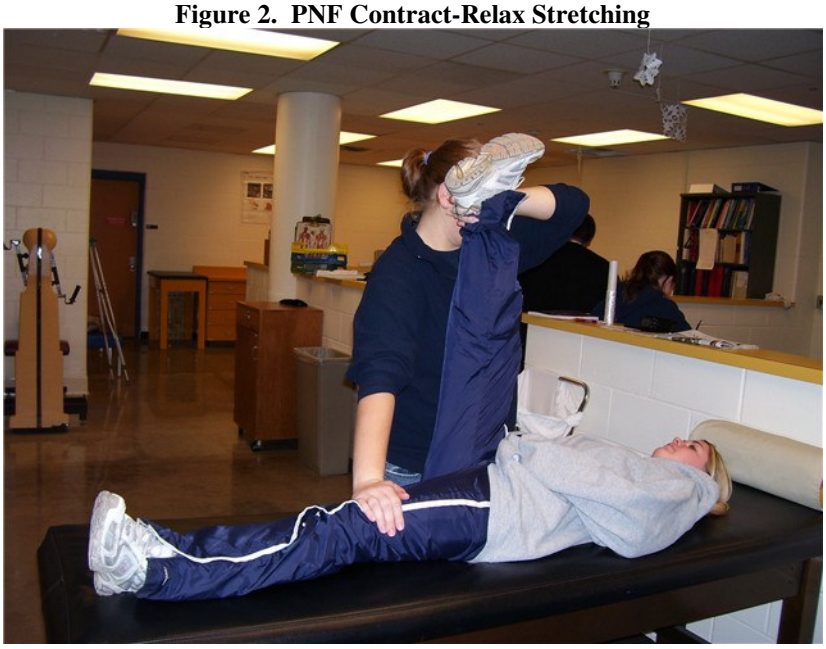
Instrumentation

For our initial baseline flexibility assessment, we used a standard sit-and-reach box (Figure 1). This gave us valid and reliable results. We took 3 measurements and use the average score for the initial assessment. For the stretching, we used a partner-assisted stretch. The stretching that was performed was a form of contract-relax PNF stretching (Figure 2). PNF stretching is a passive-assisted stretch for held for 20 seconds followed then by an 8 second isometric contraction against the instructor's manual resistance. The passive stretch was performed 3 times, with an isometric contraction in between each passive stretch. The routine for our PNF stretching was as follows: passive stretch (20 sec), isometric contraction (8 sec), passive stretch (20 sec), isometric contraction (8 sec), and passive stretch (20 sec). Subjects were requested not to do PNF stretching on the days we did not stretch them. The control group was asked to perform their normal stretching routine, which varied per individual. This will ensure adherence to our program.

For the final assessment, we used a sit-and-reach box once again, using the average of 3 trials. The study was conducted 3 times a week for 3 weeks. A final sit-and-reach test was administered following the 3 week trial to determine whether flexibility was increased.

Figure 1. Sit-and-Reach Testing

Figure 2. PNF Contract-Relax Stretching



Procedures

We kept track of initial/final assessment and put the data into SPSS. We also kept track of each time we stretched, the time, which participant was missing, or who did not get stretched and the reason. Instructions were given to the subjects before any stretching was performed. We did not stretch any individuals who were injured, or those who were prone to specific injuries of the hamstrings. This was done to protect the welfare and health of the athletes in the study. Adherence was monitored by daily interaction and motivation of the athletes.

Statistical Analyses

Before our study was conducted, the significance level was established at $p \leq 0.05$. We analyzed our data using the statistical software SPSS. The independent variables are the control group and the stretching group. The dependent variable is flexibility. We compared the initial baseline scores to the final baseline scores in each group. T-tests were used to determine the mean between the experimental and control groups. Sample size was pre-determined by the number of athletes on the soccer team.

RESULTS

A total of 20 female collegiate soccer players (18-22 years of age) participated in our study. A chart of their demographics can be found below in Table 1. The average weight of the control group was (128.2 lbs ± 16.8) and the stretching group was (137.3 in. ± 13.4).

Table 1. Subject demographics from both groups (N = 20). Mean ± SD

FEMALES n = 20	
Age (yrs)	19.2 ± 1.2
Height (in)	65.4 ± 2.3
Weight (lbs)	131.4 ± 15.1

There were no significant differences at baseline between the stretching (m = 36.0) and control groups (m = 34.2), $t(19) = 0.6$, $p \geq 0.05$. There were also no differences post-stretching between the stretching (m = 37.3) and control groups (m = 33.1), $t(19) = 1.631$, $p \geq 0.05$. However, there were significant differences ($p < 0.05$) in the mean change in flexibility from baseline to post-program between the control group (m = -1.1 cm) and stretching group (m = 1.3 cm), $t(19) = -2.233$, $p = 0.038$.

Table 2. Group Statistics

	Group	N	Mean	Std. Deviation
Pre	stretching group	10	36.0	8.4
	control group	10	34.2	6.5
Post	stretching group	10	37.3	6.5
	control group	10	33.1	5.4

Figure 3. Mean Sit and Reach Scores Before and After PNF Program

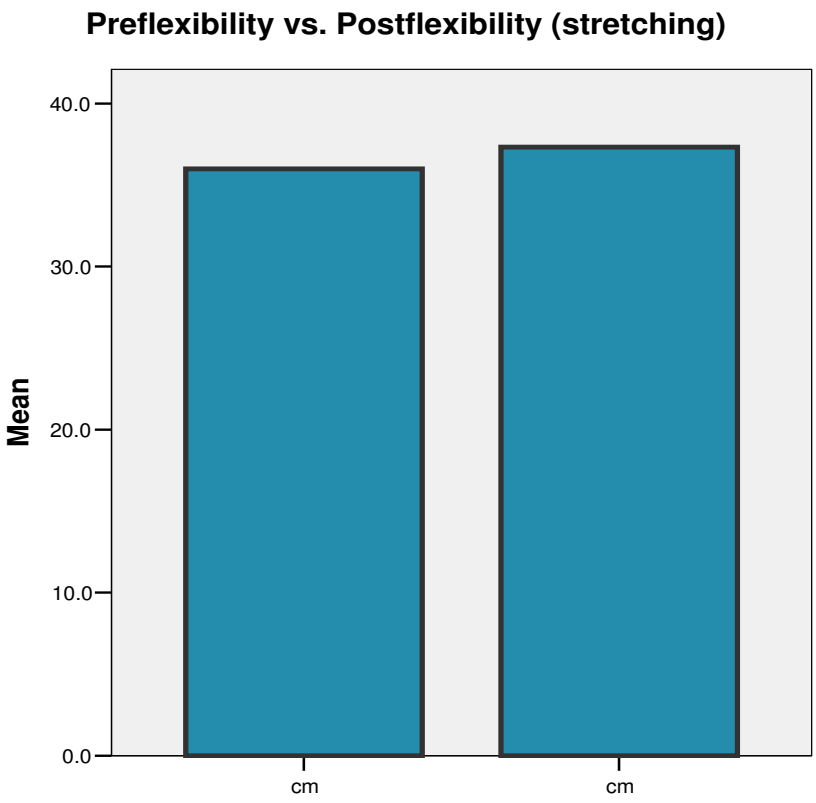


Figure 4. Mean Sit and Reach Scores Before and After PNF Program.

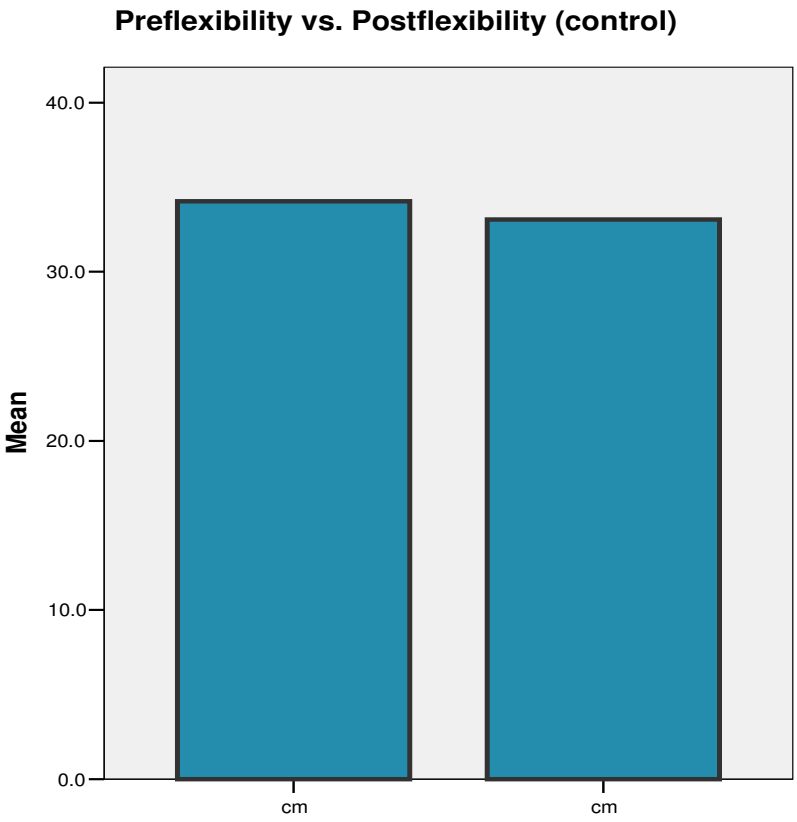
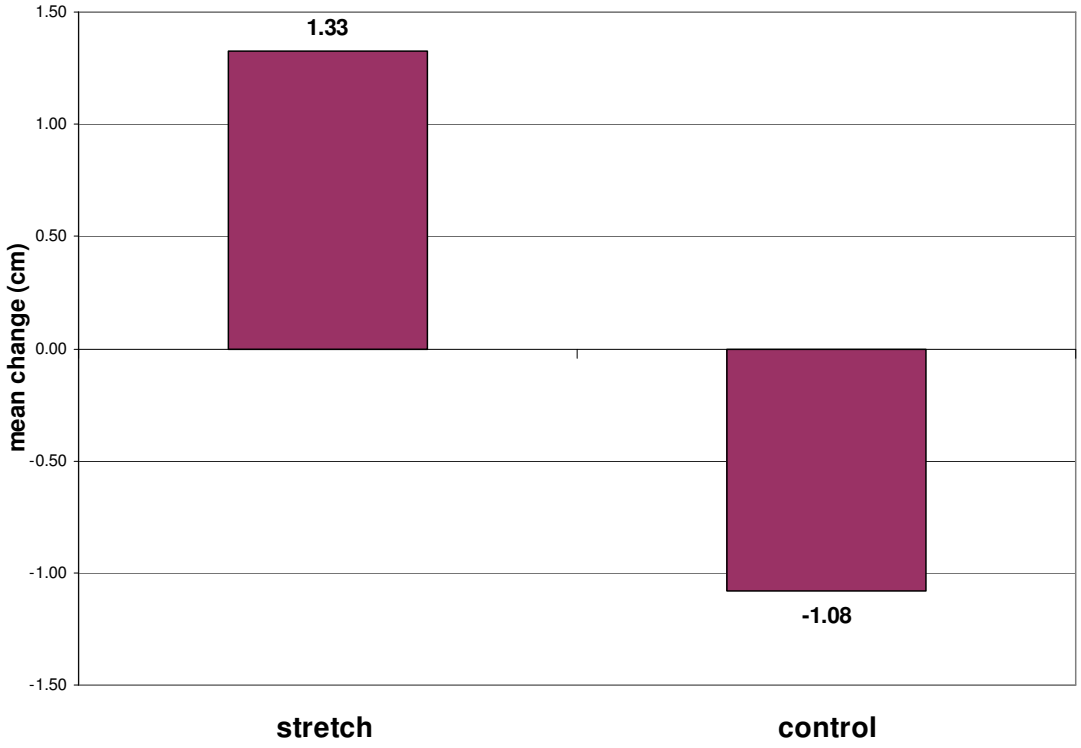


Figure 5. Mean Change between Stretching and Control Groups



DISCUSSION

Based on the results of our study, we rejected the null hypothesis. This study compared the effects of PNF stretching in a stretching group vs. a control group. There were significant differences between the mean difference of the stretching group (m = 1.3) as compared to the mean difference of the control group the stretching and control group (m = -1.1).

The control group's flexibility decrease suggested that tight hamstring muscles possibly due to fatigue and/or poor stretching regimens. Since the stretching group increased in flexibility, PNF stretching can be considered a useful way to stretch. A study conducted by Funk et al., found that PNF stretching performed after exercise enhanced short-term hamstring flexibility, and implementing a PNF stretching routine after exercise may enhance current stretching routines used by athletes (5). The results of our study contradict the findings of Davis et al. who concluded that PNF stretching 3 days per week is not sufficient to increase hamstring flexibility. They also concluded that the inconsistent parameters of PNF stretching make it impossible to determine the most effective type of stretching (7). There is also a study done by Carter et al. on how PNF stretching may cause a decrease in the muscle spindle activity. They concluded that this decrease in activity immediately following PNF stretching could increase the risk of a muscle of tendon injury (8).

We had several limitations in our study. PNF stretching is most effective when it is performed 5-6 days a week (9). Our group was not able to be at practice every day to stretch the girls. Another limitation to our study was not being able to obtain a final

baseline immediately after the 3-week stretching period was done. We had a hard time getting the girls to comply with our wishes to come in on their time to get a final baseline sit-and-reach test done. Our results might be skewed because of this limitation. If we would have been able to get our final baseline done immediately after the stretching period, we could have gotten better results. Results might have been different if we stretched for a longer time period, instead of only three weeks. We hypothesize this to be true due to findings stated by Prentice, who found that "PNF stretching is capable of producing greater improvements in flexibility over an extended training period" (9). Another disadvantage of PNF stretching is that a partner is required to assist with the stretch (10).

CONCLUSIONS

In conclusion, it is determined that there is a significant difference between the stretching group, which did PNF stretching, and the control group. The effectiveness of PNF stretching would be important information for athletes, coaches, and athletic trainers. Coaches could use this information to incorporate a stretching regimen for their athletes. There are many types of stretching, so it is important to know which type is most effective for the activity an individual is participating in. This information would also be very useful for athletic trainers, who can help fulfill the needs of individual athletes who wish to stretch.

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REFERENCES

1. Marek, Sarah M. et al. (2005). Acute effects of static and proprioceptive neuromuscular facilitation stretching on muscle strength and power output. *Journal of Athletic Training.* 40(2). P. 94-103.
2. Feland JB, H. Marin. (2004). Effect of submaximal contraction intensity in contract-relax proprioceptive neuromuscular facilitation. *Journal of Sports Medicine.* 38(4).
3. Baechle, Thomas and Roger Earle. (2000). Essentials of Strength Training and Conditioning. Human Kinetics: Champaign, IL.
4. Crieco, Carmine. (2002). PNF stretching. American Fitness. 20(4). p. 37
5. Funk, Daniel C., et al. (2003). Impact of prior exercise on hamstring flexibility: a comparison of proprioceptive neuromuscular facilitation and static stretching. *Journal of Strength and Conditioning.* 17(3). P 489-492.
6. Rowlands AV et al. (2003). Chronic flexibility gains: effect of isometric contraction duration during proprioceptive neuromuscular facilitation stretching techniques. Research Quarterly for Exercise & Sport. 74(1). p. 47-52.
7. Davis, D. S. et al. (2005). The effectiveness of 3 stretching techniques on hamstring flexibility using consistent stretching parameters. *Journal of Strength and Conditioning Research.* 19(1), p. 27-32.
8. Carter, Allyson M., et al. (2000). Proprioceptive neuromuscular facilitation decreases muscle activity during the stretch reflex in selected posterior thigh muscles. *Journal of Sport Rehabilitation.* 9(4), p. 269-279
9. Prentice, William. (2003). Arnheim's Principles of Athletic Training. McGraw-Hill: New York, NY.
10. Prentice, William. (1999). Rehabilitation Techniques in Sports Medicine. McGraw-Hill: New York, NY.