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The Proper Use of Proprioceptive Neuromuscular Facilitation

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With the current emphasis on sports performance and the availability of improved research and medical technology have come many advancements in the area of sports medicine and performance enhancement. One area where this is increasingly apparent is in the variety of methods of muscle stretching. The three most common techniques are dynamic stretching, static stretching, and proprioceptive neuromuscular facilitation (PNF). Dynamic stretching involves "moving a limb through its full range of motion to the end ranges and repeating several times" (Page 110). Static stretching, on the other hand, involves holding a stretched position "for 20 to 30 seconds" (Reynolds). PNF stretching is "promoting or hastening the response of the neuromuscular mechanisms through stimulation of the proprioceptors and other sensory potentials of the sport participant" (Irvin 149). Athletes use these three methods of stretching as both rehabilitation methods and pre-event stretches. While all three are effective at increasing range of motion, some are more ideal to practice in certain situations than others. Even though it can be an effective method of increasing range of motion as a pre-event stretch, athletes and sports medicine professionals should limit the use of proprioceptive neuromuscular facilitation to therapeutic settings because dynamic stretching is more effective than PNF at maintaining muscle power and performance as a pre-event stretch for athletes, and PNF is a highly effective method of rehabilitation.

Dynamic stretching is a more effective stretch than PNF at maintaining muscle power and performance as a pre-event stretch. The reasoning behind this assertion is dependent on two facts. First, many studies show that dynamic stretching does not sacrifice muscle power and performance for range of motion in the same way that static stretching does. Second, the mechanics and effects of static stretching are similar to those of PNF. If dynamic stretching is more effective as a pre-event stretch than static stretching, and static stretching and PNF stretching are similar, then it follows that dynamic stretching is more effective as a pre-event stretch than PNF.

Many researchers have conducted studies that prove that dynamic stretching is more effective at maintaining muscle power and performance than static stretching is. Thomas Little from Staffordshire University and Alun Williams from Manchester Metropolitan University conducted a study in 2006 on the "effects of differential stretching protocols during warm-ups on high-speech motor capacities in professional soccer players" (203). They had professional soccer players conduct 3 different warm up routines within a week, each more than 48 hours apart (203). The first routine involved static stretching in

addition to warm up exercises in order to increase heart rate and blood flow. The second routine involved dynamic stretches in addition to warm up exercises, and the third involved no stretching at all and relied solely on exercises to increase heart rate and blood flow (Little 204). After completing the warm up protocol for the day, the players participated in various performance tests. Little and Williams tested the players with a vertical jump, a 10-meter sprint, a 20-meter sprint, and an agility course. Little and Williams designed the performance tests to assess "leg power, acceleration, maximal speed, and agility capacities" (204). The results of the study indicated that every player obtained the best results on all the tests, save the vertical jump, after participating in dynamic stretching (Little 205). They particularly noted that "there were significant differences among the warm-up protocols for agility, with dynamic stretching resulting in significantly better performance than static stretching and no stretching" (205). Because of the superior performance of the dynamic stretching as opposed to the static stretching, Little and Williams recommend that sports requiring high-speed performances utilize dynamic stretching as part of the pre-competition warm-up (205-206).

Mohammadtaghi Amiri-Khorasani from the Shahid Bahonar University of Kerman conducted a similar study in 2016 on the way that different stretching methods included in pre-event warm-ups affect the acceleration and speed of soccer players (179). He had 20 collegiate soccer players randomly divide into five groups, and each group performed a different warm-up protocol on non-consecutive days (Amiri-Khorasani 180). The first of the various warm-up protocols involved no stretching, the second involved dynamic stretching followed by static stretching, the third involved static stretching followed by dynamic stretching, the fourth involved dynamic stretching, and the final protocol involved static stretching (Amiri-Khorasani 182). After the warm-up protocol each group tested their acceleration performance by running a 10-meter sprint and a 20-meter sprint (Amiri-Khorasani 180). Amiri-Khorasani's results back up the results of Little's and William's study, proving once again that dynamic stretching is more effective than static stretching. Amiri-Khorasani states, "the current findings show that DS [dynamic stretching] during a warm-up is more effective than SS [static stretching] as a preparation to the abrupt acceleration and speed required in soccer" (185). M. P. McHugh and C. H. Cosgrave of the Nicholas Institute of Sports Medicine and Athletic Trauma authored a review of various studies on the roles of stretching in injury prevention and performance, which also showed that dynamic stretching is more effective than static stretching. McHugh and Cosgrave noted that "it is clear that an acute bout of stretching will decrease the ability to generate a maximal force" (179). Based on the evidence of the research many have put forth on the subject, it is clear that dynamic stretching is "better suited for athletes requiring running or jumping performance" (Page 114).

However, some will argue that while dynamic stretching is better at maintaining muscle power and performance, that does not mean that it is a more effective pre-event stretch. McHugh and Cosgrave concluded in their review that the majority of the studies show "that pre-participation stretching in addition to a formal warm-up [does] not affect injury risk compared with a control group performing a warm-up without stretching" (176). Contrary to the majority of the findings however, they do discuss some studies that show positive results of static stretching on injury risk. McHugh and Cosgrave reference a study conducted on thigh strains in military recruits where there was a 1.2% prevalence of muscle strains in the control group but only 0.3% prevalence in the stretching group (176). McHugh and Cosgrave also reference another study done on military recruits where stretching "resulted in a 67% reduction in muscle strains and low back muscle injuries combined" (177). While there is some evidence that static stretching pre-event may help reduce muscle strains in particular, "further research is needed in this area" in order to draw any firm conclusions (Cosgrave 179).

Static stretching and PNF are similar forms of pre-event stretching; therefore, dynamic stretching is also better at maintaining muscular power and performance then PNF stretching is. Dr. Phil Page, certified athletic trainer and physical therapist in Baton Rouge, Louisiana states that "several studies show similar increases in ROM and performance when comparing pre-contraction stretching (PNF) and static stretching" (114). It is also evident from the studies that both PNF and static stretching decrease strength (Page 114). Meaghan Maddigan and her colleagues performed a study comparing various PNF techniques with static stretching. She concluded that the PNF techniques and static stretching both "provided similar improvements in the ROM [range of motion] and poststretching performance decrements in MT [movement time]" (abstract). Based on the evidence that both static stretching and PNF result in similar decreases, and 3.4% decrease in the athletes' movement time with both stretching techniques, she makes the recommendation that "athletes should not use these techniques before important competitions or training because of the impairment of … MT" (abstract). If both static stretching and PNF stretching result in similar decreases in muscle performance, and dynamic stretching is more effective at maintaining muscle power and performance as a pre-event stretch than static stretching is, then it follows that dynamic stretching is a more effective pre-event stretch than PNF stretching.

Some researchers, on the other hand, have provided evidence that suggests that PNF and static stretching may not in fact yield similar results. Dr. Page touches on the controversy in his commentary "Current Concepts in Muscle Stretching for Exercise and Rehabilitation". He states that "some authors report that both static and pre-contraction stretching are able to increase acute hamstring flexibility, which others suggest static stretching of PNF stretching are more effective" (Page 114). Wyatt Briggs and his

colleagues at Willamette University reference a study on the way stretching affects the hamstring and gastrocnemius (calf) muscles (110). Static stretching, dynamic stretching, and a PNF stretching technique were the three stretching methods that the study focuses on. The subjects participated in the stretching methods three times a week and their range of motion was measured before the treatment, after 11 rounds of treatment, and after 21 rounds of treatment (Briggs 110). Surprisingly, the results indicated that "the longer the treatment time, the less significant the results differed among the three treatments" (Briggs 110). Another study that Briggs references in his article on PNF evaluated various stretching methods, and he summarized the conclusion of the study by stating that "significant increases in ROM [range of motion] were seen throughout the treatment groups, but it was found that the PNF techniques were more effective than the SS [static stretching] method for both hip flexion and shoulder extension" (111). The results of this study point to the fact that it is possible that while PNF and static stretching are similar, they do not yield exactly the same results. Therefore, some can conclude to claim that because static stretching is less effective at maintaining muscle power and performance than dynamic stretching, PNF stretching is also less effective than dynamic stretching, would be an illogical conclusion. PNF is in fact not similar to static stretching, but is able to yield superior results in some areas. Researchers must conduct more studies comparing PNF and dynamic stretching directly before making the assertion that dynamic stretching is more effective at maintaining muscle power and performance than PNF stretching.

Not only is there research that proves that dynamic stretching is more effective at maintaining muscle power and performance as a pre-event stretch than PNF, but there is evidence showing the significant effectiveness of PNF as a therapeutic methodology. Briggs mentions seven studies that researchers conducted on the effects of PNF and summarizes the conclusion that all seven studies came to: "The results of these seven studies discussing ROM [range of motion] imply that PNF… increases ROM and flexibility in all of the subjects (111)." One of the studies that he mentions targeted four muscle groups: the gastrocnemius, the ankle dorsiflexors, the hip adductors, and the hamstrings. The researchers treated each of those specific muscles with a PNF technique except for the ankle dorsiflexors (Briggs 110). The researchers treated the ankle dorsiflexors with the ballistic stretching method, which is a form of dynamic stretching that involves "'bouncing' at end range of motion" (Page 110). After 14 rounds of treatment the group treating the ankle dorsiflexors switched to the PNF method because "flexibility was increased more with the [PNF] method than with the [ballistic stretching] method" (Briggs 110). The PNF technique ended up being the most effective method of stretching in the rehabilitation process. In comparing the effectiveness of static stretching and PNF stretching as methods of therapy, Dr. Page states that "patients with knee osteoarthritis can benefit from static stretching to increase knee ROM; however, PNF stretching may be more effective" (115).

Dr. Page also observes that "athletes with hamstring strains recover faster by performing more intensive stretching than by performing less intensive stretching" (115). PNF is a more intense form of stretching than static stretching because it involves continuously desensitizing the nerves that protect the body's muscles from stretching too far. Stretching, then contracting, followed by more stretching has more of an intense effect on the stretching reflex than simply static stretching does.

PNF is not merely a highly effective method of therapy, but was in fact developed for the very purpose of aiding "the rehabilitation of clients with spasticity and weakness by facilitating muscle elongation" (Victoria 623). A physical therapist named Margaret Knott and a doctor named Herman Kabat designed PNF specifically for the rehabilitation of "neurological dysfunctions" (Victoria 623). It was obvious early on that the new rehabilitation method the experts developed and called PNF was effective. Because the new rehabilitation technique was so successful, physiotherapists and others involved in health and sports medicine began to explore additional application for the new method of therapy (Victoria 623). The technique has "broad applications in treating people with neurologic and musculoskeletal conditions," therefore it is a useful tool in the rehabilitation of many musculoskeletal injuries (Victoria 623). Recently, PNF techniques "have been used as a stretching technique for increasing flexibility" in place of or in addition to other methods such as static stretching and dynamic stretching (Prentice 110). However, it may function less than ideally outside of the therapeutic uses for which Knott and Kabat developed it. If Knott and Kabatt designed it initially for the purpose of therapy, and it functions extremely well in that capacity while functioning less ideally in other applications of the technique, then it follows that PNF use should be limited to therapeutic settings.

However, some will argue that PNF is not always the best method to use in therapy. Dr. Page observes that while it was designed for neurological dysfunctions, it does not have a positive effect all the time. He mentions a specific situation where this is the case, stating that "stretching appears to have no benefit for neurological patients who have had a stroke or spinal injury" (Page 115). Not only that, but others will also argue that while PNF causes a decrease in muscle power and performance in high intensity activities, PNF is in fact an effective method to increase performance in low intensity performances. Briggs states in his article on PNF and its mechanisms and effects that "although PNF may decrease performance in high intensity exercises, it has been found to improve performance in submaximal exercises such as jogging" (109-110). If PNF stretching can be effective to improve performance in low intensity exercises, then athletes should still be able to utilize PNF as a pre-event stretch before low intensity performances instead of limiting it to simply therapeutic settings.

More pressure is put on athletes on a regular basis to get any edge to compete, and some have turned to new methods of stretching to help give them that extra advantage

over their opponent. Margaret Knott and Dr. Herman Kabat originally developed PNF as a method of therapy for neurological problems, however its application is widening to assist in various aspects of athletic performance and enhancement. PNF does increase range of motion, but it also decreases muscle power and performance. Dynamic stretching, on the other hand, is able to increase range of motion to a functional range for the athletic activity while increasing muscle power and performance. Because there are other methods of pre-event stretching that not only assist with increasing functional range of motion for that athletic activity, but also increase muscle power and performance, sports medicine professionals should not consider PNF as a viable method of pre-event stretching. They should limit its use to the therapeutic setting which Kabat and Knott designed it to be effective in. By limiting the use of PNF to therapeutic settings and utilizing dynamic stretching as a pre-event stretch, the athlete will be able to maintain maximum muscle power and performance, and therefore will be able to perform at the highest level possible.

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