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Mechanism of stretching technique PNF (Proprioceptive neuromuscular facilitation)

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Abstract
Proprioceptive neuromuscular facilitation encompasses all aspects of the rehabilitation process—and can help athletes with various dysfunctions achieve their goals. PNF techniques help develop muscular strength and endurance, joint stability, mobility, neuromuscular control and coordination–all of which are aimed at improving the overall functional ability of athletes. Most PNF stretching techniques employ isometric agonist contraction/relaxation where the stretched muscles are contracted isometrically and then relaxed. Some PNF techniques also employ isometric antagonist contraction where the antagonists of the stretched muscles are contracted. In all cases, it is important to note that the stretched muscle should be rested (and relaxed) for at least 20 seconds before performing another PNF technique. Terms about muscle contraction are commonly used when discussing PNF. Concentric isotonic contraction is when the muscle shortens, eccentric isotonic is when it lengthens even though resisting a force is being applied, and isometric contraction is when the muscle remains the same length even while it is contracting. How PNF Stretching Works For the following information, you should know that the golgi tendon organ relaxes a muscle after a sustained contraction has been applied to it for longer than 6 seconds. Isometric contractions (the hold phase) and concentric contractions (the contract phase) used immediately before the passive stretch (the relax phase) facilitate autogenic inhibition. Autogenic inhibition is a reflex relaxation that occurs in the same muscle where the golgi tendon organ is stimulated. Similarly, we can use a technique that involves a concentric contraction of the muscle group opposing that which is being stretched, in order to achieve reciprocal inhibition. Reciprocal inhibition is a reflex muscular relaxation that occurs in the muscle that is opposite the muscle where the golgi tendon organ is stimulated. Using the hold, contract, and relax phases, we can develop the following 4 PNF stretching techniques. While slightly different, each technique starts by holding a passive stretch for about 10 seconds

Keywords: Mechanism, stretching technique, PNF

Introduction
PNF stretching is a type of flexibility training performed by physical therapists and fitness coaches to help increase flexibility, improve muscular function, and reduce the risk of injury. Learn about the various PNF techniques and their benefits. PNF stretching, or Proprioceptive neuromuscular facilitation, is a method of flexibility training that can reduce hypertonus, allowing muscles to relax and lengthen. PNF stands for Proprioceptive muscular facilitation and it is generally considered as one the most effective forms of stretching available. (http://articles.submityourarticle.com/the-basics-and benefits- of-pnf-stretching-83751). PNF stretching, or proprioceptive neuromuscular facilitation stretching, are stretching techniques commonly used in clinical environments to enhance both active and passive range of motion with the ultimate goal being to optimize motor performance and rehabilitation (http://en.wikipedia.org/wiki/PNF_stretching). Generally an active PNF stretch involves a shortening contraction of the opposing muscle to place the target muscle on stretch, this is followed by an isometric contraction of the target muscle. PNF can be used to supplement daily stretching and is employed to make quick gains in range of motion to help athletes improve performance (Marek, Cramer, Fincher, Massey et al., 2005) [15].

Advantages of PNF Stretching

When performed correctly, PNF stretching offers several notable benefits

1. **Increased flexibility:** Good flexibility can be accomplished by regularly practicing a stretching routine. PNF stretching is an advanced form of flexibility training that combines dynamic stretching with isometric contraction to target specific muscle groups, such as the hip flexors.
2. **Reduced risk of injury:** Practicing PNF stretching can aid in injury prevention and help prevent soreness after a strength-training routine.
3. **Increased ROM:** Golgi tendon organs (GTO) exist wherever a tendon meets a muscle. GTOs regulate muscle force to help prevent muscle tearing. PNF stretching lengthens GTOs, improving their elasticity and increasing the body's active and passive range of motion (ROM). This is especially beneficial for individuals who have sustained soft tissue damage due to an injury or invasive surgery, as well as those looking to improve their athletic performance.

Proprioceptive neuromuscular facilitation (PNF) was first developed by Margaret Knott PT, and Herman Kabat MD in the 1940's to treat neurological dysfunctions. (http://www.stretching-exercisesguide.com/pnf-stretching.html). Initial PNF techniques were used to aid the rehabilitation of clients with spasticity and weakness by facilitating muscle elongation. This is theorized to be accomplished through enhanced inhibitory mechanisms affecting the spastic muscle, and improving the muscle strength through improved excitation mechanisms in the weakened muscle. (Sharman, Cresswell, Riek, 2006) [21]. And R. Lane sustained that "PNF stretching initially developed as a form of rehabilitative therapy so as to lessen and hopefully reverse the impact of a paralysis or stroke. The effectiveness of the technique led physiotherapist and other health/sports professionals to investigate it further and apply it to other areas" (http://articles.submityourarticle.com/the-basics-andbenefits- of-pnf-stretching-83751) PNF techniques help develop muscular strength and endurance, joint stability, mobility, neuromuscular control and coordination–all of which are aimed at improving the overall functional ability of athletes (Scifers, 2004) [19], http://physicaltherapy. advanceweb.com/Article/The-Truth-About- PNF-Techniques-1.aspx).

PNF techniques have broad applications in treating people with neurologic and musculoskeletal conditions, most frequently in rehabilitating the knee, shoulder, hip and ankle (Surburg, Schrader, 1997) [22]. Stretching is a main component of PNF. In fact, PNF stretching is superior to other stretching techniques (Burke, Culligan, Holt, 2000; Funk, Swank, Mikla, et al., 2003) [6, 24].

PNF exercises can be applied to athletes of all ages. Klein et al., 2002, [8] found that using PNF techniques for older adults improved range of motion, isometric strength and selected physical function tasks (Klein, Stone, Phillips, et al., 2002) [8]. Whether promoting flexibility, developing muscular strength and endurance, improving joint stability or increasing neuromuscular control and coordination, PNF is a valuable part of every rehabilitation program.

Proprioceptive neuromuscular facilitation encompasses all aspects of the rehabilitation process—and can help atheltes with various dysfunctions achieve their goals (Scifers, 2004) [19], http://physicaltherapy. advanceweb.com/Article/The-Truth-About- PNF-Techniques-1.aspx). PNF patterns of movements were developed because all normal coordinated human movements occur in spiral or diagonal motions. Muscular contractions are strongest and most coordinated during these diagonal patterns of movement. These diagonal patterns involve rotation of the extremities and require core stability. Muscular contraction is also enhanced through irradiation and there is optimal facilitation of the stretch reflex in a synergistic muscle group during movements within these patterns of movement (Knott, Voss, 1968) [12].

Proprioceptive neuromuscular facilitation (PNF) stretching techniques are commonly used in the athletic and clinical environments to enhance both active and passive range of motion with a view to optimizing motor performance and rehabilitation. PNF stretching is positioned in the literature as the most effective stretching technique when the aim is to increase passive range of motion (Sharman, Cresswell, Riek, 2006) [21].

Terms about muscle contraction are commonly used when discussing PNF. Concentric isotonic contraction is when the muscle shortens, eccentric isotonic is when it lengthens even though resisting a force is being applied, and isometric contraction is when the muscle remains the same length even while it is contracting (McAtee, Charland, 1999) [16].

On the other hand, we cannot talk about PNF techniques without making reference to Golgi tendon organ and Muscle spindles. Muscle spindles are sensory receptors within the belly of a muscle, which primarily detect changes in the length of this muscle. They convey length information to the central nervous system via sensory neurons. This information can be processed by the brain to determine the position of body parts. The responses of muscle spindles to changes in length also play an important role in regulating the contraction of muscles, by activating motoneurons via the stretch reflex to resist muscle stretch (Dumitru, 1988) [9].

How PNF Stretching Works For the following information, you should know that the golgi tendon organ relaxes a muscle after a sustained contraction has been applied to it for longer than 6 seconds. Isometric contractions (the hold phase) and concentric contractions (the contract phase) used immediately before the passive stretch (the relax phase) facilitate autogenic inhibition. Autogenic inhibition is a reflex relaxation that occurs in the same muscle where the golgi tendon organ is stimulated. Similarly, we can use a technique that involves a concentric contraction of the muscle group opposing that which is being stretched, in order to achieve reciprocal inhibition. Reciprocal inhibition is a reflex muscular relaxation that occurs in the muscle that is opposite the muscle where the golgi tendon organ is stimulated. Using the hold, contract, and relax phases, we can develop the following 4 PNF stretching techniques. While slightly different, each technique starts by holding a passive stretch for about 10 seconds

(http://www.google.ro/imgres?imgurl=http://www.projectswole.com/wpcontent/uploads/2009/10/pnfstretching1.jpg& imgrefurl=http://www.projectswole.com/flexibility/improve recovery time after a strenuous workout).

Techniques

Most PNF stretching techniques employ isometric agonist contraction/relaxation where the stretched muscles are contracted isometrically and then relaxed. Some PNF techniques also employ isometric antagonist contraction where the antagonists of the stretched muscles are contracted.

In all cases, it is important to note that the stretched muscle should be rested (and relaxed) for at least 20 seconds before performing another PNF technique. The most common PNF stretching techniques are:

Contract Relax: Passive placement of the restricted muscle into a position of stretch followed by an isometric contraction of the restricted muscle. Most isometric contractions in PNF stretching techniques should he held for a minimum of 3 seconds (Surburg, Schrader, 1997) [22] at a sub maximal effort (20-50% of maximal effort) to avoid muscle fatigue and injury (Feland, Marin, 2004) [26]. After the contraction period the patient is instructed to relax the restricted muscle that was just contracting and activate the opposing muscle to move the limb into a greater position of stretch. Through Reciprocal Inhibition, the tight muscle is relaxed, and allowed to lengthen.

Hold Relax: Very similar to the Contract Relax technique. This is utilized when the agonist is too weak to activate properly. The patient's restricted muscle is put in a position of stretch followed by an isometric contraction of the restricted muscle. After the allotted time the restricted muscle is passively moved to a position of greater stretch. Contraction times and efforts will remain the same as the Contract Relax technique. This technique utilizes the golgi tendon organ, which relaxes a muscle after a sustained contraction has been applied to it for longer than 6 seconds (http://en.wikipedia.org/wiki/PNF_stretching).

Hold-Relax Agonist: Most familiar. It can be used to lengthen out tight muscle and increase passive range of motion. In this technique, the tight muscle is the antagonist, hence the agonist contracts (provided that the agonist is strong enough). The therapist asks the patient to isometrically contract the agonist for around 6 seconds before it gets moved further into range. Through Reciprocal Inhibition, the tight muscle is relaxed, and allowed to lengthen. Verbal cues for the patient performing this exercise would include, "Hold. Hold. Don't let me move you. (http://en.wikipedia.org/wiki/PNF_stretching)

Hold-Relax Antagonist: Very similar to the Hold- Relax Agonist technique. This is utilized when the agonist is too weak to activate properly. The patient isometrically contracts the tight muscle (the antagonist muscle) against the therapist's resistance. After a 6 second hold has been achieved, the therapist removes his/her hand and the patient concentrically contracts the agonist muscle (the muscle opposite the tight muscle, the non-tight muscle) in order to gain increased range of motion. This technique utilizes the golgi tendon organ, which relaxes a muscle after a Taken after sustained contraction has been applied to it for longer than 6 seconds. Notice that in the hold-relax-contract, there is no final passive stretch. It is replaced by the antagonist contraction which, via reciprocal inhibition (see section Reciprocal Inhibition), serves to relax and further stretch the muscle that was subjected to the initial passive stretch. Because there is no final passive stretch, this PNF technique is considered one of the safest PNF techniques to perform (it is less likely to result in torn muscle tissue). Some people like to make the technique even more intense by adding the final passive stretch after the second isometric contraction. Although this can result in greater flexibility gains, it also increases the likelihood of injury (http://web.mit.edu/tkd/stretch/stretching_4.htm).

Hold Relax Swing: This technique (and a similar technique called the hold-relax-bounce) actually involves the use of dynamic or ballistic stretches in conjunction with static and isometric stretches. It is very risky, and is successfully used only by the most advanced of athletes and dancers that have managed to achieve a high level of control over their muscle stretch reflex (see section The Stretch Reflex). It is similar to the hold-relax technique except that a dynamic or ballistic stretch is employed in place of the final passive stretch (http://web.mit.edu/tkd/stretch/stretching_4.html).

Hold-Relax-Swing/Hold-Relax Bounce: These are similar techniques to the Hold-Relax and CRAC. They start with a passive stretching by the therapist followed by an isometric contraction. The difference is that at the end, instead of an antagonist muscle contraction or a passive stretching, dynamic stretching and ballistic stretching is used. It is very risky, and is successfully used only by people that have managed to achieve a high level of control over their muscle stretch reflex. Ballistic stretching should ONLY be used by athletes prior to engaging in a High Energy movement (e.g. A sprinter running a 100m dash) (Arredondo, 2009) [25].

How to Work Out Safely and Avoid Injury: If you have a previous or pre-existing health condition, consult your physician before beginning an exercise program. Proper exercise technique is essential to ensure the safety and effectiveness of an exercise program, but you may need to modify each exercise to attain optimal results based on your individual needs. Always select a weight that allows you to have full control of your body throughout the movement. When performing any exercise, pay close attention to your body, and stop immediately if you note pain or discomfort.

To see continual progress and build body strength, incorporate proper warm-ups, rest, and nutrition into your exercise program. Your results will ultimately be based on your ability to adequately recover from your workouts. Rest for 24 to 48 hours before training the same muscle groups to allow sufficient recovery.

General Guidelines for PNF Stretching

Always precede PNF stretching with 10-15 minutes of moderate exercise. Avoid PNF prior to exercise. Choose dynamic stretching and mobility work instead. Perform only one stretch per muscle group per PNF session. Perform at least two sets of each stretch for the chose muscle group. Hold each stretch for 30 seconds after the initial contraction. Separate PNF stretching routines with at least a 48 hour recovery period.

PNF stretching usually involves a 10 second push phase followed by a 10 second relaxation phase, typically repeated a few times. PNF stretching is capable of producing greater improvement in flexibility compared to other techniques. Its disadvantage is that it typically requires a partner, although stretching with a partner may have some motivational advantage for some individuals (http://www.exrx.net/ExInfo/Stretching.html).

References

1. McAtee RE, Charland J. Facilitated stretching: assisted and Unassisted PNF stretching made easy. 2nd ed. Champaign (IL). 1988;59(3):222-228.
2. Tanigawa MC. Comparison of the hold-relax procedure

and passive mobilization on increasing muscle length. Physical therapy. 1972 Jul 1;52(7):725-35.
3. Allison C, Jean W, Verduzco-Gutierrez M. Traumatic Brain Injury. Medical Clinics of North America. 2000;104(2):213-38.
4. Arietta Spinou. A Review on Cough Augmentation Techniques: Assisted Inspiration, Assisted Expiration and Their Combination, Physiol. Res. 2020;69(1):S93-103.
5. Ashtankar AP. Comparative Effect of Proprioceptive Neuromuscular Facilitation (PNF) and Chest Physiotherapy with Chest Physiotherapy alone on SP02, Heart Rate, Respiratory Rate and Lung Compliance in Mechanically Ventilated Patient. J Pharm Sci Res. 2020;11(10):3514-8.
6. Burke D, Culligan C, Holt L. The theoretical basis of proprioceptive neuromuscular facilitation. Journal of Strength and Conditioning Research. 2000;14(4):496-500.
7. Chang D. Clinical Application of Mechanical Ventilation. 4th Edition, Delmar, New York. 2014: 10-11. Conditioning Research. Davis: Philadelphia 2000;17(3):489-492
8. Klein D, Stone W, Phillips W, Gangi J, Hartman S. PNF training and physical function; c2002.
9. Dumitru G. Fiziologia educatiei fizice si sportului. Ovidius University Press, Constanta, 1988, 52-55.
10. Heckmann CJ, Gorassini MA, Bennett DJ. Persistent inward currents in motoneuron dendrites: implications for motor output. Muscle Nerve. 2005;31(2):135-156. http://articles.submityourarticle.com/the-basics-andbenefits- of-pnf-stretching-83751, viewed 15.01.2013 http://physical-therapy.advanceweb.com/Article/The-Truth-About-PNF-Techniques-1.aspx,viewed 15.01.2013
11. Hutchinson PJ, Kolias AG, Timofeev IS, Corteen EA, Czosnyka MT, Jake AI, *et al*. Trial of Decompressive Craniecto MY for Traumatic Intracranial Hypertension. N Eng J Med. 2016;NEJMoa1605215.
12. Knott M, Voss D. Proprioceptive Neuromuscular Facilitation (2nd ed.). Harper & Row: Philadelphia; c1968.
13. Kolias AG, Kirkpatrick PJ, Hutchinson PJ. Decompressive craniectomy: past, present and future. Nature Rev Neurol. 2013;9(7):405-15.
14. Louise R. Cochrane Database of Systematic Reviews (Reviews), Cough augmentation techniques for extubation or weaning critically ill patients from mechanical ventilation, 1996, 1.
15. Marek S, Cramer J, Fincher A, Massey L, Dangelmaier S, Purkayastha S, *et al*. Acute effects of static and proprioceptive neuromuscular facilitation stretching on muscle strength and power; c2005.
16. Mcatee RE, Charland J. Facilitated stretching: assisted and unassisted PNF stretching made output. Journal of Athletic Training. 1999;40:94-103
17. Paul M. Effectiveness of PNF of respiration to improve the exercise capacity in patients with COPD: A pilot study. Medicine. 2017, 6.
18. Prochazka A, Gorassini M. Ensemble firing of muscle afferents recorded during normal locomotion in cats, J Physiology. 1998;507(1):293-304. DOI:10.1111/j.1469-7793.1998.293bu.x. PMC 2230769. PMID 9490855
19. Scifers JR, Scifers JR. Proprioceptive neuromuscular rehabilitation is more than just stretching and functional movement. Truth PNF Tech. 2004;15:40-43.
20. Rose L, Mckim D, Katz S, Leasa D, Nonoyama M, Pedersen C, *et al*. Institutional care for long-term mechanical ventilation in Canada: A national survey. Can Respir J. 2014;21(6):357-62.
21. Sharman M, Cresswell A, Riek S. Proprioceptive Neuromuscular Facilitation Stretching. Sports Medicine. 2006;36:929-939
22. Surburg P, Schrader J. Proprioceptive neuromuscular facilitation techniques in sports medicine: A reassessment. Journal of Athletic Training. 1997;11(4):34-39
23. The Truth About PNF Techniques, Vol. 15 •Issue 26 • Page 40, http://physicaltherapy. advanceweb.com/Article/The-Truth- About-PNF-Techniques-1.aspx viewed 15.01.2013.
24. Funk DC, Swank AM, Mikla BM, Fagan TA, Farr BK. Impact of prior exercise on hamstring flexibility: a comparison of proprioceptive neuromuscular facilitation and static stretching. The Journal of Strength & Conditioning Research. 2003 Aug 1;17(3):489-92.
25. Arredondo E, Castaneda D, Elder JP, Slymen D, Dozier D. Brand name logo recognition of fast food and healthy food among children. Journal of community health. 2009 Feb;34:73-8.
26. Feland JB, Marin HN. Effect of submaximal contraction intensity in. Br. J. Sports Med. 2004;38(18).