

AUGUST 2023

## Dear IPNFA®Members, Dear Friends

We present the next IPNFA® Newsletter prepared by the Research Committee.

Below you will find the newest articles approved by the members of our committee also information about Level 5 courses and virtual conference "Talk about PNF". We hope to see every member at the upcoming AGM in Sofia.

### NEW LEVEL 5 COURSE - SOUTH KOREA



**February 06th – February 10th, 2023**

**Organizer: KPNFA® North branch of Seoul-Gyeonggi-do**

**Instructors: Kitty Hartmann and Agnieszka Stepien**

**16 participants, 1 from Croatia, 3 from Brazil and 12 colleagues from Korea.**

## **NEW LEVEL 5 COURSE - JAPAN**

**Dates: 23-27 February 2023**

**Organiser: Gen Matsuda.**

**Instructors : Betina Lang and Frits Westerholt**



**Participants (18): 17 Japanese therapists, 1 Korean therapist**

## VIRTUAL CONFERENCE "TALK ABOUT PNF" - TAIWAN

Dates: 17 June 2023

Organiser: Show Wang, Ashlee Yu - Ming Su

instructors : Monica Cilento, Katarzyna Fountoukidis, Marcel Grzebellus

First Marcel has had a lecture in the topic of PNF Philosophy, then Kasia talked about combination of trunk and foot during therapy. Monica pointed issues of clinical reasoning in PNF with ICF.

virtual  
Conference

# 2023

2:00-8:00 pm  
17th June,  
2023

Location  
Virtual learning event via Zoom

Contact  
循序漸進  
TPNFA  
CPNFA

## TALK ABOUT PNF

PROPRIOCEPTIVE  
NEUROMUSCULAR  
FACILITATION

Our speaker



**SHOW WANG**  
CEO & Founder of  
TPNFA



**MONICA CILENTO**  
CEO of IPNFA



**MACEL GRZEBELLUS**  
Educational Chairman of  
IPNFA



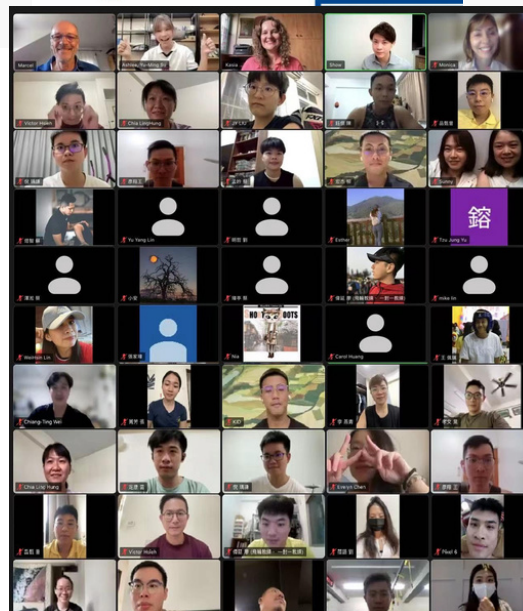
**KASIA KATARZYNA**  
Secretary of  
IPNFA





## Meeting Contents

- 01 Opening
- 02 Marcel 14pm  
PNF philosophy
- 03 Kasia 17pm  
How to combine trunk and foot activities in the PNF concept
- 04 Show 18pm  
How to implement PNF concept into your coaching skills
- 05 Monica 19pm  
Principles of Clinical Reasoning with PNF using ICF
- 06 Wrap  
Lorem ipsum is simply dummy text of the printing and typesetting industry. Lorem ipsum has been the industry's standard dummy text



## 16 NEW ARTICLES APPROVED BY RESEARCH COMMITTEE !!!

**You can find 16 new articles attached below. The articles were approved by all members of the Res Com.**

**Enjoy the reading.**

Randomized Controlled Trial PLoS One. 2023 Feb 13;18(2):e0280941.  
doi: 10.1371/journal.pone.0280941. eCollection 2023.

**Effects of proprioceptive neuromuscular facilitation stretching in relieving pain and balancing knee loading during stepping over obstacles among older adults with knee osteoarthritis: A randomized controlled trial**

Bo Gao 1, Li Li 2, Peixin Shen 3 4, Zhipeng Zhou 4, Peiming Xu 5, Wei Sun 4, Cui Zhang 6, Qipeng Song 4 Affiliations expand  
Free PMC article

### Abstract

**Objective:** The purpose of this study was to investigate the effects of an 8-week proprioceptive neuromuscular facilitation (PNF) stretching in relieving pain and balancing knee loading during stepping over obstacles among older people with knee osteoarthritis, and further explore the improvements in gait patterns.

**Design:** Thirty-two older adults (66~72 years) with KOA were recruited and randomly assigned into PNF or control groups. They received PNF stretching or health lecture series for 8 weeks. Final data analyses were conducted among 13 participants in the PNF and 14 in the control groups. At weeks 0 and 9, they were asked to step over an obstacle of 20% of their leg length. The pain scores and knee abduction moment (KAM) (primary outcomes) were analyzed by multivariate ANOVA, and the gait variables (secondary outcomes) were analyzed by two-way (group by pre-/post) ANOVAs with repeated measures.

**Results:** Significant interactions were detected in the pain score, first and second peaks of KAM, and crossing velocity during stepping over obstacles, and significant between-group differences of these outcomes were detected at week 9.

**Conclusion:** An 8-week PNF stretching could relieve pain and balance loading between knee compartments, as well as increase crossing velocity during stepping over obstacles.

Randomized Controlled Trial Int J Chron Obstruct Pulmon Dis. 2021 Apr 13;16:969-977. doi: 10.2147/COPD.S300569. eCollection 2021.

## Effects of Proprioceptive Neuromuscular Facilitation Stretching Combined with Aerobic Training on Pulmonary Function in COPD Patients: A Randomized Controlled Trial

Kai Liu # 1, Xinjuan Yu # 2, Xuefen Cui 2, Yi Su 2, Lixin Sun 3, Jiulong Yang 4, Wei Han 2

### Abstract

**Background:** The proprioceptive neuromuscular facilitation (PNF) stretching could improve the contractile capacity of respiratory muscles, but the effect on pulmonary function, when it is combined with aerobic training, remains unknown.

**Objective:** To evaluate the effect of PNF combined with aerobic training on respiratory symptoms, pulmonary function and neck/shoulder mobility in patients with COPD.

**Design:** Randomized controlled trial.

**Participants:** Fifty-five COPD patients were randomly divided into PNF group (n=28) and control group (n=27).

**Intervention:** On the basis of conventional treatment, the control group performed 30 min aerobic training on a treadmill, while the PNF group added 10-minute PNF stretching 3 times every training day. Both groups did their training in 5 days per week for 6 weeks.

**Measures:** Measures were taken before and after 6 weeks of training. COPD Assessment Test (CAT), dyspnea Visual Analog Scale (VAS), forced vital capacity (FVC), forced expiratory volume in first second (FEV1), inspiratory capacity (IC), inspiratory reserve volume (IRV), 6-minute walk test (6MWT), the range of motion (ROM) of head protraction, shoulder flexion, and the non-dominant pectoralis minor muscle (PmM) length were measured.

**Results:** All the indicators of both groups were significantly improved after 6 weeks of intervention except for FVC, FEV1 and PmM length. Compared to the control group, the PNF group showed significant improvement in the CAT score, dyspnea VAS score, IC, IRV, 6MWT, as well as head protraction ROM and shoulder flexion ROM. Furthermore, IC was positively correlated with the head protraction ROM and PmM length ( $r=0.415$ ,  $0.579$ ,  $P=0.028$ ,  $0.001$ ); IRV was positively correlated with the shoulder flexion ROM ( $r=0.405$ ,  $P=0.032$ ) in the PNF group.

**Conclusion:** PNF stretching combined with aerobic training reduces dyspnea and improves some pulmonary function measures, which is associated with neck/shoulder mobility, in COPD patients.

**Keywords:** aerobic training; chronic obstructive pulmonary disease; proprioceptive neuromuscular facilitation stretching; pulmonary function.



J Bodyw Mov Ther. 2023 Jul;35:342-347. doi: 10.1016/j.jbmt.2023.04.054. Epub 2023 Apr 19.

## Acute effects of different proprioceptive neuromuscular facilitation stabilization techniques on the balance of elderly women

Jessica da Silva Lamp 1, Lucas Menghin Beraldo 2, Willian Vieira Dos Santos 2, Leandro Giacometti da Silva 2, Eduardo Lusa Cadore 2, Caroline Pietta-Dias 2

### Abstract

**Aim:** To compare the acute effects of rhythmic stabilization (RS) and stabilizer reversal (SR) techniques of PNF on the balance of sedentary elderly women.

**Methods:** Women aged ( $\geq 70$ ) were allocated into three groups: RS, SR and control (CR). The experimental groups (RS and SR) performed balance exercises with the addition of rhythmic stabilization techniques (RS group) or with stabilizers reversal (SR group) for 15 min. The CR group performed the exercises without adding the PNF stabilization techniques. Participants performed the Time Up and Go (TUG) test, the Functional Reach Test (FRT) and static and dynamic stabilometry pre and post intervention. Kruskal-Wallis and Mann-Whitney tests were used for comparison between groups and post hoc analysis, respectively, with  $p \leq 0.05$ . For the effect size measurements, the  $r$  for Wilcoxon and Mann-Whitney signal were used.

**Results:** For functional tests intra-group analysis, a reduction in TUG time and an increase in FRT range ( $p \leq 0.05$ ) were observed in RS e SR groups. Stabilometry analysis showed a significant difference only for the RS group, with reduced average velocity of the centre of pressure (COP), and an increased in the left foot pressure.

**Conclusions:** A single RS or SR session reduced the TUG time and the range distance in the FRT in elderly women. A single session of the RS technique was also able to reduce the mean velocity of the COP and the maximum pressure on the left foot.

**Impact:** This study shows an easy-to-apply methods without additional materials that can help prevent falls in the elderly.

**Keywords:** Aging; Stabilization techniques; Stabilometry.

Biomol Biomed. 2023 May 21. doi: 10.17305/bb.2023.9049. Online ahead of print.

## Exploring the latest advancements in physical therapy techniques for treating cervical spondylosis patients: A narrative review

Quanzheng Chen 1, Zhenshan Wang 1, Shuna Zhang 1

### Abstract

Cervical spondylosis is a widespread medical condition that significantly impacts patients' quality of life. Treatment options include surgical and conservative approaches, with conservative treatment often being the preferred choice. Rehabilitation therapy is an essential component of conservative treatment, and advancements in technology have the way to the development of new physiotherapy techniques. The effectiveness of treatment largely hinges on the patient's ability to improve their dysfunction. This study aims to provide valuable insights into the use of new physical therapy techniques, such as Sling Exercises Training (SET), fascia manipulation, muscle energy technique (MET), and proprioceptive neuromuscular facilitation (PNF), that aid the rehabilitation of cervical spondylosis. By scrutinizing the current research status of these techniques, this study aims to present innovative ideas enhancing the rehabilitation process and outcomes for patients suffering from cervical spondylosis.

Poliochoreia

J Clin Med. 2023 Mar 30;12(7):2610. doi: 10.3390/jcm12072610.

## Immediate and Long-Term Effectiveness of Proprioceptive Neuromuscular Facilitation and Static Stretching on Joint Range of Motion, Flexibility, and Electromyographic Activity of Knee Muscles in Older Adults

Sahar Zaidi 1 2, Asfak Ahamad 1, Anam Fatima 1, Irshad Ahmad 1 3, Deepak Malhotra 2, Wafa Hashem Al Muslem 4, Sahar Abdulaziz 4, Shibili Nuhmani 4

### Abstract

**Introduction and Objective:** Previously, various stretching techniques were compared to study their effects on the different physiological parameters of hamstring muscles in the elderly population. There is no research that compares the immediate and long-term effects of proprioceptive neuromuscular facilitation-contract-relax (PNF-CR) and static stretching (SS) techniques on knee range of motion (ROM), hamstring flexibility, and knee flexor muscle EMG activity in the elderly. This study intends to compare the same.

**Methods:** A total of 30 males aged 55-75 years were randomly assigned into the PNF-CR group (n = 10), SS group (n = 10), and control group (n = 10). The PNF-CR group received four trials of the contract-relax technique, the SS group received passive stretching of an 80 s duration by the therapist, and the control group received no intervention. A total of 12 sessions were given during the four-week period. Knee range of motion, electromyographic activity of the biceps femoris, and the sit-and-reach test were taken for the dominant side thrice: pre-intervention, immediately after stretching, and after the training period.

**Results:** A statistically significant difference was observed in the maximum voluntary isometric contraction (MVIC) of biceps femoris between the PNF and the control groups ( $p = 0.01$ ) after four weeks of intervention. The knee ROM and hamstring flexibility for the PNF group showed significant improvement immediately post-test ( $p = 0.01$ ) and after four weeks of training ( $p = 0.07$  and  $p = 0.001$ ). SS showed significant results for both ROM and flexibility after four weeks of intervention ( $p = 0.001$ ), and significant immediate post-test improvements were seen for ROM only ( $p = 0.007$ ).

**Conclusions:** PNF stretching has an immediate, as well as long-term, effect on knee ROM and hamstring flexibility, whereas it has only a long-term effect on muscle electromyographic activity. SS has an immediate, as well as long-term, effect on knee ROM and only a long-term effect on hamstring flexibility, without any immediate or long-term effects on muscle electromyographic activity.

**Keywords:** contract-relax; elders; electromyography; flexibility; range of motion.



## Randomized Controlled Trial

Int J Environ Res Public Health. 2023 Jan 12;20(2):1439. doi: 10.3390/ijerph20021439.

### Foam Rolling vs. Proprioceptive Neuromuscular Facilitation Stretching in the Hamstring Flexibility of Amateur Athletes: Control Trials

Albert Pérez-Bellmunt 1 2, Oriol Casasayas-Cos 1 2, Paolo Ragazzi 1 2, Jacobo Rodríguez-Sanz 1 2, César Hidalgo-García 3, Max Canet-Vintró 1 2, Iván Caballero-Martínez 1 2, Laura Pacheco 1, Carlos López-de-Celis 1 2 4

#### Abstract

**Background:** the use of stretching techniques in the sports world is frequent and common thanks to their many effects. One of the main benefits of stretching is an increased range of motion (ROM). Recently, the use of a foam roller has spread in sports practice due to benefits that are similar to those of shoes observed in stretching. The objective of the following study was to compare the results of proprioceptive neuromuscular facilitation stretching (PNF) with foam rolling (FR).

**Methods:** The design of the study was a single-blind, randomized controlled trial (clinicaltrial.gov NCT05134883), and the participants were 80 healthy young athletes. The range of motion was evaluated with a modified sit-and-reach test before, during (at 30 s), and at the end of the intervention (at 2 min). The subject's discomfort sensation was measured using the Borg scale. Effect sizes were calculated using Cohen's d coefficient. Volunteers were randomized into the PNF group or FR group.

**Results:** the differences were statistically significant ( $p < 0.001$ ) during the intervention in favor of PNF group. The differences at the end of intervention showed that the PNF group had a greater increase in flexibility, with this difference being statically significant ( $p < 0.001$ ). The sensation of perceived exertion with PNF at the end of the intervention was similarly classified as moderate for both groups.

**Conclusion:** Despite the fact that the use of FR is spreading in the field of sports and rehabilitation, the results of the present study suggest that the gain in flexibility in the hamstrings is greater if PNF-type stretches are used instead of FR.

**Keywords:** ROM; extensibility; fascia; flexibility; hamstring muscles; healthy adults; muscle stretching; myofascial rolling; strength.

## Review

Front Sports Act Living. 2022 Nov 15;4:1035190. doi: 10.3389/fspor.2022.1035190. eCollection 2022.  
Inter-set stretch: A potential time-efficient strategy for enhancing skeletal muscle adaptations  
Brad J Schoenfeld 1, Henning Wackerhage 2, Eduardo De Souza 3

## Abstract

Time is considered a primary barrier to exercise adherence. Therefore, developing time-efficient resistance training (RT) strategies that optimize muscular adaptations is of primary interest to practitioners. A novel approach to the problem involves combining intensive stretch protocols with RT. Conceivably, integrating stretch into the inter-set period may provide an added stimulus for muscle growth without increasing session duration. Mechanistically, stretch can regulate anabolic signaling via both active and passive force sensors. Emerging evidence indicates that both lengthening contractions against a high load as well as passive stretch can acutely activate anabolic intracellular signaling pathways involved in muscle hypertrophy. Although longitudinal research investigating the effects of stretching between RT sets is limited, some evidence suggests it may in fact enhance hypertrophic adaptations. Accordingly, the purpose of this paper is threefold: (1) to review how the active force of a muscle contraction and the force of a passive stretched are sensed; (2) to present evidence for the effectiveness of RT with inter-set stretch for muscle hypertrophy (3) to provide practical recommendations for application of inter-set stretch in program design as well as directions for future research.

**Keywords:** contraction; force sensors; hypertrophy; lengthening; mechanical tension.

Sports Health. 2021 Mar;13(2):181-186. doi: 10.1177/1941738120938649. Epub 2020 Aug 28.

Muscle Activation Differences During Eccentric Hamstring Exercises

Sonay Guruhan 1, Nihan Kafa 1, Zeynep B Ecemis 1, Nevin A Guzel 1

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## Abstract

**Background:** The hamstring muscles play a critical role in the prevention of lower limb injuries. However, it is still unclear which exercises are more effective in terms of muscle activation.

**Hypothesis:** In healthy individuals, there are differences between muscular activations of the biceps femoris (BF), semitendinosus (ST), and semimembranosus (SM) muscles during eccentric hamstring exercises.

**Study design:** Cross-sectional.

Level of evidence: Level 2.

**Methods:** A total of 31 healthy participants (18 male; mean age, 22.5 years; SD, 3.1) were included in this study. The maximum voluntary isometric contraction of the hamstring muscles was measured using an isokinetic dynamometer. The participants were asked to perform one of the following exercises randomly (3 repetitions each): stiff-leg deadlift (SLDL), unilateral stiff-leg deadlift (USLDL), Nordic hamstring exercise (NHE), and ball leg curl (BLC). Activation of the BF, ST, and SM muscles was measured using surface electromyography during the exercises. In the statistical analysis of this study, factorial analysis of variance was used to compare the effects of each exercise on the muscle groups and to analyze which exercise type was more effective for each muscle group.

**Results:** The NHE led to higher muscle activation than the other exercises ( $P < 0.001$ ). When exercise type and muscle interaction were examined, SM activation was lower than BF ( $P = 0.04$ ) and ST ( $P = 0.001$ ) during NHE ( $P < 0.05$ ). The highest level of muscular activation was recorded during the NHE in both male and female participants.

**Conclusion:** The NHE may be the most effective exercise for the hamstring muscles as it leads to greater muscle activation. SLDL, USLDL, and BLC exercises may be preferred at the beginning of strength training programs since they lead to lower muscular activation compared with the NHE.

**Clinical relevance:** To select the optimum hamstring exercise, it is important to know the activation levels of the hamstring muscles during different eccentric exercises.

**Keywords:** eccentric exercise; electromyography; hamstring; muscle activity.

Review Sports Health. 2017 Jul/Aug;9(4):333-340. doi: 10.1177/1941738117710913. Epub 2017 Jun 1.

Eccentric Exercise to Enhance Neuromuscular Control

Lindsey K Lepley 1, Adam S Lepley 1, James A Onate 2, Dustin R Grooms 3 4

Free PMC article

## Abstract

**Context:** Neuromuscular alterations are a major causal factor of primary and secondary injuries. Though injury prevention programs have experienced some success, rates of injuries have not declined, and after injury, individuals often return to activity with functionality below clinical recommendations. Considering alternative therapies to the conventional concentric exercise approach, such as one that can target neuromuscular injury risk and postinjury alterations, may provide for more effective injury prevention and rehabilitation protocols.

**Evidence acquisition:** Peer-reviewed sources available on the Web of Science and MEDLINE databases from 2000 through 2016 were gathered using searches associated with the keywords eccentric exercise, injury prevention, and neuromuscular control.

**Hypothesis:** Eccentric exercise will reduce injury risk by targeting specific neural and morphologic alterations that precipitate neuromuscular dysfunction.

**Study design:** Clinical review.

**Level of evidence:** Level 4.

**Results:** Neuromuscular control is influenced by alterations in muscle morphology and neural activity. Eccentric exercise beneficially modifies several underlying factors of muscle morphology (fiber typing, cross-sectional area, working range, and pennation angle), and emerging evidence indicates that eccentric exercise is also beneficial to peripheral and central neural activity (alpha motoneuron recruitment/firing, sarcolemma activity, corticospinal excitability, and brain activation).

**Conclusion:** There is mounting evidence that eccentric exercise is not only a therapeutic intervention influencing muscle morphology but also targets unique alterations in neuromuscular control, influencing injury risk.

**Keywords:** eccentric exercise; injury prevention; neuromuscular.

## Randomized Controlled Trial

NeuroRehabilitation. 2021;48(4):513-522. doi: 10.3233/NRE-201601.

**Eccentric training effects for patients with post-stroke hemiparesis on strength and speed gait: A randomized controlled trial**

Nisrine Abdelnour Lattouf 1, Roland Tomb 2, Ayman Assi 3, Luc Maynard 4, Serge Mesure 5

### Abstract

**Background:** In hemiparetic patients, the skeletal muscle is mainly affected with a combination of abnormalities (denervation, remodeling, spasticity, and eventually muscular atrophy).

**Objective:** This study examined the role of eccentric exercise in strengthening muscles of the lower extremity and ultimately improving autonomy in patients with post-stroke hemiparesis during gait.

**Methods:** Thirty-seven patients hemiparetic adults were recruited, randomized into a control group (n = 19) and an intervention group receiving eccentric muscle strengthening (n = 18). The protocol consisted of three sets of five repetitions of eccentric contraction of the paretic limb after determining the maximum repetition (1 MRI). Evaluation of the 1RM, 10 meters and 6WMT was performed before and after the exercise for each group. Manova test was used to compare the differences between the control and intervention groups.

**Results:** The paretic limb showed significant increase in one-repetition maximum (1RM) between before and after rehabilitation ( $p \leq 0.00003$ ). The two groups of Patients increased their walking speed ( $p \leq 0.0005$ ), but we observed a significant difference between groups only for the 6MWT and not on the 10 meters Test.

**Conclusions:** Eccentric training can be useful in strengthening the muscles of the lower limbs, and promoting gait performance. Eccentric training could complement other methods of managing patients with post-stroke hemiparesis.

**Keywords:** Post-stroke hemiparesis; eccentric training; gait; muscle rehabilitation.

PLoS One. 2017 Mar 13;12(3):e0173909. doi: 10.1371/journal.pone.0173909. eCollection 2017.

## Prevention of downhill walking-induced muscle damage by non-damaging downhill walking

Sumiaki Maeo <sup>1 2</sup>, Masayoshi Yamamoto <sup>3</sup>, Hiroaki Kanehisa <sup>3</sup>, Kazunori Nosaka <sup>4</sup>

[Affiliations expand](#)

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### Abstract

**Purpose:** Mountain trekking involves level, uphill, and downhill walking (DW). Prolonged DW induces damage to leg muscles, reducing force generating ability and muscle coordination. These increase risks for more serious injuries and accidents in mountain trekking, thus a strategy to minimize muscle damage is warranted. It has been shown that low-intensity eccentric contractions confer protective effect on muscle damage induced by high-intensity eccentric contractions. This study tested the hypothesis that 5-min non-damaging DW would attenuate muscle damage induced by 40-min DW, but 5-min level walking (LW) would not.

**Methods:** Untrained young men were allocated (n = 12/group) to either a control or one of the two preconditioning groups (PRE-DW or PRE-LW). The PRE-DW and PRE-LW groups performed 5-min DW (-28%) and 5-min LW, respectively, at 5 km/h with a load of 10% body mass, 1 week before 40-min DW (-28%, 5 km/h, 10% load). The control group performed 40-min DW only. Maximal knee extension strength, plasma creatine kinase (CK) activity, and muscle soreness (0-100 mm visual analogue scale) were measured before and 24 h after 5-min DW and 5-min LW, and before and 24, 48, and 72 h after 40-min DW.

**Results:** No significant changes in any variables were evident after 5-min DW and 5-min LW. After 40-min DW, the control and PRE-LW groups showed significant (P<0.05) changes in the variables without significant differences between groups (control vs. PRE-LW; peak strength reduction:  $-19.2 \pm 6.9\%$  vs.  $-18.7 \pm 11.0\%$ , peak CK:  $635.5 \pm 306.0$  vs.  $639.6 \pm 405.4$  U/L, peak soreness:  $81.4 \pm 14.8$  vs.  $72.0 \pm 29.2$  mm). These changes were significantly (P<0.05) attenuated (47-64%) for the PRE-DW group ( $-9.9 \pm 9.6\%$ ,  $339.3 \pm 148.4$  U/L,  $27.8 \pm 16.8$  mm).

**Conclusions:** The results supported the hypothesis and suggest that performing small volume of downhill walking is crucial in preparation for trekking.



Front Physiol. 2021 Nov 30;12:790034. doi: 10.3389/fphys.2021.790034. eCollection 2021.

Potential Benefits of a Minimal Dose Eccentric Resistance Training Paradigm to Combat Sarcopenia and Age-Related Muscle and Physical Function Deficits in Older Adults

[Sara A Harper](#) <sup>1 2</sup>, [Brennan J Thompson](#) <sup>1 2</sup>

[Affiliations expand](#)

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## Abstract

The ability of older adults to perform activities of daily living is often limited by the ability to generate high mechanical outputs. Therefore, assessing and developing maximal neuromuscular capacity is essential for determining age-related risk for functional decline as well as the effectiveness of therapeutic interventions. Interventions designed to enhance neuromuscular capacities underpinning maximal mechanical outputs could positively impact functional performance in daily life. Unfortunately, < 10% of older adults meet the current resistance training guidelines. It has recently been proposed that a more "minimal dose" RT model may help engage a greater proportion of older adults, so that they may realize the benefits of RT. Eccentric exercise offers some promising qualities for such an approach due to its efficiency in overloading contractions that can induce substantial neuromuscular adaptations. When used in a minimal dose RT paradigm, eccentric-based RT may be a particularly promising approach for older adults that can efficiently improve muscle mass, strength, and functional performance. One approach that may lead to improved neuromuscular function capacities and overall health is through heightened exercise tolerance which would favor greater exercise participation in older adult populations. Therefore, our perspective article will discuss the implications of using a minimal dose, submaximal (i.e., low intensity) multi-joint eccentric resistance training paradigm as a potentially effective, and yet currently underutilized, means to efficiently improve neuromuscular capacities and function for older adults.

**Keywords:** aging; maximal strength; muscle function; resistance training; strength training.

Open Access Published: 13 November 2019 The effects of mechanical tactile stimulation on corticospinal excitability and motor function depend on pin protrusion patterns

Sho Kojima, Shota Miyaguchi, Ryoki Sasaki, Shota Tsuiki, Kei Saito, Yasuto Inukai, Naofumi Otsuru & Hideaki Onishi

Scientific Reports volume 9, Article number: 16677 (2019)

## Abstract

Somatosensory stimulation modulates corticospinal excitability. Mechanical tactile stimulation (MS) activates cortical activity depending on tactile stimulation patterns. In this study, we examined whether the effects of mechanical tactile stimulation on corticospinal excitability and motor function depend on different pin protrusions patterns. This single-blind study included 18 healthy subjects. Two types of MS interventions were used: repetitive global stimulus (RGS) intervention was used to stimulate the finger by using 24 pins installed on a finger pad, and sequential stepwise displacement stimulus (SSDS) intervention was used to stimulate the finger by moving a row of 6 pins between the left and right sides on the finger pad. MS interventions were applied to the right index finger for 20 min (stim on/stim off, 1 s/5 s) at a frequency of 20 Hz. After RGS intervention, motor evoked potentials (MEPs) by transcranial magnetic stimulation were observed to be significantly smaller than pre-intervention MEPs; however, motor function using the grooved pegboard task remained unchanged. After SSDS intervention, MEPs were significantly larger and motor function significantly improved compared with pre-intervention values. Our results demonstrated that MS intervention can modulate corticospinal excitability and motor function and that the effects of MS intervention depend on MS intervention patterns.

Neural Plast. 2018 Apr 3;2018:5383514. doi: 10.1155/2018/5383514. eCollection 2018.

## Modulation of Corticospinal Excitability Depends on the Pattern of Mechanical Tactile Stimulation

Sho Kojima 1 2, Hideaki Onishi 1 2, Shota Miyaguchi 1 2, Shinichi Kotan 3, Ryoki Sasaki 1, Masaki Nakagawa 4, Hikari Kirimoto 5, Hiroyuki Tamaki 1 2

### Abstract

We investigated the effects of different patterns of mechanical tactile stimulation (MS) on corticospinal excitability by measuring the motor-evoked potential (MEP). This was a single-blind study that included nineteen healthy subjects. MS was applied for 20 min to the right index finger. MS intervention was defined as simple, lateral, rubbing, vertical, or random. Simple intervention stimulated the entire finger pad at the same time. Lateral intervention stimulated with moving between left and right on the finger pad. Rubbing intervention stimulated with moving the stimulus probe, fixed by protrusion pins. Vertical intervention stimulated with moving in the forward and backward directions on the finger pad. Random intervention stimulated to finger pad with either row protrudes. MEPs were measured in the first dorsal interosseous muscle to transcranial magnetic stimulation of the left motor cortex before, immediately after, and 5-20 min after intervention. Following simple intervention, MEP amplitudes were significantly smaller than preintervention, indicating depression of corticospinal excitability. Following lateral, rubbing, and vertical intervention, MEP amplitudes were significantly larger than preintervention, indicating facilitation of corticospinal excitability. The modulation of corticospinal excitability depends on MS patterns. These results contribute to knowledge regarding the use of MS as a neurorehabilitation tool to neurological disorder.

## Systematic Review:

J Sport Rehabil. 2019 Oct 18;29(4):488-497. doi: 10.1123/jsr.2018-0498. Print 2020 May 1.

The Effect of Proprioceptive Neuromuscular Facilitation on Joint Position Sense: A Systematic Review

Hiroshi Takasaki, Yu Okubo, Shun Okuyama

Free article

## Abstract

**Context:** Accurate joint position sense (JPS) is necessary for effective motor learning and high performance in activities that require fine motor control. Proprioceptive neuromuscular facilitation (PNF) can be a promising intervention.

**Objective:** To examine existing peer-reviewed original studies that have investigated the effect of PNF techniques on the JPS in terms of the methodological quality, PNF techniques, outcomes, and participant characteristics.

**Evidence acquisition:** A systematic literature search was performed using PubMed, EMBASE, MEDLINE, CINAHL, SocINDEX, Scopus, and Cochrane Library from inception to January 2018. The following inclusion criteria were used: (1) assessment of the JPS; (2) peer-reviewed original studies with a randomized controlled trial or quasi-randomized controlled trial design; (3) participants with musculoskeletal disorders or healthy individuals (ie, neither animal studies nor those involving neurological problems); and (4) no cointervention with PNF, except for warm-up procedures. The methodological quality was assessed using PEDro scale and 5 additional criteria. Effect size ( $\eta^2$ ) was calculated where a positive value indicated an increased JPS after PNF as compared with other approaches including the wait-and-see method.

**Evidence synthesis:** Nine studies were examined for their methodological quality, and only one study scored >6 on the PEDro scale. Positive and large effect size ( $\eta^2 > .14$ ) was detected in 2 studies where JPS of the knee with contract-relax and replication techniques was assessed in healthy individuals. However, the methodological quality of these studies was poor (PEDro scores of 3 and  $\leq 5$  in the total quality score out of 16, respectively).

**Conclusions:** The current study did not find multiple studies with high methodological quality and similar PNF techniques, outcomes, and characteristics of participants. More high-quality studies are required to achieve a comprehensive understanding of the effect of PNF on the JPS.

**Keywords:** physical therapy techniques; proprioception; proprioceptive neuromuscular facilitation (PNF) stretching.

**Case Report Open Access Published: 28 April 2021**

**Impact of structured physical therapy intervention on functional recovery in a patient with CAPOS syndrome: a case report**

**Shailesh Gardas & Aishwarya Mahajan**

**Bulletin of Faculty of Physical Therapy volume 26, Article number: 8 (2021)**

**Abstract**

**Background**

CAPOS syndrome (cerebellar ataxia, areflexia, pes cavus, optic atrophy, and sensorineural hearing loss) is a rare congenital autosomal dominant disorder. The resulting neurological sequelae of impairments are progressive in nature and may interfere with functional independence, performing activities of daily living (ADL's), and subsequently, affecting the quality of life (QOL). Since it is an extremely rare disorder, there is a severe dearth in the literature about how specific physiotherapy interventions may affect their functional status. Therefore, our objective was to investigate the effects of proprioceptive neuromuscular facilitation (PNF) and Frenkel's coordination exercises on functional recovery in a patient with CAPOS syndrome.

**Case presentation**

We herein present a case of a 25-year-old Indian male with complaints of generalized body weakness, difficulty visualizing distant objects, nystagmus, progressive sensorineural deafness, and ataxia. He was rehabilitated with a structured/customized physiotherapy protocol consisting of PNF approach and coordination exercises for 4 weeks, 6 days/week, 60 min daily. An improvement in overall functional performance of patient as per post-intervention scores of manual muscle testing, trunk control measurement scale, functional independence measure (components of self-care, transfers, and locomotion), and decline in severity of ataxia on scale for assessment and rating of ataxia scale was observed.

**Conclusion**

PNF and Frenkel's exercises resulted in an improvement in overall functional performance of the patient. Improvement was observed in post-test scores of Manual Muscle Testing (MMT), Trunk Control Measurement Scale (TCMS), and Functional Independence Measure (FIM) for the components of self-care, transfers, and locomotion. Additionally, results also showed a decline in severity of ataxia on post-test scores of scale for the assessment and rating of ataxia (SARA) scale (i.e., from severe to moderate).