

## Literature list, direct PNF related in subsections:

**Disclaimer:**

**The IPNFA includes these PNF and PNF related texts for your reference/information and is not responsible for the content, scientific background and terminology used in these publications.**

## Philosophy

### **Functional approach**

1. Smedes F, Heidmann M, Schäfer C, Fischer N, Stepien A. The proprioceptive neuromuscular facilitation-concept; the state of the evidence, a narrative review. *Physical Therapy Reviews* 2016; 21(1):17-31 DOI:10.1080/10833196.2016.1216764
2. Smedes F, Functioneel oefenen, de betekenis van het functioneel oefenen binnen het PNF concept. *FysioPraxis* 2002 (11) 9-11 (functional exercise, the meaning for PNF)

### **Treating the total human being**

3. Clark, Treleaven, Röijezon, Proprioception in musculoskeletal rehabilitation. Part 2 Basic science and principles of assessment and clinical Interventions. *Manuel Therapy* 2015(20) 378- 387
4. Röijezon, Clark, Treleaven. Proprioception in musculoskeletal rehabilitation. Part 1 Basic science and principles of assessment and clinical interventions. *Manuel Therapy* 2015(20) 368-377
5. Smedes F, PNF beter (be)grijpen. *FysioPraxis* 2001 (12) 42-46. (Better understanding of PNF)
6. Westwater-Wood S, Adams N, Kerry R. The use of proprioceptive neuromuscular facilitation in physiotherapy practice *Physical Therapy Reviews* 2010 VOL.15. (1) 23-28

### **Use of motor learning and motor control principles**

7. Atun-Einy O, Kafri M. Implementation of motor learning principles in physical therapy practice, survey of PT's perceptions and reported implementation. *Phys Theory and Practice* 2019;34(7):633-44
8. Luft CDB. Learning from FB. The neural mechanisms of fb processing facilitating beter performance. *Behavioural Brain Research* 2014(261) 356– 368
9. Cauraugh J H, Kim S B. Stroke motor recovery: active neuromuscular stimulation and repetitive practice schedules. *J Neurol Neurosurg Psychiatry* 2003;74:1562–1566
10. Celnik P, Stefan K et al. Encoding a motor memory in the older adult by action observation. *NeuroImage* 2006 (29) 677 – 684
11. Charlton JL, Motor control issues and clinical applications. *Physiotherapie theory and practice* 1994 (10) 185-190
12. Corcos DM, Strategies underlying the control of disordered movement. *Physical Therapy* 1991 (71) 25-38
13. Filimon F, et al. Human cortical representations for reaching mirror neurons for execution, observation and imagery. *Neuroimage*. 2007 37(4): 1315–1328
14. Frank JS, Earl M, Coördination of posture and movement. *Physical Therapy* 1990 (12) 109-117

15. Frey SH, Fogassi L, Grafton S, Picard N, Rothwell JC, Schweighofer N, Corbetta M, Fitzpatrick SM. Neurological Principles and Rehabilitation of Action Disorders : Computation, Anatomy, and Physiology (CAP) Model *Neurorehabil Neural Repair* 2011; 25: 6-20
16. Grafton ST, Salidis J, Willingham DB. Motor Learning of Compatible and Incompatible Visuomotor Maps *Journal of Cognitive Neuroscience* 2001 13:2, 217–231
17. Halsband U, Lange RK. Motor learning in man: A review of functional and clinical studies. *Journal of PhysiologyParis* 2006 (99) 414-424
18. Hecht H, Prinz W, Vogt S. Motor Learning enhances perceptual judgment. a case for action-perception transfer. *Psychological research* 2001(65) 3-14
19. Kesar TM, Sauer MJ, Binder-Macleod SA et al. Motor learning during post stroke gait rehabilitation: A case study. *J Neurological PT* 2014; 38:183-189
20. Kleyenens M, Beurskens A, Olijve H, Kamphuis J, Braun S. Application of motor learning in neurorehabilitation, a framework for health-care professionals *Physiotherapie theory and practice* 2018 DOI: [10.1080/09593985.2018.1483987](https://doi.org/10.1080/09593985.2018.1483987)
21. Krakauer JW. Motor learning: its relevance to stroke recovery and neurorehabilitation. *Current Opinion in Neurology* 2006, 19:84–90
22. Latash ML, Levin MF, Scholz JP, Schönner G. Motor control theories and their applications. *Medicina (Kaunas)* 2010;46(6):382-92
23. Lee TD, Swanson LR, Hall AL, What is repeated in a repetition? Effects of practice conditions on motor skill acquisition. *Physical Therapy* 1991 (71) 150-156
24. Malouin F, Jackson PL, Richards CL. Towards the integration of mental practice in rehab programs. a critical review. *Frontiers in Human Neuroscience* 2013 (9) 01-20
25. Marks R, Peripheral mechanisms underlying the signaling of joint position. *NZ Journal of Physiotherapy* 1997 April
26. Mulder T, A process- oriented model of human motor behaviour: toward a theory-based rehabilitation approach. *Physical Therapy* 1991 (2) 82-89.
27. Newell KM, Vaillancourt DE. Dimensional change in motor learning. *Human Movement Science* 2001 (20) 695-715
28. Rokni U et al. Motor Learning with Unstable Neural Representations *Neuron* 2007 (54) 653–666
29. Sanes JN, Donoghue JP. Plasticity and Primary Motor Cortex. *Annu. Rev. Neurosci.* 2000. 23:393–415
30. Stanley J, Krakauer JW. Motor skill depends on knowledge of facts. *Frontiers in Human Neuroscience* 2013 (8) 01-11
31. Stefan K, Classen J, CelnikP, Cohen LG. Concurrent action observation modulates practice-induced motor memory formation. *European Journal of Neuroscience* 2008 (27) 730–738
32. Taub E, et al. An operant approach to rehab medicine, overcoming learned nonuse by shaping. *Journal of experimental analysis of behaviour.* 1994 (61) 281-293
33. Taylor JA, Ivry RB. The role of strategies in motor learning *Ann. N.Y. Acad. Sci.* 2012 doi: [10.1111/j.1749-6632.2011.06430.x](https://doi.org/10.1111/j.1749-6632.2011.06430.x)
34. Vereijken B, Whiting HTA, Newell KM. Free(z)ing Degrees of Freedom in Skill Acquisition. *Journal of Motor Behavior* 1992 (24) 1, 133-142
35. Vereijken et al. Changing coordinative structures in complex skill acquisition. *Human Movement Science* 1997 (16) 823-844
36. Vereijken B, Van Emmerik REA, Bongaardt R, Beek WJ , K.M. Newell. Changing coordinative structures in complex skill Acquisition. *Human Movement Science* 1997 (16) 823-844

37. Vliet van PM, Wulf G. Extrinsic feedback for motor learning after stroke what is the evidence. *Disability and Rehabilitation* 2006 (28) 831 – 840
38. Waddell KJ, Strube MJ, Bailey RR et al. Does task-specific training improve upper limb performance in daily life post stroke? *Neurorehabilitation and Neural Repair* 2017, Vol. 31(3) 290-300, doi: 10.1177/1545968316680493
39. Winstein CJ, Knowledge of results and motor learning - Implications for physical therapy. *Physical Therapy* 1991 (71) 140-149.
40. Wulf G, Höss M, Prinz W. instructions for motor learning differential effect for internal versus external focus of attention. *Journal of motor behavior* 1998 (30) 2
41. Wulf G, Shea C, Lewthwaite R. Motor Learning and Performance: A Review of Influential Factors. *Medical Education* 2010;44:75–84
42. Wulf G, Lewthwaite R. Optimizing performance through intrinsic motivation and attention for learning: The OPTIMAL theory of motor learning. *Psychon Bull Rev* 2016; 23:1382–1414
43. Zwicker JG, Harris SR. A reflection on motor learning theory in pediatric occupational therapy practice. *Canadian journal of Occupational Therapy* 2009 (76) 1 29-37

## **Basic procedures**

### **Tactile stimulus**

44. Fallon JB et al. Evidence for Strong Synaptic Coupling Between Single Tactile Afferents From the Sole of the Foot and Motoneurons Supplying Leg Muscles. *J Neurophysiol* 2005 (94) 3795–3804
45. Jeka JJ, Lackner JR. Fingertip contact influences human postural control 1994. *Exp Brain Res* 1994 (100) 495-502
46. Saradjian AH, Tremblay L, Perrier J, Blouin J, Mouchnino L. Cortical facilitation of proprioceptive inputs related to gravitational balance constraints during step preparation. *J Neurophysiol* 2013;110: 397–407

### **Verbal stimulus**

47. Sadowski J, Mastalerz A, Niznikowski, Wisniowski W, Biegajlo M, Kulik M. The effects of different types of verbal feedback on learning a complex movement task. *Polish Journal of Sports and Tourism*. 2011;18:308-310

### **Visual stimulus**

48. Mohapatra S, Krishnan V, and Aruin AS. The effect of decreased visual acuity on control of posture *Clin Neurophysiol*. 2012 January ; 123(1): 173–182
49. Prodoehl J, Vaillancourt DE. Effects of visual gain on force control at the elbow and ankle *Exp Brain Res*. 2010; 200(1): 67–79.
50. Ramachandran VS, Altschuler EL. The use of visual feedback, in particular mirror visual feedback, in restoring brain function. *Brain* 2009: 132; 1693–1710

### **Resistance**

51. Gabriel DA, Kamen G, Frost G: Neural adaptations to resistive exercise, mechanisms and recommendations for training practices. *Sports Med* 2006 (2) 183-189
52. Kofotolis N, Vrabas IS, Vamvakoudis E, Papanikolaou A, Mandroukas K: Proprioceptive neuromuscular facilitation training induced alterations in muscle fiber type and cross sectional area. *British Journal of Sports Medicine* 2005 (3):e11.

## Approximation

53. Fitts RH1, Riley DR, Widrick JJ. Functional and structural adaptations of skeletal muscle to microgravity. *J Exp Biol.* 2001 Sep;204(Pt 18):3201-8.
54. Horstmann GA1, Dietz V. A basic posture control mechanism: the stabilization of the centre of gravity. *Electroencephalogr Clin Neurophysiol.* 1990;76(2):165-176
55. Mahani MK, Karimloo M, Amirsalari S. Effects of Modified Adeli Suit Therapy on Improvement of Gross Motor Function in Children With Cerebral Palsy. *Cerebral Palsy Hong Kong Journal of Occupational Therapy,* 2010 (21),1:9-14
56. Ratliffe KT, Alba BM, Hallum A, Jewell MJ. Effects of approximation on postural sway in healthy subjects. *Phys Ther.* 1987;67(4):502-6.
57. Shin WS, Lee SW, Effect of gait training with additional weight on balance and gait in stroke patients. *Phys Ther Rehab Sci.*2014(3);1:55-62
58. Sylos-Labini F, Lacquaniti F, and Ivanenko YP. Human Locomotion under Reduced Gravity Conditions: Biomechanical and Neurophysiological Considerations. *BioMed Research International* 2014 DOI:10.1155/2014/547242
59. Yigiter K, Sener G, Erbahceci F, BayarK, Ülger ÖG, Akodogan S: A comparison of traditional prosthetic training versus PNF resistive gait training with trans-femoral amputees. *Prosthetics and orthotics international* 2002 (26) 213-217

## Pattern

60. Lial L, Moreira R, Correia L. Proprioceptive neuromuscular facilitation increases alpha absolute power in the dorsolateral prefrontal cortex and superior parietal cortex. *Somatosensory & motor research,* 2017; 34(3): 204–212, doi.org/10.1080/08990220.2017.1392298
61. Moreira et al. Diagonal movement of the upper limb produces greater adaptive plasticity than sagittal plane flexion in the shoulder. *Neuroscience Letters* 2017,643:8–15
62. Mc Mullen J, Uhl TL: A kinetic chain approach for shoulder rehabilitation. *Journal of athletic training* 2000 (3) 329-337
63. Myers JB, Lephart SM: The role of the sensorimotor system in the athletic shoulder *Journal of athletic training* 2000 (3) 351-363
64. Shimura K, Kasai T: Effects of proprioceptive neuromuscular facilitation on the initiation of voluntary movement and motor evoked potentials in upper limb muscles. *Human movement science* 2002 (1) 101-113
65. Youdas JW, Adams KE, Bertucci JE, Brooks KJ, Steiner MM, Hollman JH. Magnitudes of gluteus medius muscle activation during standing hip joint movements in spiral-diagonal patterns using elastic tubing resistance. *Physiother. Theory Pract.* 2015; 27:1-8 [Epub ahead of print]
66. Youdas JW, Arend DB, Extrom JM, Helmus TJ, Rozeboom JD, Hollman JH. Comparison of muscle activation levels during arm abd. in the plane of the scapula vs PNF upper extr. Patterns. *Journal of Strength and Conditioning Research* 2012 (26) 4, 1058-1065
67. Witt D, Talbott N, Kotowski S: Electromyographic activity of scapular muscles during diagonal patterns using elastic resistance and free weights. *International Journal of Sports Physical Therapy* 2011 (4) 322- 332

## **Irradiation**

68. Abreu R, Lopes AA, Sousa AS, Pereira S, Castro MP. Force irradiation effects during upper limb diagonal exercises on contralateral muscle activation. *J Electromyogr Kinesiology*. 2015; 25 (2):292-297
69. Arai M, ea : Effects of the use of cross-education to the affected side through various resistive exercises of the sound side and settings of the length of the affected muscles. *Hiroshima journal of medical science 2001 (3):65-73*
70. Barss TS, Pearcey GEB, Zehr EP. Cross-education of strength and skill: an old idea with applications in the aging nervous system *Yale Journal of Biology and Medicine 2016;89:81-86*.
71. Carroll GTJ, Herbert RD, Munn J, Lee M, Gandavia SC. Contralateral effects of unilateral strength training. Evidence and possible mechanisms. *J Appl Physiol* 2006 (101):1514-1522
72. Chiou SY, Wang RY, Liao KK, Yang YR: Facilitation of the lesioned motor cortex during tonic contraction of the unaffected limb corresponds to motor status after stroke. *JNPT*. 2016; 40: 15-21
73. Dionisio VC, Baptista CRdJA, de Sales Rodrigues A, Sande de Souza LAP. Is it possible to stabilize the trunk using rhythmic stabilization in the upper limb? A cross-sectional study of asymptomatic individuals, *Journal of Manual & Manipulative Therapy*, 26:4, 212-217, DOI:10.1080/10669817.2018.1467994
74. Gontijo LB, Pererla PD, Neves CDC, Santos AP, Castro Dutra Machado D, Vale Bastos, VH. Evaluation of Strength and Irradiated Movement Pattern Resulting from Trunk Motions of the Proprioceptive Neuromuscular Facilitation. *Rehabilitation Research and Practice Volume 2012, Article ID 281937, 6 pages*  
*doi:10.1155/2012/281937*
75. Hendy AM; Spittle M; Kidgell DJ Cross education and immobilisation: mechanisms and implication for injury rehabilitation. *Journal of Science and Medicine in Sport 012(15) 94–101*
76. Hwang YI, Park DJ. Comparison of abdominal muscle activity during abdominal drawing-in maneuver combined with irradiation variations. *J Exerc Rehabil*. 2017 Jun 30;13(3):335-339.
77. Kofotolis ND, Kellis E: Cross-training effects of a Proprioceptive neuromuscular facilitation exercise programme on knee musculature. *Physical Therapy in Sport 8 (2007) 109–116*
78. Lee M, Gandevia SC, Carroll TJ. Unilateral strength training increases voluntary activation of the opposite untrained limb. *Clinical Neurophysiology* 2009 (120) 802-808
79. Lee M, Carroll TJ. Cross Education Possible Mechanisms for the Contralateral Effects of Unilateral Resistance Training. *Sports medicine* 2007; 37 (1) 1-14
80. Mastalerz A, Wozniak A, Urbaniak C, Lutoslawska G. Contralateral effects after power training in isolated muscles in women. *Acta of Bioengineering and Biomechanics* 2010, 12,( 2) 1-7
81. Munn J, Herbert RD, Gandevia SC. Contralateral effects of unilateral resistance training a meta analysis. *J Appl Physiol* 2004 (96):1861-1866
82. Oliveira KCR et al. Overflow using proprioceptive neuromuscular facilitation in post-stroke hemiplegics: A preliminary study. *Journal of Bodywork & Movement Therapies* 2019 (23):399-404.
83. Reznik JE, Biroš E, Bartur G. An electromyographic investigation of the pattern of overflow facilitated by manual resistive proprioceptive neuromuscular facilitation in

- young healthy individuals: a preliminary study. *Physiother Theory Pract.* 2015 Nov;31(8):582-6
84. Sato H, Maruyama H: The effects of indirect treatment of PNF. *J. Physical therapy science* 2009, 21, 189-193
85. Shima N et al. Cross education of muscular strength during unilateral resistance training and detraining. *Eur JAppl Physiol* 2002 (86): 287–294
86. Shiratani T, Arai M, Kuruma H, Masumoto K. The effects of opposite-directional static contraction of the muscles of the right upper extremity on the ipsilateral right soleus H-reflex. *J Bodyw Mov Ther.* 2017;21(3):528-533.
87. Youdas JW , Adams KE, Bertucci JE, Brooks KJ, Steiner MM, Hollman JH. Magnitudes of gluteus medius muscle activation during standing hip joint movements in spiral-diagonal patterns using elastic tubing resistance *Physiother Theory Pract,* 2015; 31(6): 410–417
88. Zhou S. Cross education and neuromuscular adaptations during early stage of strength training. *Journal of exercise science and Fitness* 2003 (1) 54-60

### **Summation**

89. Da Silva LG, Lummertz CA, Lopes Pedralli M, Rigon F. Visual and verbal summation enhance muscle output in young female subjects. *CEP ULBRA* 2011 436H.
90. Silva et al.: Verbal and visual stimulation effects on rectus femoris and biceps femoris muscles during isometric and concentric. *International Archives of Medicine* 2013 6:38.
91. Mahoney JR, Clara Li PC, Park MO, Verghese J, Holtzer R, Multisensory integration across the senses in young and old adults. *Brainresearch* 2011;1426; 43–53
92. Urbenjaphol P, Jitpanya C, Khaorophum S. Effects of the Sensory Stimulation Program on Recovery in Unconscious Patients With Traumatic Brain Injury. *Journal of Neuroscience Nursing* 2009;41(3):10-16.

## **Techniques**

### **Replication**

93. Magarey ME, Jones MA. Dynamic evaluation and early management of altered motor control around the shoulder complex. *Manual Therapy* 2003 (4) 195-206

### **Stretch through range**

#### **Stretch at beginning of range**

94. Shimamoto Y, Suzuki M, Mikhailenko SV, Yasuda K, Ishiwata S. Inter-sarcomere coordination in muscle revealed through individual sarcomere response to quick stretch. *PNAS* 2009 106(29) 11954-11959

### **Dynamic reversals**

95. Kamimura, T., Yoshikioka, K., Ito, S., & Kusakabe, T. Increased rate of force development of elbow flexors by antagonist conditioning contraction. *Human Movement Science* 2009 (28), 407-414.
96. Gabriel DA, Basford J, An K-N. The reversal of antagonists facilitates the peak rate of tension development. *Arch Phys Med Rehab* 2001

### **Stabilizing reversals + Rhythmic stabilization**

97. Kim JJ, Park SY Immediate effects of the trunk stabilizing exercise on static balance parameters in double-leg and one-leg stances. *J. Phys. Ther. Sci.* 2016;28:1673–75

### **Hold and Contract Relax**

98. Akbulut, T and Agopyan, A. Effects of an Eight-Week Proprioceptive Neuromuscular Facilitation Stretching Program on Kicking Speed and Range of Motion in Young Male Soccer Players. *J Strength Cond Res* 2015; 29(12):3412–23.  
DOI:0.1519/JSC.0000000000001015
99. Avela J, Finni T, Liikavainio T, Niemelä E, Komi PV. Neural and mechanical responses of the triceps surae muscle group after 1 h of repeated fast passive stretches *J Appl Physiol* 2004 96:2325-2332.
100. AzevedoDC, MeloRM, Alves Corea RV, Chalmers G. Uninvolved versus target muscle contraction during contract-relax proprioceptive neuromuscular facilitation stretching. *Physical Therapy in Sport* 2011;12:117- 121
101. Behm DG, *et al.* Acute effects of muscle stretching on physical performance, range of motion, and injury incidence in healthy active individuals: a systematic review. *Appl Physiol Nutr Metab.* 2016 (1):1-11
102. Bonnar BP, Deivert RG, Gould TE: The relationship between isometric contraction durations during hold-relax stretching and improvement of hamstring flexibility. *Journal sports medicine and physical fitness* 2004 (3) 258-261
103. Borges MO, Medeiros DM, Minoto BB: Comparison between static stretching and proprioceptive neuromuscular facilitation on hamstring flexibility: systematic review and meta-analysis. *European journal of physiotherapy* 2018; 20(1): 12-19, doi.org/10.1080/21679169.2017.1347708
104. Bradley PS, Olsen PD, Portas MD: The effect of static, ballistic and PNF stretching on vertical jump performance *Journal of strength and conditioning research* 2007 (1) 223-226
105. Cayco CS, Labro AV, Gorgon EJR. Hold-relax and contract-relax stretching for hamstrings flexibility, a systematic review with meta-analysis. *Physical Therapy in Sport* 2019;35:42-55
106. Carter AM, Kinzey SJ, Chitwood LF, Cole JL: PNF decreases muscle activity during the stretch reflex in selected posterior thigh muscles. *Journal of sport rehabilitation* 2000 (9) 269-278
107. Chalmers G: Re-examination of the possible role of Golgi tendon organ and muscle spindle reflexes in proprioceptive neuromuscular facilitation muscle stretching. *Sports biomechanics* 2004 (1) 159-183
108. Chow TPY, Ng GYF. Active, passive and proprioceptive neuromuscular facilitation stretching are comparable in improving the knee flexion range in people with total knee replacement: a randomized controlled trial. *Clinical Rehabilitation* 2010; 24: 911–918

109. Church JB, Wiggins MS, Moode FM, Crist R: Effect of warm-up and flexibility treatments on vertical jump performance *Jo. Strenght cond. Research* 2001 (3):332-336
110. Davis DS, Ashby PE, Mc Cale KL, Mc Quain JA, Wine JM: The effectiveness of 3 stretching techniques on hamstring flexibility using consistent stretching parameters. *Journal of strength and conditioning research* 2005 (1):27-32.
111. Deccicco PV, Fisher FM: The effects of proprioceptive neuromuscular facilitation stretching on shoulder range of motion in overhand athletes. *Journal of sports medicine and physical fitness* 2005 (2):183-187.
112. Feland JB, Marin HN: Effect of sub maximal contraction intensity in contract-relax proprioceptive neuromuscular facilitation stretching. *British journal of sports medicine* 2004
113. Ferber R, Gravelle DC, Osternig LR. Effect of PNF stretch techniques on trained and untrained older adults. *Journal of aging and physical activity* 2002 (10) 132-142
114. Ferber R, Osternig LR, Gravelle DC: Effect of PNF stretch techniques on knee flexor muscle EMG activity in older adults. *Journal of electromyography and kinesiology* 2002 (12) 391-397
115. 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. *Journal of strength and conditioning research* 2003 (3):489-492
116. Godges JJ, Matsen-Bell M, Thorpe D, Shah D: The immediate effects of soft tissue mobilization with proprioceptive neuromuscular facilitation on glenohumeral external rotation and overhead reach. *Journal of orthopedics sports and Physical Therapy* 2003 (12) 713-718
117. Hindle KB, Whitcomb TJ, Briggs WO, Hong J. Proprioceptive Neuromuscular Facilitation (PNF): Its Mechanisms and Effects on Range of Motion and Muscular Function. *Journal of Human Kinetics* 2012 (31) 105-113
118. Kay AD, Dods S, Blazeovich AJ. Acute effects of contract-relax (CR) stretch versus a modified CR technique. *Eur J Appl Physiol.* 2016 (116) 611-21
119. Konrad A, Stafilidis S, Tilp M. Effects of acute static, ballistic, and PNF stretching exercise on the muscle and tendon tissue properties. *Scand J Med Sci Sports* 2016;...: ...-... doi: 10.1111/sms.12725
120. Kwak DH, Ryu YU. Applying proprioceptive neuromuscular facilitation stretching: optimal contraction intensity to attain the maximum increase in range of motion in young males. *J Phys Ther Sci.* 2015;27(7):2129-32
121. Lempke L, WilkinsonR, Murray C, Stanek J. The Effectiveness of PNF Versus Static Stretching on Increasing Hip-Flexion Range of Motion. *Journal of Sport Rehabilitation, 2018; 27:289-294*
122. Lim W. Optimal intensity of PNF stretching: maintaining the efficacy of stretching while ensuring its safety. *J. Phys. Ther. Sci.* 2018; 30: 1108–1111
123. Marek SM et al: Acute effects of static and PNF stretching on muscle strength and power output. *Journal of athletic training* 2005 (2) 94-103
124. Mahieu NN, Cools A, De Wilde , Boon M, Witvrouw E: Effect of PNF stretching on the plantar flexor muscle-tendon tissue properties. *Scandinavian journal of medicine & science in sports* 2009 (19) 4,553-560
125. Medeiros DM, Martini TF. Chronic effect of different types of stretching on ankle dorsiflexion range of motion: Systematic review and meta-analysis. *Foot (Edinb).* 2017 ;34:28-35.



126. Moore MA, Kulkulka CG: Depression of Hoffmann reflexes following voluntary contraction and implications for proprioceptive neuromuscular facilitation therapy. *Physical Therapy* 1991 (4):321-329; discussion 329-33.
127. Moyano FR, Valenza MC, Martin L M, Caballero YC, Jimenez EG, Demet GV Effectiveness of different exercises and stretching physiotherapy on pain and movement in patellofemoral pain syndrome: a randomized controlled trial. *Clinical Rehabilitation* 2012 27(5) 409– 417
128. O'Hora J, Cartwright A, Wade CD, Hough AD, Shum GLK: Efficacy of static stretching and PNF stretch on hamstrings length after a single session. *Journal of Strength and Conditioning Research* 2011;25 (6) 1586-91
129. Olivo SA, Magee DJ: Electromyographic assessment of the activity of the masticatory using the agonist contract – antagonist relax technique (AC) and contract – relax technique (CR). *Manual therapy* 2006 (2) 136-145
130. Rees SS, Murphy AJ, Watsford ML, McLachlan KA, Coutts AJ: Effects of PNF stretching on stiffness and force producing characteristics of the ankle in active women. *Journal of strength and conditioning research* 2007 (2) 572-577
131. Rowlands AV, Marginson VF, Lee J: Chronic flexibility gains: effect of isometric contraction duration during proprioceptive neuromuscular facilitation stretching techniques. *Research Quarterly Exercise and sports* 2003 (1):47-51.
132. Surburg PR, Schrader JW. Proprioceptive Neuromuscular Facilitation techniques in Sports Medicine. A re assessment. *Journal of Athletic Training* 1997 32 (1) 34-39
133. Schuback B, Hooper J, Salisburg L: A comparison of a self stretch incorporating PNF components and a therapist applied PNF technique on hamstring flexibility. *Physiotherapy* 2004 (3) 151-157
134. Sharman MJ, Cresswell AG, Riek S: Proprioceptive Neuromuscular Facilitation Stretching, mechanisms and clinical implications. *Sports Med* 2006 (11) 929-939
135. Wanderley D, Lemos E, Moretti E et al. Efficacy of proprioceptive neuromuscular facilitation compared to other stretching modalities in range of motion gain in young healthy adults: A systematic review, *Physiotherapy Theory and Practice* 2018;35(2):109-129, DOI:10.1080/09593985.2018.1440677
136. Weerapong P, Hume PA, Kolt GS: Stretching: mechanisms and benefits for sport performance and injury prevention. *Physical Therapy Reviews* 2004 (9) 189-206
137. Wenos DL, Konin JG: Controlled warm-up intensity enhances hip range of motion. *Journal of strength and conditioning research* 2004 (3):529-533
138. Youdas JW, Haeflinger KM, Kreun MK, Holloway AM, Kramer CM, Hollman JH: The efficacy of two modified PNF stretching techniques in subjects with reduced hamstring muscle length. *Physiotherapy Theory and Practice* 2010 26 (4) 240-250

## **Rehab topics**

### **Vital functions**

139. Areas GPT, Silva AB, Lobato AN, Silva AA, Friere jr RC, Areas FZS. Effect of upper extremity proprioceptive neuromuscular facilitation combined with elastic resistance bands on respiratory muscle strength: a randomized control trial. *Braz J Phys Ther.* 2013; 17(6):541-546
140. Bujar- Misztal M, Chcialowski A. Influence of PNF on lung function in patients after coronary artery bypass graft surgery. *Adv Exp Med Biol.* 2018;3: 11–17 [https://doi.org/10.1007/5584\\_2018\\_243](https://doi.org/10.1007/5584_2018_243)

141. Cornelius WL, Jensen RL, Odell ME: Effects of PNF stretching phases on acute arterial blood pressure. *Can. Jo. Appl Physiology* 1995 (2)222-229
142. Ha KJ, Lee SY, Lee H, Choi SJ. Synergistic Effects of Proprioceptive Neuromuscular Facilitation and Manual Lymphatic Drainage in Patients with Mastectomy-Related Lymphedema. *Front Physiol.* 2017 Nov 28;8:959.
143. Nitz J, Burke B. A study of the facilitation of respiration in myotonic dystrophy. *Physiotherapy research international* 2002 (4) 228-238
144. Pyszora A, Budzinsky J, Wojcik A, Prokop A, Krajnik M. Physiotherapy programme (PNF) reduces fatigue in patients with advanced cancer receiving palliative care RCT. *Support Care Cancer* 2017;25:2899–2908
145. Slupska L, Halski T, Zytkeiwicz M et al. Proprioceptive Neuromuscular Facilitation for Accessory Respiratory Muscles Training in Patients After Ischemic Stroke. *Adv Exp. Medicine, Biology - Neuroscience and Respiration* 2019, PP 81-91 <https://doi.org/10.1007/5584> 2018 325
146. Souza RJP, Brandao DC, Martins JV. Addition of proprioceptive neuromuscular facilitation to cardiorespiratory training in patients post stroke: study protocol for a randomized controlled trial. *Trials* 2020; 21:184, [doi.org/10.1186/s13063-019-3923-1](https://doi.org/10.1186/s13063-019-3923-1)

### **Transfers and mat progression**

147. Barros Ribeiro Cilento M: Evaluation of the efficacy of train protocols of the sit to stand movement. *Fisioterapi Brasil* 2006 (6)
148. Hoogenboom BJ, Voight ML. Rolling Revisited: Using Rolling to Assess and Treat Neuromuscular Control and Coordination of the Core and Extremities of Athletes. *Int J Sports Phys Ther.* 2015 (6):787-802
149. Klein DA, Stone WJ, ea. PNF training and physical function in assisted living older adults. *Journal of aging and physical activity* 2002 (10) 476-488.
150. Richter RR, VanSant AF, Newton RA: Description of Adult Rolling Movements and Hypothesis of Developmental Sequences *Physical Therapy* 1989; 69:63-71
151. Santos de Britto VL, Correa R, Vincent MB: Proprioceptive neuromuscular facilitation in HTLV – I – associated myelopathy/tropical spastic paraparesis. *Rev Soc Bras Med Trop.* 2014; 47(1): 24-29
152. Teixeira de Carvalho F, de Andrade Mesquita LS, Pereira R, Neto OP, Amaro Zangaro R. Pilates and Proprioceptive Neuromuscular Facilitation Methods Induce Similar Strength Gains but Different Neuromuscular Adaptations in Elderly Women. *Exp Aging Res.* 2017;43(5):440-452
153. Wong YH, Cheung KW, KoYC, Tse HC, Law YL, Hwang SS, Ngai PC. Effect of a 4-week Theraband Exercise with PNF Pattern on Improving Mobility, Balance and Fear of Fall in Community-Dwelling Elderly. *J Korean Soc Phys Med,* 2017; 12(4): 73-82

### **Gait**

154. Anjum H, Amjad I, Malik AN. Effectiveness of PNF techniques as compared to traditional strength training in gait training among transtibial amputees. *Journal of the College of Physicians and Surgeons Pakistan* 2016, Vol. 26 (6): 503-506
155. Caplan N, Rogers R, Parr MK, Hayes PR: The effect of PNF and static stretch training on running mechanics. *J of Strength and Conditioning Research* 2009 23 (4) 1175-1180

156. Choughley A, Soomro N, Yamin F et al. Efficacy of Cryotherapy v/s Thermotherapy with PNF Technique in Improving Hemiplegic Gait. *Indian Journal of Physiotherapy and Occupational Therapy*.2016;10(1):114-119
157. Jaczewska-Bogacka J, Stolarczyk A. Improvement in Gait Pattern After Knee Arthroplasty Followed by Proprioceptive Neuromuscular Facilitation Physiotherapy. *Clinical and Experimental Biomedicine; Rehabilitation Science in Context* 2018: 1-9
158. Lacquaniti F, Ivanenko YP, Zago M: Patterned control of human locomotion. *J Physiol* 2012 590 (10) 2189–2199
159. Mirek e, ea. Przydatnosc trójwymiarowej analizy lokomocji dla usprawniania ruchowego metoda PNF chorych na chorobe Parkinsona. *Neurol. Neurochir. Poland* 2003 (5) 89-102
160. Mirek E, et al. The effects of physiotherapy with PNF concept on gait and balance of patients with Huntington's disease - pilot study. *Neurol Neurochir Pol.* 2015(6):354-7
161. Reichel HS PNF: Gangschulung. *Sportverletzung, sportschaden* 1996 (10) A11-A20
162. Sahay P, et al., Efficacy of proprioceptive neuromuscular facilitation techniques versus traditional prosthetic training for improving ambulatory function in transtibial amputees, *Hong Kong Physiotherapy Journal*, 2014 (32) 28-34
163. Yigiter K, Sener G, Erbahceci F, BayarK, Ülger ÖG, Akodogan S: A comparison of traditional prosthetic training versus PNF resistive gait training with trans-femoral amputees. *Prosthetics and orthotics international* 2002 (26) 213-217

## **Stroke**

164. Almeida De PM. et al. Hands-on physiotherapy interventions and stroke and ICF outcomes, a systematic review 2015 *European Journal of Physiotherapy*, 2015; 17: 100–115
165. Bhalerao G, Shah H, Bedekar N et al. Perspective of Neuro Therapeutic Approaches Preferred for Stroke Rehabilitation by Physiotherapists. *Indian Journal of Physiotherapy and Occupational Therapy*.2016;10 (1):47-50
166. Choi YK, Nam CW, Lee JH, Park YH. The Effects of Taping Prior to PNF Treatment on Lower Extremity Proprioception of hemiplegic Patients *J. Phys. Ther. Sci.* 2013 (25) 1119–1122
167. Duncan P et al. A Randomized, controlled pilot study of a home – based exercise program for individuals with mild and moderate stroke. *Stroke* 1998 (29) 2055-2060
168. Duncan P et al. RCT of therapeutic exercise in subacute stroke. *Stroke* 2003 (34) 2173-2180
169. Ernst E: A review of stroke rehabilitation and physiotherapy. *Stroke* 1990 (21) 1081-1085
170. Gunning E Uszynski MK. Effectiveness of the PNF method on gait parameters in patients with stroke. *Arch of Phys Med and Reh* 2019;100(5):980–986
171. Guia-Tula FX et al. The efficacy of the PNF approach in stroke rehab. study protocol *BMJ Open* 2017;7:1-5
172. Hwangbo PN, Kim KD. Effects of proprioceptive neuromuscular facilitation neck pattern exercise on the ability to control the trunk and maintain balance in chronic stroke patients. *J. Phys. Ther. Sci.* 2016;28:850–853

173. Khanal D, Singaravelan M, Khatri KM. Effectiveness of Pelvic Proprioceptive Neuromuscular Facilitation Technique on Facilitation of Trunk Movement in Hemiparetic Stroke Patients. *Journal of Dental and Medical Sciences* 2013, 3(6,)29-37
174. Kraft GH, Fitts SS, Hammond MC: Techniques to improve function of the arm and hand in chronic hemiplegia. *Arch. Phys. Med. Rehabilitation* 1992(3) 220-227
175. Kumar, S, Kumar A. Kaur J. Effect of PNF Technique on Gait Parameters and Functional Mobility in Hemiparetic Patients. *Journal of Exercise Science and Physiotherapy*, 2012;8(2): 67-73
176. Luke C, Dodd KJ, Brock K: Outcomes of the Bobath concept on upper limb recovery following stroke. *Clinical Rehabilitation* 2004;18:888-898
177. de Oliveira, K.C.R., et al., Overflow using proprioceptive neuromuscular facilitation in post-stroke hemiplegics: A preliminary study. *Journal of Bodywork & Movement Therapies* (2019), <https://doi.org/10.1016/j.jbmt.2018.02.011>
178. Park Se, Oh DS, Moon SH. Effects of oculo-motor exercise, functional electrical stimulation and proprioceptive neuromuscular stimulation on visual perception of spatial neglect patients. *J. Phys. Ther. Sci.* 2016;28:1111–15
179. Park SI, Moon SH. Effects of trunk stability exercises using PNF with change in chair height on the gait of patients who had a stroke *J. Phys. Ther. Sci.* 2016;28:2014–18
180. Pohl M, Mehrholz J, Ritschel C, Rückriem S: Speed dependent treadmill training in ambulatory hemiparetic stroke patients : A RCT. *Stroke* 2002;33:553-558
181. Ribeiro T, Britto H, Oliveira D, Silva E, Galvio E, Lindquist A. Effects of treadmill training with partial body weight support and the proprioceptive neuromuscular facilitation method on hemiparetic gait: a comparative study. *European Journal of Physical and Rehabilitation Medicine* 2012;48:1-11
182. Ribeiro TS, et al. Effects of training program based on the PNF method on post stroke motor recovery- a preliminary study. *Journal of Bodywork & Movement Therapies.* 2014;18:526-532.
183. Sharma V, Kaur J. Effect of core strengthening with pelvic proprioceptive neuromuscular facilitation on trunk, balance, gait, and function in chronic stroke. *Journal of Exercise Rehabilitation* 2017;13(2):200-205.
184. Shim J et al. Effects of EMG-triggered FES during trunk pattern in PNF on balance and gait performance in persons with stroke. *Restorative Neurology and Neuroscience* 2020; x–xx, doi 10.3233/RNN-190944
185. Stephenson JB, Maitland ME, Beckstead JW, Anemeat WK. Locomotor training on a treadmill compared with PNF in chronic stroke. *Technology and Innovation*, 2014;15:325–332
186. Wang RY. The effect of proprioceptive neuromuscular facilitation in case of patients with hemiplegia of long and short duration. *Physical Therapy* 1994;12:25-32
187. Wolny T, Saulicz E, Gnat R, Kokosz M. Butler's neuromobilizations combined with proprioceptive neuromuscular facilitation are effective in reducing of upper limb sensory in late-stage stroke subjects: a three-group randomized trial. *Clinical Rehabilitation* 2010;24:810–821\
188. Zhou Z, Zhou Y, Wang N, Gao F, Wei K, Wang Q. A PNF integrated robotic ankle-foot system for post stroke rehab. *Robotics and Autonomous Systems* 2015;73:111–122

**Musculoskeletal issues eg (Chronic) Spine pain (cervical - / Thoracic - / Low Back Pain) extremities issues eg (impingement syndromes etc)**

189. Alaca N, *et al.* Comparison of the long-term effectiveness of progressive neuromuscular facilitation and continuous passive motion therapies after total knee arthroplasty. *J Phys Ther Sci.* 2015 Nov;27(11):3377-80
190. Anggiat L, Hon WHC, Sokran SNBBM. Comparitive effect of PNF and McKenzie method on pain in NSLBP among university population. *IJMAES*;4(3): 475-485,
191. Areudomwong P ,Buttagat V. Proprioceptive neuromuscular facilitation training improves pain-related and balance outcomes in working-age patients with chronic low back pain: a randomized controlled trial. *Braz. J Phys Ther.* 2018
  - a. Smedes F, Shin S, Giacometti da Silva L Incorrect use of proprioceptive neuromuscular facilitation-techniques and principles, a response to: Proprioceptive neuromuscular facilitation training improves pain-related and balance outcomes in working-age patients with chronic low back pain: a randomized controlled trial *Braz. J Phys Ther* 2019; 23 (3):273-274
192. Areudomwong P, Buttagat V. Comparison of core stabilisation exercise and proprioceptive neuromuscular facilitation training on pain-related and neuromuscular response outcomes for chronic low back pain: a randomized controlled trial. *Malays J Med Sci.* 2019; 26(6): 77–89.
193. Balci NC, Yuruk ZO, Zeybek A, Gulsen M, Tekindal MA. Acute effect of scapular proprioceptive neuromuscular facilitation (PNF) techniques and classic exercises in adhesive capsulitis: a randomized controlled trial. *J. Phys. Ther. Sci.* 2016;28:1219–1227
194. Birinici T, Ozdincler AR, AltunS, Kural C. A structured exercise programme combined with proprioceptive neuromuscular facilitation stretching or static stretching in posttraumatic stiffness of the elbow: a randomized controlled trial. *Clinical Rehabilitation* 2019;33(2):241-252
195. Comel JC, Nery RM, Garcia EL, Bueno C, Silveira E, Zarantonello MM, Stefani MA. A comparative study on the recruitment of shoulder stabilizing muscles and types of exercises. *Journal of Exercise Rehabilitation* 2018;14(2):219-225
196. Dhaliwal MK, Amandeep, Jagmohan, Manjeet. To compare the effect of PNF and core stabilizing exercises for Decreasing Pain And Improving Functions In Patients With Low Back Pain. *Journal of Sports and Physical Education* 2014;1(5): 29-35
197. Epifanov VA, Shuliakovskii V V: The rehabilitative therapy of patients with osteochondrosis of the cervical spine and manifestations of hyper mobility by means of therapeutic physical exercise. *Vopr Kurortol Fizioter Lech Fiz Kult* 2000 (1):8-11.(Russian)
198. Franklin CVJ *et al.* Effectiveness of PNF Training for Chronic Low Back Pain. *Journal of Nursing and Health Science* 2013;2(4):41-52
199. Jadeja T, Vyas N, Sheth M. Effect of PNF on back muscle strength and pain and quality of life in subjects with CLBP. *Int J Physiother.* 2015; 2(5): 778-785
200. Jain AS, Anandh S, Pawar A. Effectiveness of proprioceptive neuromuscular facilitation as an adjunct to eccentric exercises in subacromial impingement. *Indian Journal of Physiotherapy and Occupational Therapy* 2017;11(2): 141 - 146.
201. Johnson GS, Johnson VS. The application of the principles and procedures of PNF for the care of lumbar spinal instabilities. *The Journal of manual and Manipulative therapy* 2002 (2) 83-105
202. Kim BR, Lee HJ. Effects of proprioceptive neuromuscular facilitation-based abdominal muscle strengthening training on pulmonary function, pain, and functional

- disability index in chronic low back pain patients. *J Exerc Rehabil.* 2017 Aug 29;13(4):486-490
203. Kim JJ, Lee SY, Ha K. The effects of exercise using PNF in patients with a supra spinatus muscle tear. *J. Phys. Ther. Sci.* 2015;27: 2443–6
  204. Kofotolis N, Eleftherios K: Effects of two 4-week PNF programs on muscle endurance, flexibility, and functional performance in women with CLBP. *Physical Therapy* 2006 (7) 1001-1012
  205. Lazarou L, Kofotolis N, Pafis G, Kellis E. Effects of two proprioceptive training programs on ankle range of motion, pain, functional and balance performance in individuals with ankle sprain. *J Back Musculoskelet Rehabil.* 2018;31(3):437-446.
  206. Maicki T, Trabka R, Szwarczyk W, Wilk Franzcuk M, Figura B. Analysis of therapy results in patients with cervical spine pain according to PNF concept and elements of manual therapy. *MEDSPORTPRESS, 2012; 3(4);12, 263-273*
  207. Maicki T, Bilski J, Szczygiel E, Trabka R. PNF and manual therapy treatment results of patients with cervical spine osteoarthritis. *J Back Musculoskelet Rehabil.* 2017;30(5):1-7
  208. Mavromoustakos S, Beneka A, Malliou V, Adamidis A, Kellis E, Kagiaoglou A. Effects of a 6-week Proprioceptive Neuromuscular Facilitation Intervention on pain and disability in individuals with chronic low back pain. *Journal of Physical Activity, Nutrition and Rehabilitation, 2015 1-13*
  209. Mowafy ZME, Sharkawy AGE, Fouda BM. Proprioceptive neuromuscular facilitation and irtual reality for improving hand functions post reconstructive surgeries. *Bioscience Research, 2019;16(2):1085-1093*
  210. Nakra N, Quddus N, Khan S, Kumar S, Meena R. Efficacy of proprioceptive neuromuscular facilitation on shoulder function in secondary shoulder impingement. *International Journal of Therapy and Rehabilitation.* 2013 (20) 9 450-458
  211. Nellutla M, Giri P. Comparative Study between Efficacy of PNF Movement Patterns Versus Conventional Free Exercises on Functional Activities Among Patients with Chronic Peri-Arthritis of Shoulder. *Indian Journal of Physiotherapy and Occupational Therapy.* 2011;.5(3):62-67
  212. Ołędzka M, Jaczewska-Bogacka J. Effectiveness of Proprioceptive Neuromuscular Facilitation (PNF) in Improving Shoulder Range of Motion. A Pilot Study. *Ortop Traumatol Rehabil.* 2017;19(3):285-292.
  213. Schneider F, Laps K, Wagner S: Chronic patello femoral pain syndrome: alternatives for cases of therapy resistance. *Knee surgery sports traumatology arthroscopy* 2001 Sep;9(5):290-295
  214. Stepień A, Fabian K, Graff K, Podgurniak M, Wit A. An immediate effect of PNF specific mobilization on the angle of trunk rotation and the TPHA range of motion in adolescent girls with double idiopathic scoliosis - a pilot study, *Scoliosis and Spinal Disorders* 2017;12:29
  215. Tedla JS, Sangadala DR. Proprioceptive neuromuscular facilitation techniques in adhesive capsulitis: a systematic review and meta-analysis. *J Musculoskelet Neuronal Interact* 2019; 19(4):482-491

### **Face and mimics.**

216. Aranha VP, Samuel AJ, Narkeesh K. Correct the smile of a child by neuromuscular facilitation technique: An interesting case report. *Int J Health Sci (Qassim).* 2017 Apr-Jun;11(2):83-84.

217. Barbara M, Antonini G, Vestri A, Volpini L, Monini S. Role of Kabat physical rehabilitation in Bell's palsy: A randomized trial. *Acta Oto-Laryngologica*, 2010; 130: 167-172
218. Kumar C, Kaur Bagga T. Comparison between Proprioceptive Neuromuscular Facilitation and Neuromuscular Re-Education for Reducing Facial Disability and Synkinesis in Patients with Bell's palsy: A Randomized Clinical Trial. *Int J Phys Med Rehabil* 2015;3:4
219. Kumar S, Tiwari SP, Effect Of Neuromuscular Reeducation In Bilateral Facial Palsy On Patient With GBS. *Int J Physiother Res* 2014; 2(2):449-52.
220. Monini S, Iacolucci CM, Di Traglia M, Lazzarino AJ, Barbara M. Role of Kabat rehabilitation in facial nerve palsy: a randomised study on severe cases of Bell's palsy *Acta Otorhinolaryngol Ital* 2016;36:282-288
221. Namura M, Motoyoshi M, Namura Y, Shimizu N: The effect of PNF training on the facial profile. *Journal of oral science* 2008 (1) 45-51
222. Olivo SA, Magee DJ: Electromyographic assessment of the activity of the masticatory using the agonist contract – antagonist relax technique (AC) and contract – relax technique (CR). *Manual therapy* 2006 (2) 136-145
223. Olivo SA, Magee DJ: Electromyographic activity of the masticatory and cervical muscles during resisted jaw opening movement. *Journal of oral rehabilitation* 2007 (34) 184-194
224. Sardaru D, Pendefunda L. Neuro Muscular Facilitation in the re-education of functional problems in facialis paralysis. a practical approach. *Rev. Med. Chir. Soc. Med. Nat.* 2013; 117(1) 1-6

### **Case reports**

225. Carlson M, Hadlock T: Physical Therapist Management following rotator cuff repair for a patient with postpolio syndrome, Case Report. *Physical Therapy* 2007 (87) 179-192
226. Cayco CS, Gorgon EJR, Lazaro RT. Effects of PNF facilitation on balance, strength, and mobility of an older adult with chronic stroke, a case report *Journal of Bodywork & Movement Therapies* 2016; :1-8
227. Cayco CS, Gorgon EJR, Lazaro RT. Proprioceptive neuromuscular facilitation to improve motor outcomes in older adults with chronic stroke. *Neurosciences* 2019;24(1):53-60, doi: 10.17712/nsj.2019.1.20180322
228. Hwang WT, Chung SH, Chung MS, Lee KH, Kim T. Effect of proprioceptive neuromuscular facilitation D2 flexion and breathing exercises on lymphedema without a short stretch compression bandage. *J Phys Ther Sci.* 2015 (10):3341-3
229. Lee BK. Effects of the combined PNF and deep breathing exercises on the ROM and the VAS score of a frozen shoulder patient: Single case study. *J Exerc Rehabil.* 2015;11(5):276-81
230. Lee BK. Influence of the proprioceptive neuromuscular facilitation exercise programs on idiopathic scoliosis patient in the early 20s in terms of curves and balancing abilities: single case study. *J Exerc Rehabil.* 2016;12(6):567-574
231. Luterek M, Baranowski M, Zakiewicz W, Biel A, Pedizisz P: PNF based rehabilitation in patients with severe haemophilic arthropathy-case study. *Ortopedia traumatologia rehabilitacja* 2009 (11) 3, (6) 280-289

232. Morley J J, Perrault T. Chiropractic Management of Myositis Ossificans Traumatica: A Case Report *Journal of the American Chiropractic Association* 2012, 4, 16-24
233. Orsini M et al. Physical Therapy Improved Hand Function in a Patient with Traumatic Peripheral Lesion: A Case Study. *American Medical Journal* 2012;3(2): 161-168.
234. Pasiut SA, Banach M, Longawa K, Windak F: Stroke rehabilitation conducted by PNF method, with and without the application of botulinum toxin– case reports. *Medical rehabilitation* 2005 (9) 1, 15-24
235. Peteraitis T, Smedes F. Scapula motor control training with proprioceptive neuromuscular facilitation in chronic subacromial impingement syndrome: A case report. *Journal of Bodywork & Movement Therapies* 2020;24:1–7, doi.org/10.1016/j.jbmt.2020.03.005
236. Smedes F, Giacometti da Silva L. Motor learning with the PNF-concept, an alternative to CIMT in a patient after stroke; a case report. *JBMT* 2019;23:622-627. <https://doi.org/10.1016/j.jbmt.2018.05.003>
237. Smedes F, Oefentherapie met het PNF concept: een zinvolle behandelstrategie. *Fysiopraxis* 2006 (6) 22-27+ internet (Exercise therapy with the PNF concept a useful therapy strategy)
238. Smedes F, Komt een vrouw bij de fysiotherapeut. Case report. *Fysiopraxis* 2009 (1) 42-46+ internet (Comes a woman to the physiotherapist. Case report)

### **Spasticity**

239. Bohannon RW, Smith MB. Interrater reliability of a modified Ashworth Scale of muscle spasticity. *Physical Therapy* 1987; 67; 206-207
240. Bovend'Eerd T J, Newman M, Barker K, Dawes H, Minelli C, Wade DT. The effects of stretching in spasticity: a systematic review. *Arch Phys Med Rehabil* 2008; 89:1395-406.
241. Burridge JH, Wood DE, Hermens HJ, Voerman GE, Johnson GR, Wijck van F, Platz T, Gregoric M, Hitschcock R, Pandyan AD. Theoretical and methodological considerations in the measurement of spasticity. *Disability and Rehabilitation* 2005; 27(1/2): 69-80
242. Gracies JM. Pathophysiology of spastic paresis. I: paresis and soft tissue changes. *Muscle&Nerve* 2005 (31), 535-551
243. Li S. Spasticity, Motor Recovery, and Neural Plasticity after Stroke. *Front. Neurol.* 8:120. doi: 10.3389/fneur.2017.00120
244. Lieber RL, Steinman S, Barash IA, Chambers H. Structural and functional changes in spastic skeletal muscle. *Muscle Nerve* 2004; 29; 615-627
245. Malhotra S; Pandyan AD; Rossewilliam S; Roffe C; Hermens H. Spasticity and contractures at the wrist after stroke: time course of development and their association with functional recovery of the upper limb. *Clinical Rehabilitation* 2011; 25: 184–191
246. Malhotra S, Pandyan AD, Day CR, Jones PW, Hermens H. Spasticity, an impairment that is poorly defined and poorly measured. *Clinical rehabilitation* 2009; 23: 651-658
247. Malhotra S, Cousins E, Ward A, Day C, Jones P, Roffe C, Pandyan A. An investigation into the agreement between clinical, biomechanical and neurophysiological measures of spasticity. *Clinical rehabilitation* 2008; 22; 1105-1115



248. Pandyan AD; Cameron M; Powel J; Stott DJ; Granat MH. Contractures in the post-stroke wrist: a pilot study of its time course of development and its association with upper limb recovery *Clinical Rehabilitation* 2003; 17: 88–95
249. Patrick E, Ada L. The tardieu scale differentiates contracture from spasticity whereas the Ashworth Scale is confounded by it. *Clinical rehabilitation* 2006; 20; 173-182
250. Petropoulou KB; Panourias JG; Rapidi CA; Sakas DE. The phenomenon of spasticity: a pathophysiological and clinical introduction to neuromodulation therapies. *Acta Neurochir Suppl* 2007 97(1) 137-144
251. Sheehan JL, Winzeler-Mercay U, Mudie MH. A randomized controlled pilot study to obtain the best estimate of the size of the effect of a thermoplastic resting splint on spasticity in the stroke-affected wrist and fingers. *Clinical rehabilitation* 2006;20;1032-1037.
252. Yelnik AP, Simon O, Parratte B, Gracies JM. How to clinically assess and treat muscle overactivity in spastic paresis. *J. Rehabil. Med.* 2010;42; 801-807