SUOMEN
VOIMISTELULIITTO

FLEXIBILITY TRAINING FOR GYMNASTS

9.1.2021

Johanna Osmala ja Sannakaisa Vastamäki

SUOMEN VOIMISTELULIITTO

TERMINOLOGY AROUND FLEXIBILITY

Flexibility = a single joint's range of motion (ROM)

- active, as in capability of taking a joint to long muscle lengths
- passive, as in capability of relaxing at long muscle lengths
- loaded, as in capability of producing power at long muscle lengths

Flexibility is defined by several factors:

- *morphological factors*, anatomical shape of the bones, structure of the joint capsule and other connective tissue
- *mechanical factors*, such as elasticity of the soft tissue
- *neural factors*, e.g. muscle activity and perception of pain
- *several external factors*, e.g. psychosocial factors, temperature etc.

(Knudson, D. 2006)

SUOMEN VOIMISTELULIITTO

TERMINOLOGY AROUND FLEXIBILITY

Suppleness = general flexibility and elasticity of the whole body. The structure of joints and soft tissue allows a wide range of motion in one joint or several joints.

Hypermobility = flexibility that exceeds the joint's so-called normal range of motion, which makes it more difficult to stabilise (control) joint movement. It can be structural (genetic) or a consequence of excessive passive stretching, and occurs typically in one joint.

Hypermobility syndrome = a condition in which genetic factors have a negative effect on the mechanical properties of the connective tissue, thus making all joints of the body hypermobile.

(Pacey et.al. 2010, Armstrong & Relph 2018)

SUOMEN
VOIMISTELULIITTO

SYSTEMATIC REVIEW Open Access

Screening Tools as a Predictor of Injury in Dance: Systematic Literature Review and Meta-analysis

Ross Armstrong[1*] and Nicola Relph[2]

CME

Generalized Joint Hypermobility and Risk of Lower Limb Joint Injury During Sport

A Systematic Review With Meta-Analysis

Verity Pacey,*†‡ GradDip (Sports Physiotherapy), Leslie L. Nicholson,† PhD, Roger D. Adams,† PhD, Joanne Munn,† PhD, and Craig F. Munns,§‖ MBBS, PhD, FRACP
From the †Discipline of Physiotherapy, The University of Sydney, Sydney, New South Wales, Australia, the ‡Physiotherapy Department, and §Department of Endocrinology, The Children's Hospital at Westmead, Westmead, New South Wales, Australia, and ‖Discipline of Pediatrics and Child Health, The University of Sydney, Sydney, New South Wales, Australia

Voimistelu liikuttaa!

SUOMEN VOIMISTELULIITTO

TERMINOLOGY AROUND FLEXIBILITY

Stretch = a single stretch, where one joint or several joints are actively or passively taken into a position where the muscle is lengthened.

Overstretch = one joint or several joints are taken into an extreme, passive position, which passes the joint's capacity. In this context, the term 'overstretch' does not refer to any specific position but stands for a stretch that passes the limit of an individual's capacity.

Flexibility training = systematic and regular training, that may consist of different kinds of stretching techniques. All stretching techniques are considered as flexibility training.

Stretching is usually seen as an activity that consists of more static and/or passive stretches, and **flexibility training** as more versatile training that includes active stretches.

(Knudson, D. 2006)

SUOMEN VOIMISTELULIITTO

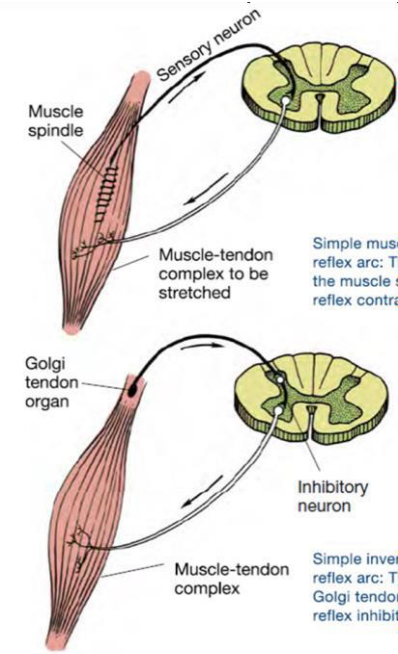
WHAT HAPPENS WHEN YOU STRETCH?

- The stretch affects several tissues and organ systems, never just the single tissue

- The central nervous system plays a significant part in managing flexibility
  - muscle spindles react to changes in the length of muscle fibres and Golgi tendon organs react to changes in muscle tension
  - the central nervous system acts based on its assessment on the threat that it is sensing
  - neural reactions are considered as one of the key factors behind stretching

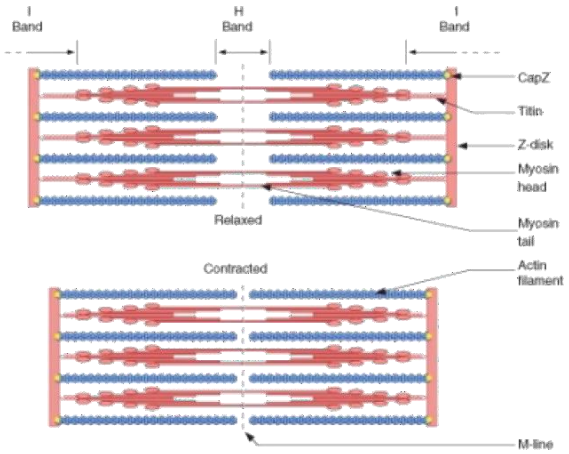
- Frequent stretching causes neural adaptation and stress-relaxation in muscles surrounding the joint

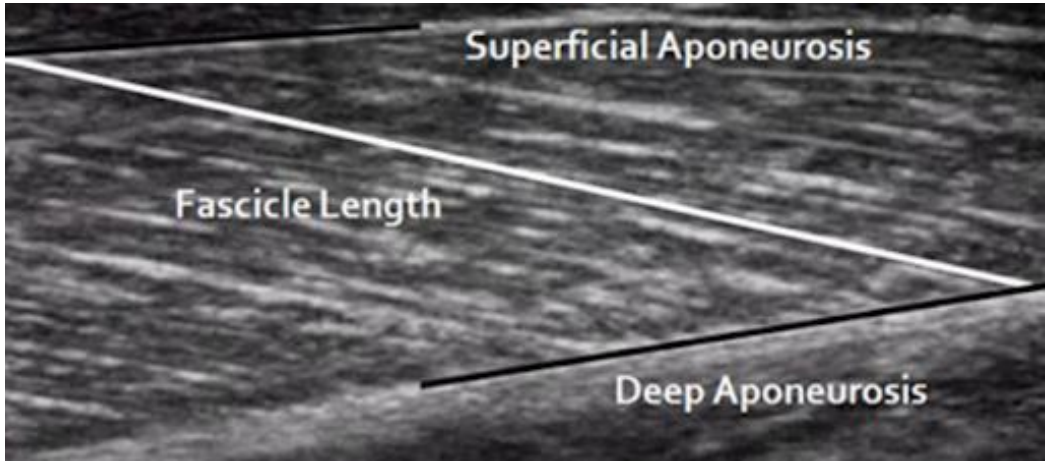
  (Moltubakk 2019, McHugh et al.1992, Magnusson et al. 1995)



SUOMEN VOIMISTELULIITTO

STRUCTURAL CHANGES





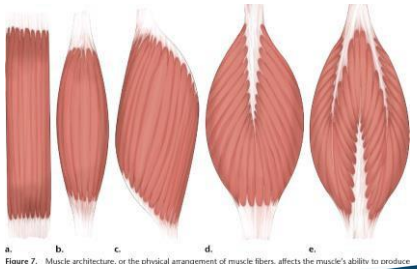


Figure 7. Muscle architecture, or the physical arrangement of muscle fibers, affects the muscle's ability to produce

- Viscoelastic structure always recoils back to its original length
- The structural changes in muscle fibres are still unclear

(Hall 2006, César et al. 2017, Gérard et.al. 2020, Freitas et al. 2018, Lima et.al. 2015, Moltubakk et al. 2018, Moltubakk 2019)

SUOMEN VOIMISTELULIITTO

WHAT ARE THE EFFECTS OF STRETCHING?

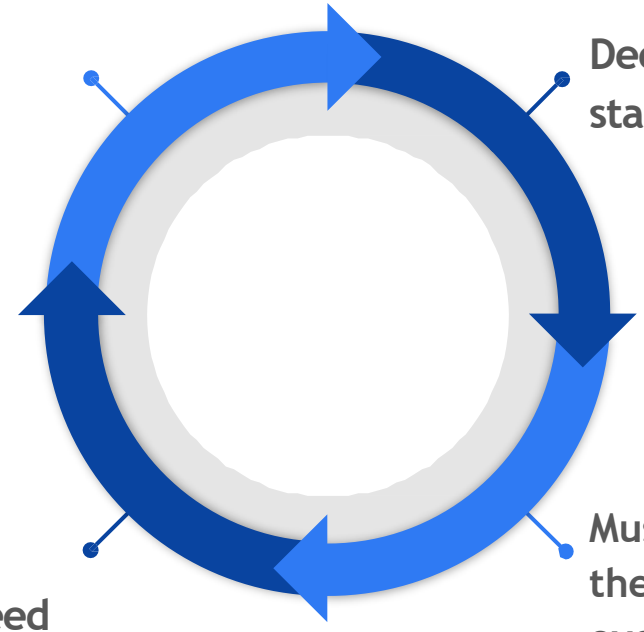
In research, flexibility is often measured by passive ROM (Mizuno et al. 2013, Kataura et al. 2017)

- passive ROM increases rapidly with various stretching interventions (4 to 8 weeks)
- regularity is important to maintain the ROM

Passive, static stretching may have adverse effects:

- *Acute effect:* decrease in muscle strength (Rubini et al. 2007)
- There is a greater risk for microdamage to muscles if the intensity of the stretch is too high (Hakkarainen et al. 2009)
- *Chronic effect*: stress relaxation of muscle-tendon unit
  - the muscle stops resisting the stretch → causes also decreased muscle activation → decreased joint stability
  - the joint may become hypermobile if no joint-stabilising strength training is included

(McHugh et al.1992, Magnusson et al. 1995,Sá et al. 2016)


Passive,
static stretching
Decreased joint
stability
Muscles supporting
the joint become
overactive
Feeling of
tightness, need
to stretch

A Comparison of Strength and Stretch Interventions on Active and Passive Ranges of Movement in Dancers: A Randomized Controlled Trial

Matthew A. Wyon,[1,4] Anna Smith,[1,2] and Yiannis Koutedakis[1,3]

[1]Research Center for Sport, Exercise and Performance, University of Wolverhampton, Walsall, United Kingdom; [2]King Edward VI College, Stourbridge, United Kingdom; [3]Department of Exercise Sciences, University of Thessaly, Trikala, Greece; and [4]National Institute for Dance Medicine and Science, Birmingham, United Kingdom

→ When it comes to increasing active range of motion in hip area, strength training is more effective than stretching.

Osmala & Vastamäki 2021

STRETCH-RELATED PAIN

- a stimulus that causes or is close to causing tissue damage, triggers a protective reaction, usually pain, and, consequently, muscle tension

  (Widmaier et al. 2004)
  - a stretch with high intensity or a fast stretch
  - “forcing” a stretch with, for example, external force

- stretch-related pain decreases over time (Magnusson et al. 1996; Moltubakk et al. 2018)
  - pain tolerance increases, or the nervous system learns that there is no danger

INTENSITY

- Stretching to the point of pain vs. to the point of discomfort (Muanjai et al. 2017)
  - ROM increased in both groups, no changes in viscoelastic properties were detected
  - after intervention there were no differences between the two groups in any parameters

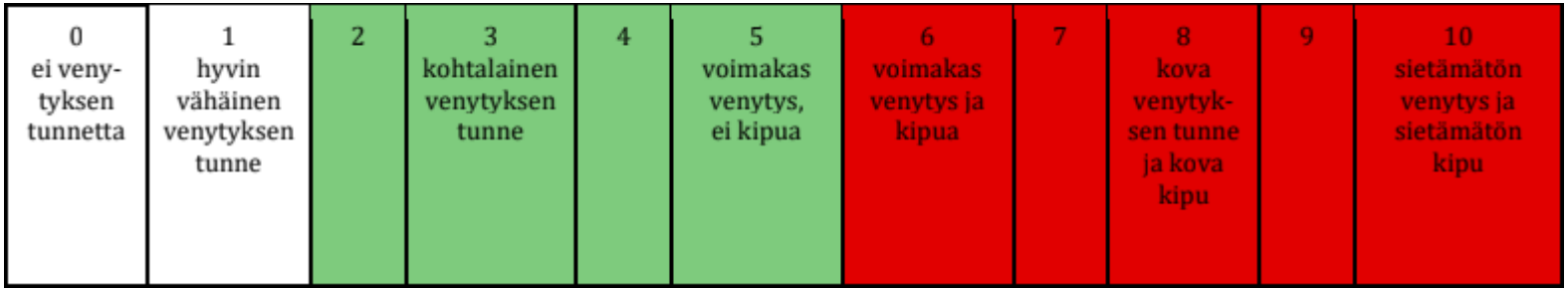
- High vs. low intensity stretching vs. strength training (Wyon et al. 2013)
  - all groups improved their PROM
  - best results in improving AROM with strength training, also low-intensity stretching showed improvement in AROM

- Very limited amount of research on athletes concerning the effects of intensity in increasing ROM, also conflicting results (Apostolopoulos et al. 2015)
  - Different intensities have given similar results on PROM

→ **Pain does not increase the effect of stretching**

SUOMEN VOIMISTELULIITTO

ASSESSING STRETCH INTENSITY



0 no feeling of stretch
1 very little feeling of stretch
2
3 moderate feeling of stretch
4
5 strong feeling of stretch, no pain
6 strong feeling of stretch and some pain
7
8 very strong feeling of stretch and severe pain
9
10 intolerable feeling of stretch and intolerable pain

Perception of pain and discomfort is different for each individual and can only be assessed by the individuals themselves.

A person's flexibility is not fixed, there may be great variation from day to day and it is a part of normal training.

FROM STRETCHING TOWARDS FLEXIBILITY TRAINING

- Reducing the difference between active and passive range of motion

- Transfer of learning → how much does passive flexibility training increase performance...
    - for gymnasts, short, dynamic/active flexibility exercises give better results than long, static ones
        - in increasing and maintaining ROM (Donti et al. 2018)
        - in hip ROM, hip isometric strength and jump performance (Ferri-Caruana et al. 2020)

Ferri-Caruana A., Roig-Ballester N., Romagnoli M..: EFFECT OF DYNAMIC RANGE … Vol. 12 Issue 1: 87 - 100

EFFECT OF DYNAMIC RANGE OF MOTION AND STATIC STRETCHING TECHNIQUES ON FLEXIBILITY, STRENGTH AND JUMP PERFORMANCE IN FEMALE GYMNASTS

Ana Ferri-Caruana, Noelia Roig-Ballester, Marco Romagnoli

Department of Physical Education and Sport, Faculty of Science of Physical Activity and Sport, University of Valencia, Spain

SUOMEN VOIMISTELULIITTO

THE NEED FOR FLEXIBILITY TRAINING AND WHEN TO DO IT

- During warm-up
  - going through the range of motion in those movement directions that are necessary in the performance the gymnast is warming up for → active movement, not staying in static positions (not relaxing in end positions)
  - variation in movements, asymmetry
  - assessing the level of flexibility on that particular day and listening to the body

- Sport-specific training already includes a lot of flexibility training
  - active flexibility training is recommended to be adopted regularly
  - use flexibility often, challenge it less frequently
  - higher intensity flexibility training should be carried out as a separate training session
  - individuality
    - differences within the group
    - individual differences in daily performance

SUOMEN VOIMISTELULIITTO

ASSISTING WHEN STRETCHING

- using external force always creates a risk of causing pain
- assisting has its place when teaching movements and elements
- importance of communication

SUOMEN VOIMISTELULIITTO

TAKE HOME MESSAGES

- Flexibility is defined by several factors; *the nervous system* plays a key part.
- Low-intensity stretches give the same or better results in increasing ROM as high-intensity stretches.

  ➔ **Listening to your body!**
- *Dynamic, short* stretches during warm-up increase range of motion and maintain physical attributes that are required in gymnastics clearly better than passive, static stretches. That is why such training should be done *more frequently*.
- *Passive, static stretches* result in muscle relaxation, which, consequently, makes it harder to control joint movement, and decreases power production. That is why such stretching should be done *less frequently*.

  ➔ **Use often, challenge rarely!**
- Open communication between the gymnast and the person assisting should take place throughout the exercise if the stretch is assisted. Assistance is recommended for guiding the movements.
- Range of motion (flexibility) is different for each individual.

  ➔ **Individual training!**

SUOMEN VOIMISTELULIITTO

REFERENCES

Apostolopoulos, N., Metsios, G., Flouris, A., Koutedakis, Y. & Wyon, M. 2015. The relevance of stretch intensity and position-a systematic review. Frontiers in psychology, 6, 1128.

Armstrong, R. & Relph, N. 2018. Screening Tools as a Predictor of Injury in Dance: Systematic Literature Review and Meta-analysis. Sports Medicine - Open access.

César, E., Teixeira, L., Souza, D. & Gomes, P. 2017. Acute effects of passive static stretching on the vastus lateralis muscle architecture of healthy young men. Revista brasileira de cineantropometria & desempenho humano, 19(5), 585-595.

Donti, O., Papia, K., Toubekis, A., Donti, A., Sands, W. & Bogdanis, G. 2018. Flexibility training in preadolescent female athletes: Acute and long-term effects of intermittent and continuous static stretching. Journal of sports sciences, 36(13), 1453.

Ferri-Caruana, A., Roig-Ballester, N. & Romagnoli, M. 2020. Effect of dynamic range of motion and static stretching techniques on flexibility, strength and jump performance in female gymnasts. Science of Gymnastics Journal, 12(1), 87-106.

Freitas, S., Mendes, B., Le Sant, G., Andrade, R., Nordez, A. & Milanovic, Z. 2018. Can chronic stretching change the muscle-tendon mechanical properties? A review. Scandinavian Journal of Medicine & Science in Sports, 28 (3), 794-806.

SUOMEN VOIMISTELULIITTO

REFERENCES

Gérard, R., Gojon, L. & Decleve, P. 2020. The Effects of Eccentric Training on Biceps Femoris Architecture and Strength: A Systematic Review With Meta-Analysis. Journal of Athletic Training, 55(5), 501–514.

Hakkarainen, H. Jaakkola, T. Kalaja, S. Lämsä, J. Nikander, A. & Riski, J. 2009. Lasten ja nuorten urheiluvalmennuksen perusteet. Jyväskylä: VK- Kustannus.

Hall, S. 2006. Basic Biomechanics; The Biomechanics of Human Skeletal Muscle, s. 149-186. New York: McGraw-Hill.

Kataura S., Suzuki S., Matsuo S., Hatano G., Iwata M., Yokoi K., Tsuchida W., Banno Y. & Asai Y. 2017. Acute Effects of the Different Intensity of Static Stretching on Flexibility and Isometric Muscle Force. The Journal of Strength and Conditioning Research, 31(12), 3403-3410.

Knudson, D. 2006. The biomechanics of stretching. Journal of Exercise Science and Physiology, 2, 3–12.

Lima, M., Carneiro, P., De S. Alves, C., Peixinho, F. & De Oliveira, F. 2015. Assessment of Muscle Architecture of the Biceps Femoris and Vastus Lateralis by Ultrasound After a Chronic Stretching Program. Clinical Journal of Sport Medicine, 25(1), 55-60.

Magnusson, S., Simonsen, E., Aagaard, P., Gleim, G., McHugh, M., & Kjaer, M. 1995. Viscoelastic responses to repeated static stretching in human skeletal muscle. Scandinavian Journal of Medicine and Science in Sports, 5, 342–347.

SUOMEN VOIMISTELULIITTO

REFERENCES

McHugh, M., Magnusson, S., Gleim, G., & Nicholas, J. 1992. Viscoelastic stress relaxation in human skeletal muscle. Medicine and Science in Sports and Exercise, 24, 1375-1382.

Mizuno T., Matsumoto M. & Umemura Y. 2013. Viscoelasticity of the muscle-tendon unit is returned more rapidly than range of motion after stretching. Scandinavian Journal of Medicine & Science in Sports 23, 23-30.

Moltubakk, M., Magulas, M., Villars, F., Seynnes, O. & Bojsen-Møller, J. 2018. Specialized properties of the triceps surae muscle-tendon unit in professional ballet dancers. Scandinavian Journal of Medicine & Science in Sports, 28(9), 2023-2034.

Moltubakk, M. 2019. Effects of long-term stretching training on muscle-tendon morphology, mechanics and function. Väitöskirja, Oslo Norwegian School of Sport Sciences.

Muanjai, P., Jones, D., Mickevicius, M., Satkunskiene, D., Snieckus, A., Rutkauskaite, R., Mickeviciene, D. & Kamandulis, S. 2017. The effects of 4 weeks stretching training to the point of pain on flexibility and muscle tendon unit properties. European Journal of Applied Physiology, 117(8), 1713-1725.

Pacey, V., Nicholson, L., Adams, R., Munn, J. & Munns, C. 2010. Generalized Joint Hypermobility and Risk of Lower Limb Joint Injury During Sport: A Systematic Review With Meta-Analysis. The American Journal of Sports Medicine, 38(7), 1487-1497.

SUOMEN VOIMISTELULIITTO

REFERENCES

Rubini, E., Costa, A, & Gomes, P. 2007. The effects of stretching on strength performance. Sports Medicine, 37, 213-224.

Sá, A., Matta, T., Carneiro, P., Araujo, O., Novaes, S. & Oliveira, F. 2016. Acute Effects of Different Methods of Stretching and Specific Warm-ups on Muscle Architecture and Strength Performance. Journal of Strength and Conditioning Research, 30(8), 2324-2329.

Widmaier, E. P., Raff, H., & Strang, K. T. 2004. Human Physiology: The mechanisms of body function; Sensory Physiology, s. 205-244. New York: McGraw-Hill.

Wyon, M., Smith, A., & Koutedakis, Y. 2013. A comparison of strength and stretch interventions on active and passive ranges of movement in dancers: a randomized controlled trial. Journal of Strength and Condition Research 27, 3053-3059.

SUOMEN
VOIMISTELULIITTO

Osmala & Vastamäki 2021