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A Stretching Guide

A definitive guide with step-by-step instructions how to perform stretching exercises using different methods and techniques with modifications for elderlies

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THESIS
ABSTRACT

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The subject of this thesis is stretching. The final product is a guide that introduces stretching exercises which can be modified for people with mobility problems. The guide also includes a chapter on partner stretches. The guide was made for Myötätuuli Learning Environment at Kajaani University of Applied Sciences. In addition to sports and leisure services, Myötätuuli offers services related to health promotion and support for managing to different types of clients of different ages. Instructors in Myötätuuli classes are mostly sports and nursing students from Kajaani University of Applied Sciences. In Myötätuuli close attention is paid to planning the instructions before classes. Sometimes it is time consuming for new students to find proper exercises to be included in their plans. This guide can help students speed up their planning and can also be used as references for stretching exercises.

The purpose of this thesis was to develop a guide for Myötätuuli. The aim of the guide was to provide general information about stretching, contain theoretical background and explanations for different types of stretching exercises and give instructions for stretching exercises for different body muscles or muscle groups. The main target groups of the guide are older adults and partners: therefore, one of the tasks was to provide modifications for the exercises if possible. The guide is available as a PDF file, and it can be used by students at Myötätuuli when they make daily lesson plans and instruct classes.

Language of Thesis	English
Keywords	Stretches, PNF, Flexibility
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PREFACE

The work outlined in this thesis is carried out in the Kajaani University of Applied Sciences, Finland. The work has been done over the period of September 2014 to March 2015 for a English Bachelor's Degree in Sports and Leisure Management. The supervisor on the Thesis has been Kari Partanen. Solely the author has made the thesis; some part of the text, however, is based on the research of others, and I have done my best to provide references to these sources.

The material included in this thesis has not been submitted for a degree or diploma or any other qualification at any other university.

CONTENTS

APPENDICES

1 INTRODUCTION

Regular physical activity is essential for healthy aging. Adults aged 65 years and older gain substantial health benefits from regular physical activity, and these benefits continue to occur throughout their lives. Promoting physical activity for older adults is especially important because this population is the least physically active of any age group. Older adults are a varied group. Most, but not all, have one or more chronic conditions, and these conditions vary in type and severity. All have experienced a loss of physical fitness with age, some more than others. (U.S. Department of Health and Human Services 2008, 29.)

Older adults should maintain the flexibility necessary for regular physical activity and activities of daily life. When done properly, stretching activities increase flexibility. (U.S. Department of Health and Human Services 2008, 33.)

The purpose of this thesis was to create a guidebook for Myötätuuli health clinic organization. The aim of the guidebook is to provide general information about stretching and instruction of how to execute it. The main target groups of the guidebook are older adults.

Myötätuuli clinic's services focus on health promotion and coping support. It also offers services in the field of sports and leisure management to different types of clients. A big group of their clients are elderlies or people with different types of disabilities, which the guidebook will suit them well. Trainers that instruct the classes in Myötätuuli are mostly sport and nursing students from Kajaani University of Applied Sciences (KAMK), which they are doing their practical trainings. This product will help them quicken the process of planning their lessons. It will make it easier to find suitable stretches, according to the content of the class and target group, which they will be instructing. Because, students are the users of the guidebook, at the beginning before the main stretches part starts, the definition and concept of different stretches methods will be explained. Guidebook contains the explanation of the different types of stretches for different purposes such as warming up, cooling down or increasing the flexibility. Afterward there is a chapter, which provides a stretches movement for different muscles/muscle groups. As the target group for the thesis are mainly elderlies and people with mobility problems, the movements are mainly designed/collected for them.

There is Partner Stretches chapter in the book; this chapter contains different stretches movements, which can be done with help of a partner. These types of stretches are very useful to increase flexibility. Proprioceptive Neuromuscular Facilitation (PNF) stretching method can be used for partner stretches. Also it can improve social-emotional aspects of client's personality. While performing partner stretches one needs to trust their partner; also they need to listen to the partner and concern about their situation.

2 STRETCHING

Stretching is a method undertaken, which a group of muscle(s) and tendon will be flexed in order to achieve length in the muscle(s). Depending on how often and the methods of stretching an individual uses, the effects of it on body can be increasing flexibility, muscle control and range of motion. In addition to those main effects, stretching exercises will reduce the risk of injury, and will help in maintaining a good posture. Mainly, athletes and those whom are attending physical activities are stretching before and after the main training to warm-up or increasing flexibility of muscles. Frequently no distinction is made between warm-up exercise and those designed to increase flexibility (Enoka, 2008, 309). The main difference between warm up and flexibility exercises is that the increasing rage of motion in warm-up last shorter time than flexibility exercises. The goal of flexibility exercises is to induce a more long-term change in range of motion. There are different types of flexibility and different types of stretching. Stretching exercises can be divided into two main categories; they are either dynamic or static stretches (Bradford, 1994). Most commonly dynamic exercises are used for warm up and static stretches have been used to increase flexibility. Clinicians tend to favor exercise that combine stretching with activation of either the agonist and antagonist muscles. Three of these exercises have been derived from a rehabilitation technique known as PNF. (Kabat & Knott, 1953; Knott & Voss, 1968, as cited in, Enoka. 2008, 310). Connective tissue seems to play a significant role in limiting range of motion. For this reason stretching exercises should be directed at altering the length of connective tissue structure. To achieve this goal, flexibility exercises should cause plastic rather than elastic changes in connective tissue, because plastic changes will bring more permanent changes in tissue length. The low-force, long-duration stretch optimizes the plastic changes.

2.1 Warm-up and effect of temperature in muscles

Stretching exercises, [specially dynamic stretches] are suitable to be undertaken as a warm-up activity. Static stretching has been shown to lead to a decrease in force production, power performance, running speed, reaction and movement time and strength endurance (Baechle, & Earle, 2008, 296). Dynamic Stretching does not seem to elicit the performance reduction effects of static and PNF stretching and been shown to improve subsequent running per-

formance. Based on current evidence, dynamic stretching would be the preferred option for stretching during warm up (Baechle, & Earle, 2008, 297).

Core temperature can increase due to muscle contraction or passive heat source; which in both cases it can optimize the elasticity of muscles and tissue around the joint. Active warm-up improved execution of a brief performance more than does a passive warm-up (Bishop, 2003). In addition to elevating muscle temperature, warm-up exercises are used to increase the range of motion about a joint (Bishop, 2003; Smith, 1994; Stewart & Sleivert, 1998).

The dependence of muscle stiffness on its immediate history of activity is known as thixotropy (Campbell & Lakie, 1988; Proske et al. 1993; Walsh, 1992, as cited in, Enoka 2008, 308). It is a property exhibited by various gels, including muscles. In general the gel becomes more fluid when shaken, stirred, or otherwise disturbed, and it sets again when allowed to stand (Enoka, 2008).

Stretching exercises should be used with caution in a warm-up routine because long-duration stretches can impair maximal performance (Behm, Bambury, Cahil, & Power, 2004; Avela, Finni, & Liikavainio, 2004; Cramer, Housh, Weir, Johnson, Coburn, & Beck, 2005; Weir, Tingley, & Elder, 2005). However, the increase in core temperature that occurs during a warm-up enhances the passive extensibility of the tissues around the joint and increases the range of motion (Zakas, Grammatikopoulou, Zakas, Zahariadis, & Vamvakoudis, 2006). Nonetheless, flexibility corresponds to the range of motion about a joint, and differences in flexibility between the joints and individuals are due to long-term adaptations and not the changes that occur after a set of warm-up exercises (Halbertsma, Bolhuis, Göeken, 1996; Magnusson, 1998).

In general, a physical activity starts with a light exercise to prepare the body for the stress, which will be applied on the muscles. A proper warm-up can increase the core and muscles temperature, and blood flow. It looks like, that warm-up exercises will improve the biomechanical performance. With proper warm-up the contraction of muscles gets faster. It will improve strength and power. And also will lower the viscous resistance in muscles.

2.2 Flexibility

Flexibility is the ability of our muscles (muscle groups) and tendons to stretch and move about a joint in their full range of motion (ROM). It varies between individuals. Flexibility can be affected by numbers of factors. These factors can be anatomical [such as, joint structure, age, and sex] and training related.

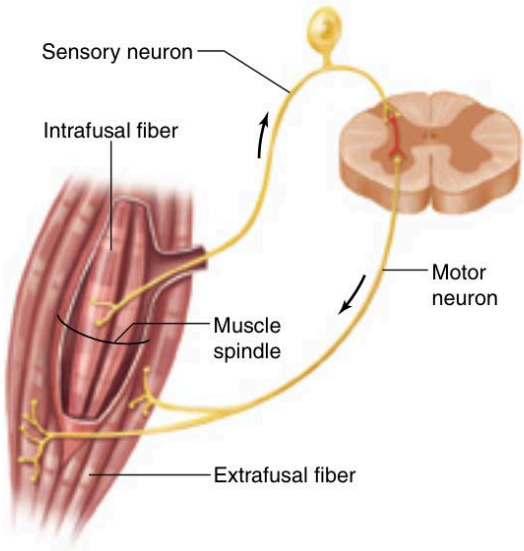
Some people are born with pliable tendons. Young people are more flexible than older people and females tend to be more flexible than males. (Baechle, & Earle, 2008, 298.) Naturally, when an individual gets older his tendons will get stiffer. Aging, also, decrease the elasticity of the muscles and connective tissue. Inactivity is another reason that affects the flexibility of muscles and tendons. Training stretching exercise on regular basis can increase flexibility of muscles and tendons. The viscous and elastic properties of muscle and the connective tissue, associated with the muscle and the joint that resist stretches and limit the range of motion are plastic and will adapt to the demands of usage, both within a single session and with training (Stromberg, & Wiederhielm, 1969; Taylor et al. 1990).

As mentioned before, connective tissue may limit ROM. Elasticity (ability to return to original length after a passive stretch) and plasticity (the tendency to assume a new and greater length after a passive stretch) of connective tissue are other factors that determine ROM. Stretching exercises can positively affect connective tissue by taking advantage of their plastic potential. (Baechle, & Earle, 2008, 298).

An interesting fact about flexibility is that, flexibility training can improve your strength. By increasing flexibility muscle are able to operate into a greater range of motion; and by recruiting more muscle fibres we generate more force.

2.2.1 Proprioceptors and Stretching

Located in muscles, tendons, and joints are sensory receptors, which are sensitive to tension and pressure. These receptors are sending information from the muscles to *Central Nervous System* (CNS) "Two important proprioceptors that should be considered during stretching are: Muscle spindles (picture 1) and Golgi tendon organs (GTOs). Muscle spindles, located within intrafusal muscle fibers that run parallel to extrafusal muscle fibers, monitor changes in muscle length. During a rapid stretching movement its sensory neuron from the muscle spindle innervates a motor neuron in the spine. The motor neuron then causes a muscle action of the previously stretched extrafusal muscle fibers; this is the *stretch reflex*. Stimulation of the muscle spindle and the subsequent activation of the stretch reflex should be avoided during stretching, as motion will be limited by the reflexive muscle action. If the muscle spindles are not stimulated the muscle relaxes and allows greater stretch. Because of the very slow movement during the static stretching, the stretch reflex is not invoked. Rapid (ballistic and dynamic) stretching movement may stimulate the muscle spindles, causing a stretch reflex.". (Baechle, & Earle, 2008, 299.)



Picture 1. Muscle spindle - stretching muscle activates sensory neuron; which sends an impulse to spinal cord, where it synapses with a motor neuron, causing the muscle to contract (Thomas r. Baechle; & Roger W. Earle; 2008).

2.3 Stretching Techniques

Stretching movements can be done either passively or actively (Baechle, & Earle, 2008, 300). In an active stretching movement, the doer use muscles to supply the force needed to stretch. Whereas; in passive stretch a partner or an apparatus provides the force. The two basic stretches are static and ballistic (dynamic) stretches (Enoka, 2008, 309). The static stretch involves lengthening the muscle to the limit of its ROM and holding the position for several seconds, whereas the ballistic stretch comprises repetitive bouncing movement to the limit of the range of motion.

2.3.1 Static Stretching

Static stretching is one of the most used techniques of stretching. This method of stretches is a very effective for increasing ROM; yet not as effective as PNF method, [which will be explained shortly] (Hatfield, 2011, 327). In general there are 2 types of static stretching: *static-active* and *static-passive* (Hatfield, 2011, 327). In *static-active* stretches the person will slowly move to assume a position, where is his or her extreme range of motion for the joint they want to stretch, and they hold the position for 20 to 30 seconds; using their muscles without any assist. In *static-passive* stretching the doer will remain in the assumed position with the help of an assistant. The assistant can be partner or another apparatus such as a wall.

Static stretching does not elicit a stretch reflex; therefor the likelihood of injury is less than during ballistic stretching, and allows greater stretch. (Baechle, & Earle, 2008, 300). Of course you can never fully avoid injuries, static stretching might also lead to injuries if it be performed too intense.

An example of a static stretching can be *supine knee flex* (Picture 2). To perform this stretching movement the athlete will lie on the back, flexes the knee and hip, bringing the thigh toward the chest, interlace the fingers behind the leg and pull the thigh slowly toward the chest till he or she feels discomfort in hip extensors (gluteus maximus and hamstrings). The athlete holds this position for about 30 seconds and slowly returns the leg to the starting position. This position is assumed slowly and held without any dynamic or ballistic movement, so the stretching technique is a static stretching.

Picture 2. Static stretching - Supine knee flex.

2.3.2 Dynamic stretching

A dynamic stretch is a type of functionally based stretching exercise that uses sport-specific movements to prepare the body for activity (Baechle. & Earle. 2008, 300). In dynamic stretching one will move body part, such as limbs and/or torso and gradually will increase the range of the movement (and speed in some cases). An example of a dynamic stretching would be, standing with legs slightly more than hip wide apart, hands relaxed on sides, leaning from the waist to the left trying to reach the left knee, slowly rise up to the starting position, and lean to the right side; in a slowly and controlled movement lean more to reach lower with the hand in every repetition. Another simple example of dynamic stretching would be legs swings forward and backward to stretch the quadriceps and hamstring muscles.

One may confuse ballistic stretches [to be defined shortly] with dynamic stretches. These two types of stretching are more or less similar; however, there are few differences in their characteristics. Unlike in ballistic stretching, dynamic stretching movements are more controlled and there is no bouncing in performing them. Because, dynamic stretching uses less speed and velocity used in ballistic stretches, it may have a smaller ROM. In comparison of these two types of stretching, dynamic stretching is safer in case of injuries. Especially, when there has been a previous injury, it is always safer when the stretches movement is done in a controlled way to avoid over-stretching the muscle.

As we mentioned before, one of the purposes of warm-up activities is to increase the temperature. Mostly, in dynamic stretching a group of muscles and joint are working as a single unit to perform a stretching movement. The execution of the movement is happening actively and the muscle is not relaxed unlike in static stretching. In this case, those movements are promoting more temperature. This makes dynamic stretching very time efficient and ideal for warm-up activities. Static and PNF stretching methods are preferred when increasing flexibility is needed.

2.3.3 Ballistic stretching

In Ballistic stretching bouncing motion is used to stretch the muscle into the ROM. The momentum of the moving part of body will be used to stretch the limb beyond its normal ROM (Bradford, 1994). In ballistic stretching the ending position of the movement is not held (Baechle. & Earle. 2008, 300); because jerking movement triggers a stretch reflex and the muscle will pull back to avoid overstretching. In this type of stretching the doer will stretch the muscle by jerking movement. An example of ballistic stretching can be standing legs hip wide apart, bending forward from the waist while the knees are straight or slightly softened, trying to reach the toes or the ground with fingers using a bouncing movement.

Ballistic stretching is not performed with a controlled movement; therefor, especially when there has been a previous injury, it may not be safe.

2.3.4 PNF stretching

Before opening up the PNF stretching topic, and explaining the main techniques of PNF, a short description about muscles, and the terms reciprocal and autogenic inhibition makes the understanding of the topic easier.

Agonist and Antagonist

During performing and action using muscles, depending on the action one takes at any given moment, the muscles can be agonists or antagonist. A muscle is called a primer Mover or agonist when it is the main muscle involved in a concentric contraction (Hatfield, 2011,129). The antagonist muscle is one, which has an action directly opposite to that of the agonist (Hatfield, 2011, 129). In another word, the muscle that contracts and gets shorter is called agonist; and the muscle that opposes the agonist muscle's action is called antagonist. For instance, the quadriceps is the agonists for extending or straightening the knee. The hamstrings stretch when the knee extends and so are the antagonists for this action. The hamstrings become the agonist muscle when the knee bends and the quadriceps become the antagonist.

Reciprocal inhibition

When an agonist muscles is contracted the antagonist muscle will relax. Relaxation that occurs in the muscle opposing the muscle experiencing the increased tension is called reciprocal inhibition (Baechle. & Earle. 2008, 299). This process occurs unconsciously through a primitive spinal cord reflex arc that scientists call "reciprocal inhibition**.**" While one is performing PNF, he or she will consciously access this reflex arc.

Autogenic inhibition

Autogenic inhibition simply means that when a muscle is tight, a stimulation of the GTO will send a massage to the same muscle to relax (Milad H. 2012). For instance, if biceps brachii muscle is contracted, a stimulation of biceps brachii tendon will send a massage to the biceps to relax.

PNF stretching was originally developed as a part of a neuromuscular rehabilitation program designed to relax muscles with increased tone or activity (Voss, Ionta, & Myers, 1985). In general, PNF stretching has two phases; relaxed phase which the muscle to be stretched is

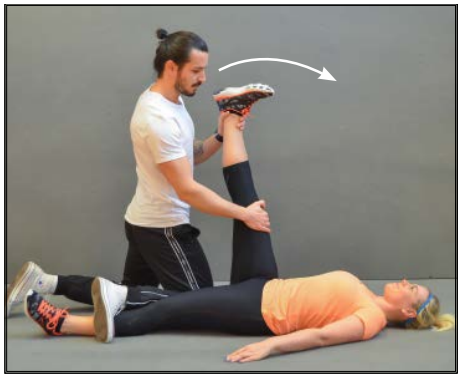
relaxed (passive) and a contraction phase. In the contracting phase either the antagonist or agonist muscle will be contracted. PNF stretching requires a [expert] partner to assist, which makes this technique impractical in comparison with other techniques.

During a PNF stretch, three specific muscle actions are used to facilitate the passive stretch. Both isometric and concentric muscle actions of the antagonist (the muscle being stretched) are used before a passive stretch of the antagonist to achieve autogenic inhibition. The isometric muscle action is referred to as hold and the concentric muscle action as contract. A concentric muscle action of the agonist, called agonist contraction, is used during a passive stretch of the antagonist to achieve reciprocal inhibition. Each technique also involves passive, static stretches that are referred to as relax. (Baechle, & Earle, 2008, 300.)

The explanation of three basic techniques of PNF can be found here:

- **Hold-relax**

  Performing the "hold-relax" technique begins so that, the assistant brings the partners limb to a point of ROM where the athlete feels mild discomfort. At this point the athlete is relaxed. This position will be held for 10 seconds (Picture 3.1). Afterwards, the assistant will ask the partner to push against his hand by contracting the muscle. The assistant will make enough force to not allow the doer's limb to move. At this point there is an isometric contraction in the muscle. As mentioned before this isometric contraction is called hold. This position will be held for 6 seconds (Picture 4.1). The athlete then relaxes and the assistant will stretch his or her limb passively for 30 seconds (Picture 5.1). The increase in ROM and greater extension of the muscle is due to autogenic inhibition.



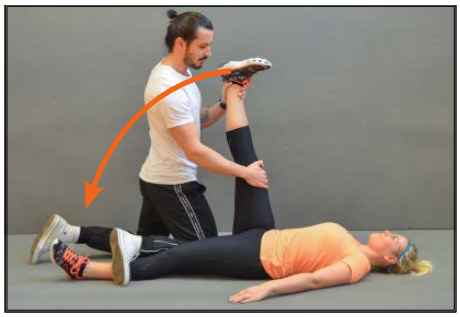
Picture 3.1 PNF - passive stretch phase.

Picture 4.1 PNF - Isometric Hold phase.

Picture 5.1 PNF - Second assive stretch (Greater ROM due to autogenic inhibition).

- **Contract-relax**

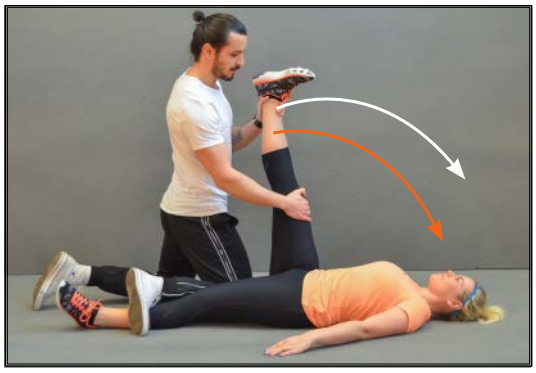
Contract-relax technique is almost the same as the hold-relax. The only difference between them is that in this technique, instead of an isometric contraction of the muscle a concentric contraction will be performed. The stretching begins with a passive stretch of the muscle for 10 seconds at the point of mild discomfort (Picture 3.1). The athlete then pushes the limb against the assistant. The assistant will make enough force to let the athlete's limb slowly move back in the opposite direction into its full ROM (Picture 6.1). The athlete then relaxes and the assistant stretches the muscle passively for about 15-30 seconds (Picture 5.1). The increase in ROM and greater extension of the muscle is due to autogenic inhibition.



Picture 6.1 PNF - Contraction phase to stimulating GTO

- **Hold-relax with agonist contraction**

Hold-relax with agonist contraction technique, follows the first two phases done in hold-relax technique (Picture 3.1 and 4.1). But the difference is that instead of the passive stretching at the end, there is an agonist concentric contraction. In the photo introduced it means that the athlete activates the hip flexors and contracts the quadriceps (Picture 7.1). This is the most effective PNF technique for increasing flexibility. During performing it both autogenic and reciprocal inhibition is happening. The increase in the final stretch is primarily due to reciprocal inhibition.



Picture 7.1 PNF - Agonist Contraction

3 AGING AFFECTS IN MUSCULATURE, AND STRETCHING FOR OLDER ADULTS

The main target group of the following thesis are elderlies. Most of the exercises in the guidebook have been chosen to suit older adults. Therefore, a short explanation around the pathological adaptations that occur with aging helps in better understanding. Older adults are among the fastest growing age groups. Number of people with the age over 65 is growing. According to the Organisation for Economic Co-operation and Development (OECD), in 2012, 18.5% of the Finnish population was over the age of 65 (OECD average 15% in 2010) and 5% of the population was over the age of 80 (OECD average 4% in 2010). In 2050, 27% of the Finnish population will be over the age of 65 and 11% of the population will be over the age of 80 (OECD Historical Population Data and Projections Database, 2013). Elderlies will become a considerably large number of the society in near future; improving physical fitness and health of them will improve overall health of the whole society.

3.1 Age-related changes in musculature

As individuals age, they experience changes in few aspects of their physical capabilities. No matter how healthy, active, and physically fit they are. One of the inevitable changes that occur is decreasing in muscle mass and muscle elasticity. The decrease in muscle mass and accompanying decline in strength are known as *sacropenia* (Evans, 1995). There are different classifications for human muscle fibres, based on a variety of criteria. In general, muscle fibres can be classified as *type I* (slow-twitch) and *type II* (fast-twitch). With aging, the proportion of muscle fibres type I will increase, and the cross-sectional area of all the fibres decreases (Enoka, 2008, 396). The changes associated with increasing age result in a decline in the structure and function of human tendons (Kannus, Paavola, & Józsa, 30). Along with aging the decrease in elasticity of tendons, ligaments, and joint capsules has been seen. It looks like that, stiffness of aging causes having smaller ROM and limits the magnitude of movements. Hydration is another important matter that affects flexibility, because the water content of connective tissue decreases with aging and contributes to stiffness.

To some point, training flexibility exercises regularly, can counterbalance the decrement in ROM. As older people can increase strength, however, they can improve flexibility with appropriate exercises. Stiffness of muscles and tendons can makes daily activities become more difficult. Lack of flexibility, is one of the important factors affecting the quality of life.

3.2 Effects of stretching in elderlies

A study done in 2001 amongst 60 healthy people (mean age 84.7) with tight hamstrings compared stretching of the hamstrings held for 15, 30 and 60 seconds over a 6 week period (Feland, Myrer, Schelthies, Fellingham, & Measom, 2001). The results of this study indicated that a 60 seconds stretch was more effective than a 30 second stretch within this group of elderly individuals. Previous studies with a younger population suggested that a 60 seconds stretch was just as effective as a 30 second stretch. (Ioannis, Christos, Nikolaos, Aikaterini, & Efstratios, 2005) In this study a 60 seconds stretch repeated four times, once a day, five times per week for six weeks improved hamstring flexibility in people over 70 better than those that stretched 15, or 30 seconds. In this group, however, improvements in range were also seen in those stretching 15 seconds and 30 seconds. In other words a short stretch is better than no stretch, but 60 seconds is optimal. This study also showed that stretching must be continued if the benefits of stretching are to be maintained over time.

3.3 What types of stretching is suitable for elderlies?

According what has been discussed previously, changes in muscles and joint will happen through years; therefore, it should be remembered that it will take time to gain flexibility back in elderlies. Since, older adults have stiffer muscles and tendon, the risk of injury might be higher in comparison with younger people. Flexibility exercises and stretches must be chosen carefully when it comes to that group of clients.

Muscles of older individuals are more susceptible to injury during eccentric contractions (the muscle is lengthened during its contraction) and are slower to recover from trauma. The diminished capacity for healing and higher risk of injury is why it is best to use static stretching

techniques as opposed to PNF or ballistic techniques in elderly people. (Buckwalter, Woo, Goldberg, Hadley, Booth, Oegema, & Eyre, 1993.)

4 RESEARCH TASKS

The purpose of this thesis was to create a guidebook for Myötätuuli health clinic organization. The aim of the guidebook is to provide general information about stretching and instruction of how to execute it. The main target groups of the guidebook are older adults and partners. The research task will reflect the content of the book and how the book should be constructed. These tasks are as follows:

1. How to specify and categorize different stretching movements?
2. How can the exercise be modified for elderlies?
3. What is the safest way to stretch with a partner?

5 PRODUCT DEVELOPMENT PROCESS

The purpose of this thesis was to develop a guidebook for Myötätuuli health clinic organization. The aim of the guidebook is to provide general information about stretching, and step-by-step instructions of how to stretch different muscle/muscle groups. The main target groups of the guidebook are older adults and partners. The outcome will be an electronic (PDF) guidebook used by Myötätuuli trainees for making daily lesson plans and instructing classes.

A product development process is a sequence of steps that transforms the set of inputs into a set of outputs. It is a sequence of steps or activities, which an enterprise employs to conceive, design, and commercialize a product. Many of these activities are not physical but organizational and intellectual. Six phases are included in the common product development process. (Ulrich & Eppinger 2003, 12-13.)

Ulrich and Eppinger (2003) describe the six phases as following:

- *Planning* precedes the project acceptance and start of the actual product development process.

- *Concept development* is where needs of the target group are recognized, different options for product concepts are created and evaluated, and one or more concepts are chosen for further development and testing. A concept is an explanation of the appearance, function and characters of a product.

- *System-level design* consists of the description of the structural design of the product and the decomposition of the product into subsystems and components.

- *Detail design* includes the total design of the geometry, materials, and tolerance of all of the parts in the product. Robust performance and production costs are two most critical issues addressed in the detail design phase.

- *Testing and refinement* includes the construction and evaluation of several preproduction versions of the product. Early prototypes are tested to verify whether the prod-

uct will work as designed and whether product satisfies the most important customer needs.

- *Production ramp-up's* purpose is to educate the work force and to solve any remaining problems in the production process.

5.1 Myötätuuli; the commissioning party of the thesis

The commissioning party of the thesis is a health clinic organization, which is a part of Kajaani University of Applied Science called Myötätuuli. The clinic is run under the "Soteli" department. Soteli is government funded and is a non-profit organization. The clinic's services focus on health promotion and coping support. It also offers services in the field of sports and leisure management to different types of clients in different age groups. Clinic's main roles include:

- Creating lesson plans
- Instructing different types of classes for different type of clients
- In-Body Testing
- Planning events
- Presentations to different groups to promote safer and healthier living

Myötätuuli clinic's clients are largely from different projects or groups who have different needs or disabilities. For instance they have exercise classes for diabetics or elderlies, gym training classes for people with brain diseases, social activities for unemployed people who have problems with social skills, or exercises for people in a retirement home with mobility and memories problems.

Myötätuuli promotes mental and physical wellbeing through different exercises classes and treatments offered, usually held by KAMK students. Trainers that instruct the classes in Myötätuuli are mostly sport and nursing students from Kajaani University of Applied Sci-

ences. Therefore, thought this product will help the organization to achieve their goal and quicken the process of planning.

5.2 What was the information Myötätuuli want in the guidebook?

Signing the contract with Myötätuuli took place after the thesis plan presentation in KAMK. At the last meeting before signing the contract, the author and the commissioning party made it clear, what information will the guidebook contain. They removed the unnecessary parts from the guidebook and bring more focus to the useful parts according to the clinic's needs. Therefor, the final product has minor differences with the first manuscript, which has been made during the thesis plan.

5.3 Production manuscript

A compilation of the manuscript and the production plan, which provides key information on how the whole process was completed, is called production manuscript.

5.3.1 Manuscript

The content of the guidebook is a versatile stretching exercise that are divided into two main different categories:

1. Stretches for different muscle groups.

2. Partner stretches.

The guidebook is designed primarily for the instructors in Myötätuuli. These instructors can be educated professionals or/and junior sports and nursing students. Therefore, it has been taken into consideration to provide scientific information that at the same time is easy to understand for interns as well as professionals.

The "stretches for different muscle groups" part of the guidebook is introducing exercises for stretching whole body muscles from head to toes. As the target group of the guidebook are seniors and elderlies, the exercises in this section are primarily designed to be performed using a chair for support. There is an "Exercise Introduction Box" on the top-left side of each exercise's page. Introduction box provides key information about the exercise, such as, name of the exercises, primary stretched muscles, and technique of stretching used for the exercises. At last you can find a modification for performing each exercise. These modifications are making the exercises either easier or more challenging (in some cases) to be performed. After the introduction part the step-by-step instruction on how to perform the movement will come along with photos.

Next chapter of the product will be a "partner stretches" section. The whole idea of this part is to provide example on how to perform stretches movements with partner. Partner stretches will improve cognitive skills, the person have to think of the way their partner are doing the movement and try to understand it. It also improves social emotional skills. Performing a stretching exercise with a help of a partner needs trust; they have to evaluate the situation and feeling of partner. It will make them try to listen and get/give feedback to each other. Stretches performed with the assistance of a partner can be more effective than stretches performed without a partner. The problem with using a partner, however, is that the partner does not feel what the other person feels, and thus cannot respond as quickly as when performed individually. This can increase the risk of injury while performing a particular exercise. To reduce and possibly avoid the risk of injuries in the product the priority is to choose the safest movements.

5.3.2 Production plan

The important matters about the production of the guidebook discussed with Liisa Paavola and Julia Kampman at December 2014. The final agreement was to make an electronic PDF version guidebook containing texts and photos. The size of the pages is 20*20 centimetres. The excellence of a square layout is that the reader does not need to scroll down the page to see whole content of the page; and it will make it easier to focus while reading an on computer monitor screen.

The organisation has their own colour theme for their printed guidebooks and materials. But, because the following product is not a printed version they did not demand the author to follow their colour theme in the design of the guidebook. The author has chosen the colours, layout and design of the product. The main colours used in the layout are white, orange, grey and black. Program used for designing is Adobe InDesign. Since the author had no previous experience with this specific program, learning the use of it required significant amount of time and energy. Consequent was a short delay in finishing the product in compare with the estimated time. The front cover of the product is designed with another program from Adobe, called Photoshop. The front cover had to include the title of the work and the colour scheme of black, orange, grey and white was introduced, as it would be used in the entire guidebook. Each chapter of the product is divided with a chapter cover page. it contains a photo, a title and short introduction on what needs to be considered during reading that chapter.

5.4 Limitations

The thesis work is a 15 credits process, but with the topics and parts that the author has been including in the planning, the work load would be too high. The organisation set some limitations on the age group and techniques used for the exercises in product. These limitations kept the work load at a sufficient level.

6 DISCUSSION

In this chapter the thesis as a whole is discussed. The discussion starts with the evaluation of the product. It is followed by a look on the reliability of the work and ethical issues. Finally, the author evaluates his own professional development, which is compared with the objectives that Kajaani School of Applied Sciences set.

6.1 The product evaluation

An evaluation is a controlled judgment of something or someone using a set of criteria a set of standards or guidelines. An evaluation is not a disagreement or argument against the content of something; rather, it is a discussion of the quality of a writing. (Jewell, 2014.) In regards to the users of the guidebook, a complete knowledge about the theoretical background needed to be studied and put into words prior to introducing the exercises. However, going through the theory was less time consuming than planning the exercises. Research and writing the theory was a complex part of the product. The author had put a great effort on theory to make it as complete and clear as possible. Planning the exercises which was the second stage of procedure were more manifest. Some of the exercises have been studied in different ways such as different literatures, coaches and observing and getting feedback from the evaluators (testers). The list of the exercises used in the product could be longer. The priority to choose was safety, quality and effectiveness of the exercises on the target muscles.

The idea beneath the layout was to make the guidebook good looking, simple, clear, enjoyable to read and easy to understand. The author had the experience of graphic design and that made the designing part easier. Still, the final layout changed few times during the procedure. Two of the sport degree schoolmates have helped in the photo shooting work of the product. As the target group of the product are elderlies it has been tried to use a photo model that is in the same age; but finding an old (or middle age) person who is flexible enough to show the movements properly was challenging. Using a model that can show the exercises correctly was important; thus, it has been decided to consider a young model for that part. The author himself, Aleksei Vasilev and Heidi Niemi (sport student at KAMK) are the photo models in guidebook and the photos have been taking by Kseniia Alekseeva.

The product needed to be evaluated by the commissioning party before presenting it to the school. Thus, a draft copy of the guidebook, which contains the theoretical background and some sample exercises, been handed to Myötätuuli before finishing the final product. The idea was to give them a perspective on how the final product will look like. Also, they had a chance to use the guidebook and evaluate its usability and practicality. The feedback about the guidebook was encouraging. They liked the guidebook and gave positive feedback on both the content and layout of the product.

6.2 The reliability and ethicality

Reliability and ethical issues bring depth into the research. During collecting information it is important to consider the ethical factor. According to Rensik (2011) these factors are honesty, objectivity, integrity, carefulness, openness, and respect. While doing this research the author has been taking all these factors into consideration. One way of honesty is to give credit to someone when using ones work and avoiding plagiarism (Hirsjärvi, Remes & Sajavaara 2004, 25, as cited in, Igendia M. 2012). This thesis is public to be used by the other students to read through. Sharing ideas, data, results and resources etc. means openness and as mentioned before, it is one of the important factors of ethicality in research.

During the research process and writing the thesis, one of the other concerns of the authors was gathering the data from reliable sources. While trying to put down the knowledge on the paper and transform it to written form the author has been critical to make sure that instructions are clear. The work has been critically examined to make sure the work has been done carefully. In the process avoiding carelessness and plagiarism has constantly been taken into consideration; even though sometimes it is not easy to avoid carelessness. Author's own experience and background in this field of exercise has made the information provided more reliable. Almost 8 years of practicing flexibility exercises as a part of his gymnastics training and yoga combined with the knowledge achieved about the anatomy and biomechanics of human body in KAMK brought a wide range of understanding on the topic.

"Identifying customer needs is an integral part of the concept development phase of the product development process. The resulting customer needs are used to guide the team in establishing product specifications, generating product concepts and selecting a product concept for further development." (Ulrich & Eppinger 2003, 68.) It was very important for

the author to identify the need of clients to ensure a good quality of the product. The author stayed in contact with the working life supervisor throughout the process, and they had meetings where they were able to present the ideas. Working life's opinion was taken into consideration when agreeing on the topic and the content of the product.

Literatures concerning the theory about the topic were not easy to find. However, with help of teachers and experts, finally the sufficient and reliable information gathered. The content of the guidebook and movements explained in there has been chosen from the scientific sources. As mentioned before the instruction portion of guidebook gathered from gymnastics instructors and professional gymnasts. Mr. Joseph Kamyab whom is a former Kurdish national gymnastic coach from Iran and currently is the manager and head coach of 'Gymnastic Time' sports club in Dubai, United Arab Emirates. Data gathered from these coaches has been from qualified instructors who are currently teaching.

For every exercise there has been some research done to make sure the information provided is reliable. Before including an exercise in the guidebook, they have been instructed on couple of individuals and their feedback has been taken into considerations. In addition, an anatomy maquette has been observed for the some exercises to increase the understanding. On completion the guidebook it was sent to the instructors for feedback and approval before finalizing the thesis.

6.3 Professional development

Aim of the thesis process is not only to develop working life, but also to develop author's own knowhow. The process of writing thesis requires a huge amount of time sitting, reading and writing; it can be long and challenging. In many cases, especially when the thesis is done individually, finding enough courage and motivation to focus on the work is not easy. It is even more challenging if the topic is not of a great interest. Being able to write a thesis on a topic that author is fascinated about was a fortune. The commissioner organization was very supportive and that was motivating the author to concentrate on the work and try his best during the research process.

The author gained deeper knowledge on topic and understood the importance of flexibility and stretching exercises. During the process the author's professionalism in a field of sports,

especially about the topic of the thesis developed. He became more confident and deepened his expertise in pedagogy and didactics in that field. The process of theoretical background collection has significantly expanded the professional vocabulary. The text needed to be studied and corrected many times to be readable and easy to understand even to those readers who are not familiar with the research field. Overall the process developed the author's ability to conduct research on a subject and to develop a product according to the research.

Apart from learning more about the topic itself, the whole process was a great tool to learn more about time management. During the process it has been tried to follow the schedule that he made. Even though there was a delay in finishing the work according to schedule and deadlines has been made; still, he learnt how much self-discipline is required when working individually and how to deal with this issue. Self-control was another great thing this process thought the author. Writing the thesis was a great practice of self-control. It taught how to push himself to focus on the work and not finding excuses to scape from it. Critical thinking was another ability, which has been improved during the process by considering the relevant and reliable information for the thesis.

Finally, the last great thing was learning another great software. Adobe InDesign will be very useful in the future for writing more articles or even books. Applicable skills on working with the software have been gained; it is a great basis for mastering the skills on how to use it. Hopefully the ending of this thesis will be a great beginning of a longer journey toward success and development.

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LIST OF APPENDICES

LIST OF APPENDICES

This is appendix 1.

1. Cover Page title: Stretches Guidebook A stretching exercise photo (Photographer: Kseniia Alekseeva – Photo models: Heidi Niemi & Diyako) Diyako Sheikh Mohammadi Myötätuuli - KUAS Size: 21x21 cm Colorfull planned to be ready by February 2015 logo of KAMK/Myötätuuli	2.Blank page Pages sizes:14x21 Myötätuuli Layout (green color theme)
3. Title page complete title: Stretches Guide-book and subtitle: A guide for stretching different muscles for different age groups author' name; copy right: Myötätuuli - Kajaani University / Finland	4. Contents page: 1. NTRODUCTION 2. PART 1 - THEORETICAL BACKGROUND 3. Previous Studies 4. Warm-up and effect of temperature in muscles 5. Flexibility 6. Proprioceptors and Stretching 7. Stretches Techniques 8. Aging affects in musculature, and stretching for older adults 9. PART 2 - STRETCHING EXERCiSE FOR DIFFERENT MUSCLE GROUPS 10. PART 3 - PARTNER STRETCHES REFERENCES
5. Introduction	7. THEORETICAL BACKGROUND - Theoretical background - Types of stretches

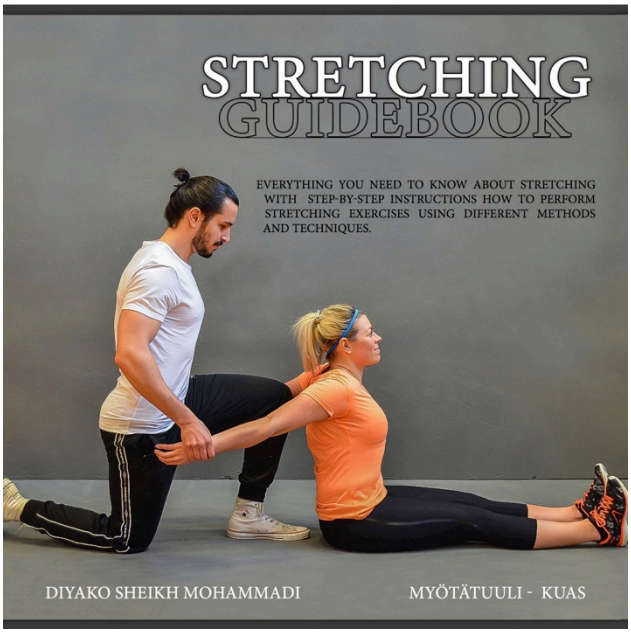
	Subtitle 1. Neck • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)
Subtitle 2. Shoulders (deltoids) • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)	Subtitle 3. 3. Chest (pectoralis) • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)
Subtitle 4. Abs (rectus abdominis) • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)	Subtitle 5. Biceps (Biceps Brachii) • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)

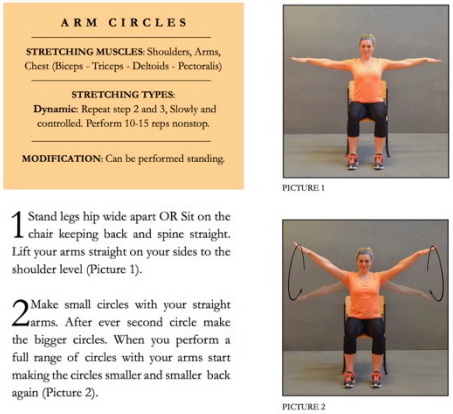
Subtitle 6. Triceps (Triceps Brachii) • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)	Subtitle 7. ForeArm (branchioradialis) • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)
Subtitle 8. Trapezious • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)	Subtitle 9. Laterals (Latissimus Dorsi) • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)
Subtitle 10. Middle and Lower Back • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)	Subtitle 11. Glutes (Gluteus Maximus) • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)

Subtitle 12. Quads (quadriceps) • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)	Subtitle 13. Hamstrings (Biceps Femuris) • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)
Subtitle 14. Calves (Gastronemius) • **Intro**duction of the movement: Suitability for age groups – Stretching type (dynamic, static etc.) – Tips • Instructions of how to perform the movement • Photo by: Peyman • Modification for elderlies (If needed) Safety tips (If needed)	Blank
8. Partner Stretches Providing a series of partner stretches for whole body	Blank

	10. Sources / References

Guidebook layout and cover





ARM CIRCLES

STRETCHING MUSCLES: Shoulders, Arms, Chest (Biceps - Triceps - Deltoids - Pectoralis)

STRETCHING TYPES:
Dynamic: Repeat step 2 and 3, Slowly and controlled. Perform 10-15 reps nonstop.

MODIFICATION: Can be performed standing.

PICTURE 1

1 Stand legs hip wide apart OR Sit on the chair keeping back and spine straight. Lift your arms straight on your sides to the shoulder level (Picture 1).

PICTURE 2

2 Make small circles with your straight arms. After ever second circle make the bigger circles. When you perform a full range of circles with your arms start making the circles smaller and smaller back again (Picture 2).

3 change the direction and do the same things in the opposite direction.

28 STRETCHING EXERCISES