Intervention study measuring thickness of the Transversus abdominis muscle in young adults with sub-acute low back pain by Ultrasound Imaging

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Virpi Helanen
Ann-Mari Nordman

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Helanen, Virpi & Nordman, Ann-Mari

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TIIVISTELMÄ

Tämä opinnäytetyö käsittelee sub- akuutin alaselkäkivun fysioterapiaa spsesifien lannerankaa stabiloivien harjoitusten avulla. Transversus abdominis (TrA)-lihaksessa, eli syvässä poikittaisessa vatsalihaksessa tapahtuneita muutoksia kuvattiin ultraäänikuvannuksen avulla. Kipumittarina toimi Visual Analogue Scale (VAS).

Opinnäytetyön tarkoitus oli tutkia spesifien lannerangan alueen harjoitusten vaikutusta kipuun. Harjoitukset suoritettiin kahdeksan viikon intervention aikana, joka sisälsi TrA:n paksuusmittaukset ennen ja jälkeen intervention ultraäänikuvannuksen avulla.

Tutkimuksessa oli mukana 13 osallistujaa. Tutkittavat olivat Lahden ammattikorkeakoulun opiskelijoita. Ennen osallistumistaan tutkimukseen, tutkittavat täyttivät esitietolomakkeen jolla varmistettiin, ettei osallistumiselle ollut lääketieteellistä estettä.

Harjoittelun ja intervention jälkeen TrA:n paksuudessa ei ollut mitattavissa huomattavia muutoksia. Suurimmalla osalla tutkittavista alaselkäkipu väheni. Harjoittelufrekvenssi vaihteli tutkittavien kesken ja joillakin oli olosuhteista johtuen vaikeuksia harjoitusten tekemisessä, millä vaikutti olleen negatiivinen vaikutus kipuun.

Tulokset osoittivat, että spesifeillä lannerangan harjoitteilla ja lateraalihengityksellä on vaikuttavuutta alaselkäkivun hoidossa.

Avainsanat:
Key words: ultrasound imaging, transversus abdominis muscle, low back pain, muscle recruitment, muscle thickness, lumbar area exercises

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ABSTRACT

This thesis concentrated in physiotherapy of sub-acute low back pain (LBP) with specific trunk stabilizing exercises. Ultrasound imaging (USI) was used to measure changes in Transversus abdominis (TrA) muscle. Pain was measured with Visual Analogue Scale (VAS).

Purpose of this thesis was to examine effects of specific lumbar area exercises on pain. The exercises were carried out within an 8-week intervention period which included measurements of the Transversus abdominis muscle with USI before and after the intervention.

Thirteen subjects commenced to the study. Subjects were students at Lahti University of Applied Sciences. Before commencing to the study, subjects filled in an initial questionnaire in order to ensure there was no medical impediment for participation.

No significant changes in TrA thickness were measured. Most of the subjects received relief to LBP. Training frequency varied amongst the subjects and some experienced difficulties in conducting the exercises due to conditions. This seemed to have a negative effect on pain.

Results indicated that specific lumbar area exercises with pilates-based approach combined with lateral breathing technique have efficacy in management of LBP.

Key words: ultrasound imaging, transversus abdominis muscle, low back pain, muscle recruitment, muscle thickness, lumbar area exercises

CONTENTS

1 INTRODUCTION

Low back pain (LBP) is a growing global problem. According to a WHO report from 2003, 80% of the world's population will experience LBP at some point in their lives. (WHO 2003, 11.)

In Finland, 75 - 80 % of 30 – 64 year olds suffer from back pain at some time in their life. When the study was made 30 % of men and 36 % of women reported to have suffered from back pain within the last month. Around 90 % of people with LBP will recover asymptomatic within three months, but every second back pain episode will recur. In around 10 % of the cases, back pain will be prolonged. (Riihimäki, Heliövaara, Heistaro, Impivaara, Jokiniemi, Luoto, Manninen, Mäkelä, Taimela, Takala, & Viikari-Juntura 2002.)

In the year 2005 over 2.3 million sick leave days were covered, which is 14, 3 % of all sick leave days covered by the state (Pohjolainen, Seitsalo, Sund & Kautiainen 2006, 2112). Studies have shown the efficacy of specific trunk stabilizing exercises on the lumbar area. The interventions decrease pain and lower the level of functional disability. (Rydeard, Leger, & Smith 2006; Urquhart, Hodges, Allen & Story 2005.)

The purpose of this study was to examine the effects of specific trunk stabilizing exercises on low back pain within an 8 week intervention period. This study also concentrates on measuring thickness of the Transversus abdominis (TrA) muscle before and after the intervention. The measurements are conducted with an ultrasound imaging (USI) device.

2 ANATOMY OF THE BACK

The spinal column can be anatomically divided into five different areas (Koistinen 2005, 39).The cervical column is formed of seven cervical vertebras, the thoracic column of twelve and the lumbar column of five vertebras. Intervertebral discs are located in between the vertebras. (Palastanga, Field & Soames 2006, 475.)

The conjoined sacral and coccyx vertebras are a part of the spinal column. There are five vertebras in the sacral column and four in the coccyx column. (Palastanga et al. 2006, 475.) The vertebras and the intervertebral discs form the columns anterior-posterior curves, lumbar lordosis, thoracic column kyfosis, and cervical column kyfosis. Shapes of the curves are partly caused by wedge-shaped intervertebral discs and partly by wedge-shaped vertebras. (Koistinen 2005, 39.)

The vertebral column has dynamic demands caused by the upright posture and independent functioning of the upper limbs. The adaptation has been relatively successful as the vertebral column has become a complicate and delicate system. Incidence of low back pain indicates the transition to human upright posture has not been entirely successful. (Palastanga et al. 2006, 475.)

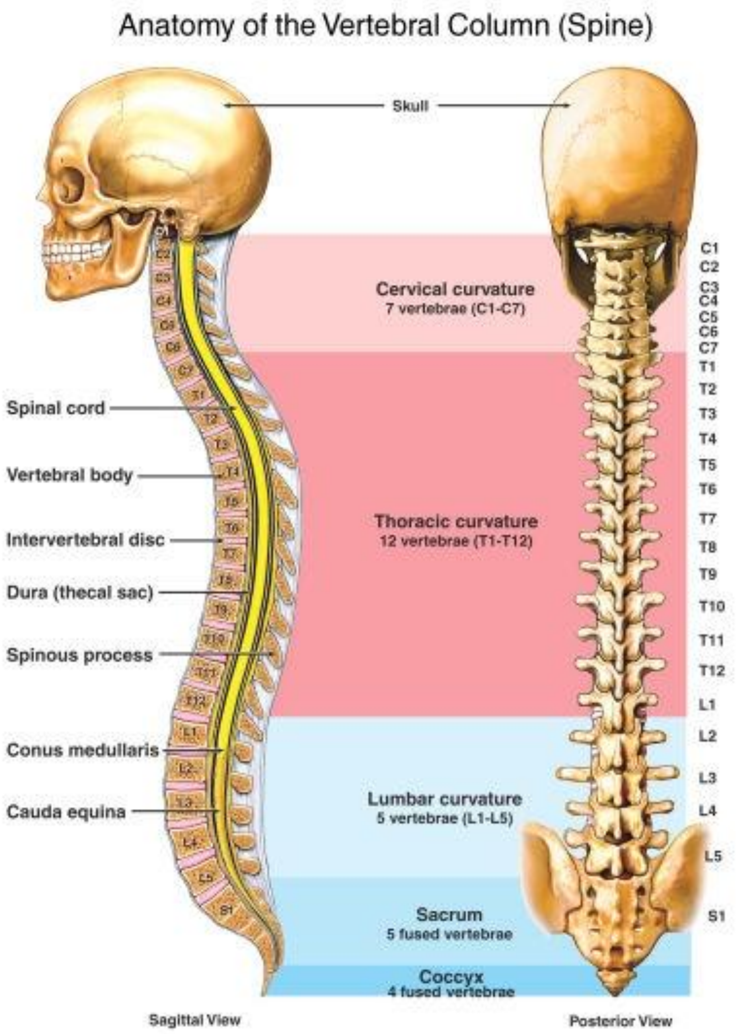


FIGURE 1. Anatomy of the vertebral column (EBSCO 2010)

2.1 Lumbar muscles

In order to understand the function of the lumbar area muscles, they should be divided into local and global muscles. Bergmark was the first to make this division in 1989. (Bergmark 1989). Current studies are still based on his theory, e.g. Crichtley, Pierson & Battersby 2011.

Muscles in the low back area are linked together through the different parts of the thoracolumbar fascia. These muscles are quadratus lumborum, transversus abdominis, external oblique, internal oblique and rectus abdominis. Through the thoracolumbar fascia, the muscles of the low back work together. (Koistinen 2005, 210.) Superficial latissimus dorsi muscle has a close and important functional connection with the thoracolumbar fascia as a global stabilizer (Koistinen 2005, 216). Deep erector muscles form the erector spinae muscle mass which runs the length of the vertebral column (Palastanga et al. 2006, 497). Multifidus is considered as the most important segmental stabilizer of the vertebral column (Koistinen 2005, 217).

2.2 Local and global stabilizers

The local muscles are the lumbar part of the multifidus, transversus abdominis and the posterior fibers of internal oblique. They attach to the vertebras and control inter-segmental movements and the stiffness of the spine. (O´Sullivan, Phyty, Twomey & Allison 1997, 2964; Hodges 2005, 17.)

The global muscles are formed of the big superficial muscles of the body including rectus abdominis, external oblique and parts of the erector spinae which cross many segments without attaching to the vertebras (O´Sullivan et al. 1997, 2967).

TABLE 1. Local-global muscle classification. (Adapted from Niemi 2005.)

Muscle classification	
Deep local stabilizers	Superficial global stabilizers
• Transversus abdominis • Multifidus • Pelvic floor muscles • Diaphragm • Posterior part of Psoas	• Internal and external Obliqi • Anterior part of Psoas • Oblique part of Qudratus lumborum • Superficial part of multifidus • Pelvic floor muscles • Gluteus medius

2.2.1 Lumbar vertebrae

There are five different vertebrae in the lumbar vertebral column (Bogduk 2005, 1). The lumbar vertebrae are stouter and stronger than the vertebrae in the cervical or thoracic regions. The lumbar vertebrae have no foramina transversaria or articular facets for the ribs. They have a large body which contains almost parallel upper and lower surfaces. L5 is an exception by being deeper anteriorly than posteriorly. The pedicles are short and strong and pass almost directly backwards. The pedicles join the narrow laminae passing backwards and medially towards the spine. Adjacent laminae have wide spaces between them shaped like a diamond, which contain the ligament flava. (Palastanga et al. 2006, 480.)

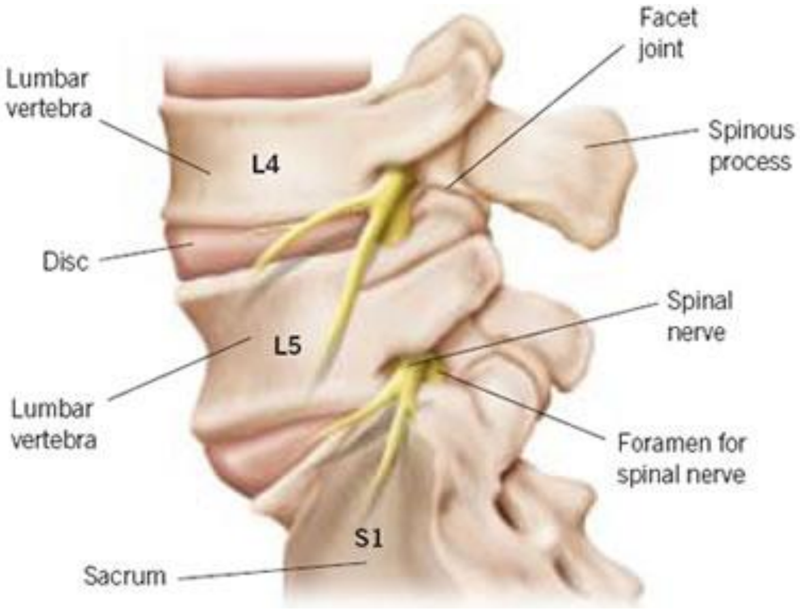


FIGURE 2. Lumbar vertebrae (Precision surgery 2007)

The spinosus processes of the lumbar vertebrae run backwards almost horizontally, which makes them level with the lower part of the body. They narrow down from above downwards and have a thickened posterior edge. Again the L5 is an exception by being frequently rounded.

The articular processes run downwards and upwards from the region where the pedicle joins the lamina. As Palastanga et al. state: “The articular facets on the superior process are concave transversely and flat vertically, facing poster medially". The mamillary process is on the posterior edge of the superior articular process. The inferior articular processes lie closer together and possess facets curved reciprocally to face anterolaterally. The vertebral canal is smaller than in the cervical region, but larger than in the thoracic region.

The transverse processes are short and thin in the lumbar vertebrae again the L5 being an exception. They project laterally and slightly backwards from the base of the pedicles and sides of the vertebral body. Transverse processes of the L5 are stout and short. The may be joined together with the lateral part of the sacrum. (Palastanga 2006, 480.)

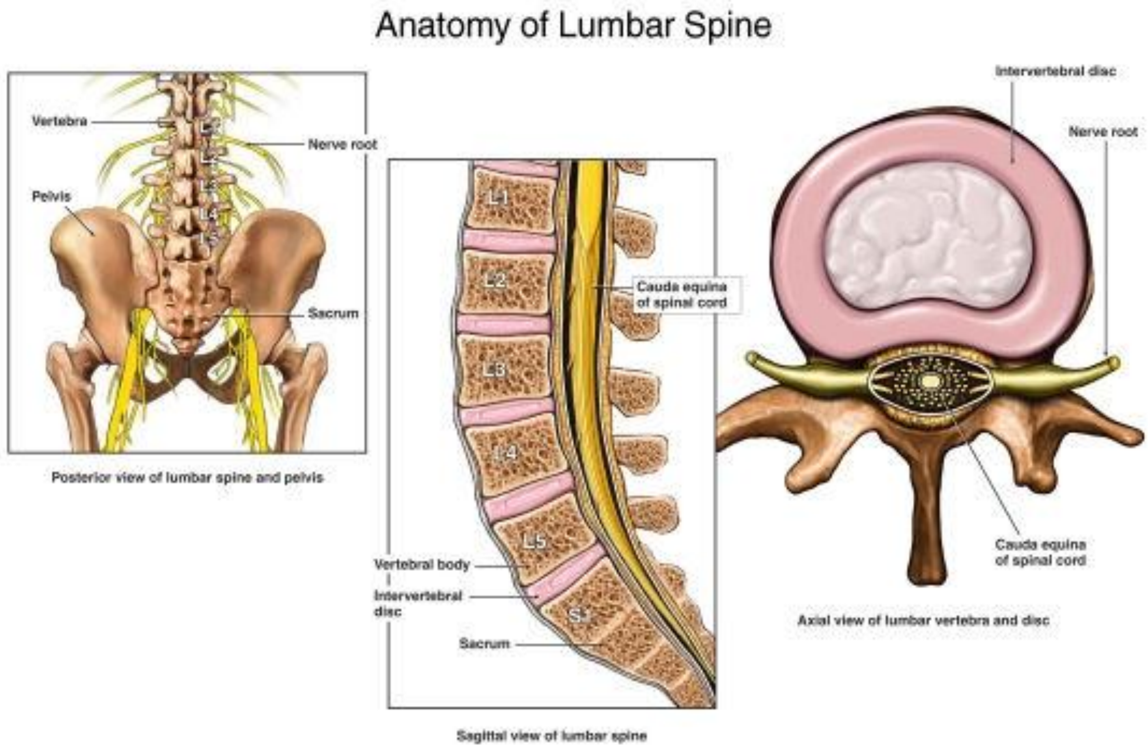


FIGURE 3. Anatomy of the lumbar spine (EBSCO 2010)

2.3 Transversus abdominis muscle

Transversus abdominis is the deepest of three sheets of abdominal muscles. The muscle fibers are arranged transversely (horizontally). Transversus abdominis arises from the lateral third of the inguinal ligament and the anterior two-thirds of the inner lip of the iliac crest inferiorly, the thoracolumbar fascia posteriorly, and the inner surface of the costal cartilages of the lower six ribs superiorly. Here it interdigitates with the attachment of the diaphragm. (Palastanga et al. 2006, 502.) Insertion of the transversus abdominis muscle is in the linea alba by means of a broad Apo neurosis, pubic crest, and pectin pubis (Kendall, McCreary, Provance, Rodgers Mclntyre & Romani 2005, 197).

Transversus abdominis muscle acts like a girdle to flatten the abdominal wall and compress the abdominal viscera; upper portion helps to decrease the infrasternal angle of the ribs, as in expiration. This muscle has no action in lateral trunk flexion, except that it acts to compress the viscera and to stabilize the linea alba, permitting better action by the anterolateral trunk muscles. The nerves associated with the transversus abdominis are T7-12, L1 ilihypogastric and ilioinguinal, ventral divisions (Kendall et al. 2005, 197).

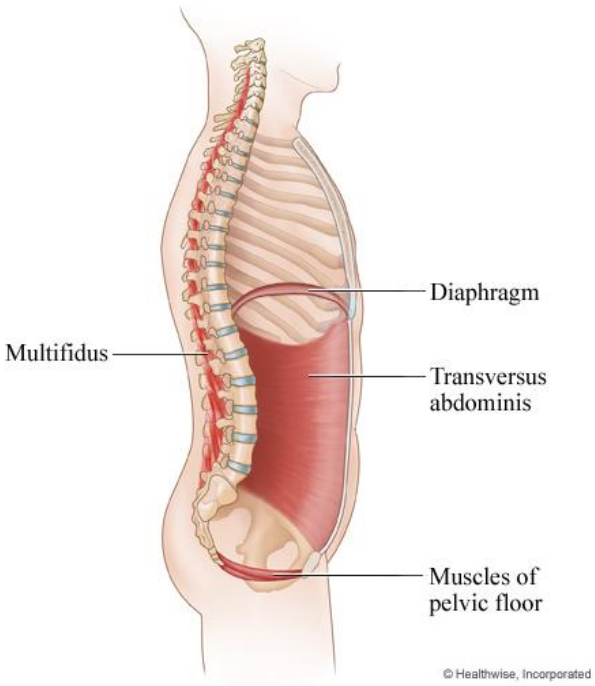


FIGURE 4. The inner core muscles (Healthwise, Incorporated 2009)

3 PAIN

Pain is the most common reason for people to seek aid from the doctor or a physical therapist. It is important to define the difference between the concept of pain and rigidity and stiffness. Constraint in functional ability, stiffness and rigidity are usually associated with the feeling of discomfort and tension rather than severe pain. (Kouri 2005, 67.)

Acute pain is to be considered as an important factor warning us of forthcoming tissue damage. Pain itself tells us of irritation in structures which sense pain or of activation of the pain pathways. (Kouri 2005, 67.)

3.1 Idiopathic pain

Pain can have a psychological origin and thus be called idiopathic pain, pain without tissue damage (Kouri 2005, 67).
A somatic origin of pain can not be defined instead the pain can be related to severe depression or delusional disorder and be defined as psychogenic pain (Vainio 2009, 157).

3.2 Nociceptive pain

If the nervous system sensing pain is intact, pain is caused by irritation of the pain nerve ends called nociceptors. Typical examples of nociceptive pain are infections, ischemia and tumors. Some of the pain nerve ends react only on mechanical stimuli such as pressure. Polymodal nociceptors react also on light and heat alongside with the biochemical changes in the tissue. When tissue oxygenation deteriorates, lactic acid and carbon dioxide accumulates in the tissue causing the pH to decrease which activates the nociceptors. (Vainio 2009, 155.)

3.3 Neuropathic pain

In case of damage in the nervous system sensing pain, neuropathic pain is occurring. This is the case often in chronic severe pain (Kouri 2005, 67). Nerve cells are sensitized to react on stimuli which usually do not cause pain. The damage can be peripheral, central or a combination of these. Neuropathic pain can change in nature as it affects the central nervous system. The pain is not always sensed in the area of damage, but throughout the whole area which the damaged nerve affects. (Vainio 2009, 156.)

4 LOW BACK PAIN

Acute LBP occurs suddenly after a period of minimum of six months without LBP and lasts for under six weeks. Sub-acute LBP occurs suddenly after a period of minimum of six months without LBP and lasts for between six weeks and three months. Chronic LBP has duration of over three months, or occurs episodically within a six-month period. (Krismer & Tulder 2007, 2.)

Respiration is associated with LBP. Disorders in respiration and continence have a relation to higher prevalence of back pain (Smith, Russel, Hodges 2006, 15). Breathing is a delicate automatic function, which can be affected intentionally. Pain, mood, tension, anxiety and many other factors affect breathing technique. Over-breathing, increased frequency, gasping of oxygen and over-costal breathing in the middle section of the body caused by muscle tension can lead to respiratory alkalosis. Already a 60 second over-breathing causes a lack in the postural or phasic action of the diaphragm and transversus abdominis. This can even cause the activation to stop completely. (Hodges 2001, 1005.)

Back pain and LBP is sensed through the nervous system. Pain can be originated from many structures of the spine through the nosiceptors which can be found in the superficial parts of the discs, joint capsules, muscles, arteries, and structures conjoined with the nerves (Koistinen 2005, 41.)

4.1 Definition of low back pain

According to the International Association for the study of Pain (IASP) as defined by Bogduk 2005, low back pain in lumbar spinal pain can be defined as pain arising from the region “bounded laterally by the lateral borders of the erector spinae, superiorly by an imaginary transverse line through the T12 spinosus process, and inferiorly by a line through the S1 spinosus process or in sacral spinal pain as pain “perceived within a region overlying the sacrum, bounded laterally by imaginary vertical lines through the posterior superior and posterior inferior iliac spines, superiorly by a transverse line through the S1 spinosus process, and inferiorly by transverse line through the posterior sacrococcygial joints. The topographical definition of spinal pain can be found from the taxonomy published by the IASP. (Bogduk 2005, 185.)

LBP can be defined as pain arising from either which of the areas mentioned before or a combination of them both. Radiation of pain is another matter, cardinal feature is the source of pain arising from these areas. The definition does not imply the source of pain being in those areas, but it simply indicates where the patient says the feeling of pain is (Bogduk 2005, 184).

4.2 Specific and non-specific low back pain

Red flags are usually associated with specific LBP. Yellow flags are considered as prognosis of a chronic course of the disease (Krismer 2007, 2).
Mechanical cause of LBP has not yet been identified. Controversial results are described in literature despite the different testing procedures and designs. Two major theories suggest LBP is caused by lumbar lordosis (McKenzie 1981).

LBP in most cases is non-specific, but in some cases (5-10%) a specific cause can be identified. Non-specific LBP can be defined as pain that has no underlying pathology. Because non-specific LBP has a high prevalence, the normal population (the whole population of all ages) is the population at risk. Almost everyone has episodes of low back pain at some point of their lives (Krismer 2007, 2.)

4.3 VAS-pain scale

VAS-pain scale, Visual Analogue Scale is the most commonly used method to measure pain. The original scale is 10 centimeters long and runs from 0-10, 0 referring to no pain and 10 to the most awful pain imaginable. Different versions of the scale which increase the application possibilities in clinical work have been developed. The amount and intensity of pain can be tracked throughout the rehabilitation process to determine clinical response to treatment. (Kalso, Kontinen 2009, 55.)

Pain rating scales, such as VAS are important tools in assessing the patients' symptoms such as pain. According to Olagun, Adedoyin, Ikem & Anifaloba VAS can be used in intervention studies to determine a reference base in the beginning and assess the clinical outcome. According to their study VAS has been determined to be reliable. (Olagun et al. 2004, 141.)

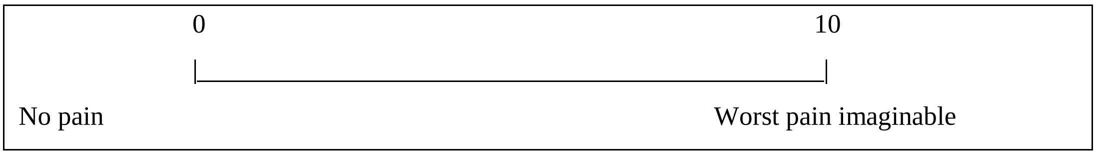


FIGURE 5. VAS- pain scale

4.4 Function of the local and global stabilizer muscles of the lumbar area in low back pain

The deep muscles of the lumbar area, known as the local stabilizers function abnormally in LBP. The local stabilizers should recruit prior to movement, but in LBP the onset is delayed. Pain or dysfunction in the muscles may result to inhibition of correct function in the muscles. Muscle tone decreases which can lead to atrophy and poor segmental control. Poor control in the neutral position of the joint is common in LBP. (Comerford, M. & Mottram, S., 2001, 22.)

The superficial muscles of the lumbar area known as the global stabilizers may be hyperactive which leads to poor control of excessive range. Loss of inner range control and low threshold tonic recruitment may occur. Deficits in eccentric control and rotation dissociation are common. (Comerford, M. & Mottram, S., 2001, 22.)

TABLE 2. Function of the local and global stabilizer muscles of the lumbar area in low back pain (Adapted from Comerford & Mottram 2001).

Function of the local and global stabilizer muscles of the lumbar area in low back pain	
Local stabilizers	**Global stabilizers**
- Delayed onset - Pain or dysfunction → inhibition - Muscle tone decreases, atrophy - Poor control in neutral joint position	- Hyperactivity - Excessive muscle tension - Poor stamina, eccentric control

Hodges, et al. 1996 suggests that the delayed onset of Transversus abdominis muscle activity plays a possible role in low back dysfunction in the patient with LBP (Hodges, Richardson 1996, 2640).

4.5 Psychological effects of low back pain

Psychological factors are associated with development of chronic LBP.
The Fear-Avoidance Model (FAM) of musculoskeletal pain is a model which explains the development and maintenance of chronic LBP. The FAM proposes that fear related to pain and pain catastrophizing are the main cognitive factors influencing perception of pain. Fear of pain includes the fear of re-injury and fear of movement. Upon these factors it is possible to determine the individual’s initial behavioral response to pain. The responses can range from avoidance (maladap-

tive) to confrontation (adaptive). It is hypothesized that long-term avoidance behavior leads to psychological, physical and societal consequences. (George, Zeppieri, Cere, Cere, Borut, Michael, Hodges, Dalton, Reed, Carolina & Robinson 2008, 145.)

5 EFFECT OF MUSCULOSKELETAL TRAINING

A dynamic, core stabilization training program is an important component of all comprehensive functional rehabilitation programs. A core stabilization program will improve dynamic postural control, ensure appropriate muscular balance and affect joint arthrokinematics around the lumbo-pelvic-hip complex. (Voight, Hoogenboom & Prentice 2007, 333.)

Training voluntary contractions of the TrA have been proven to be efficient in management of LBP. Training has been shown to result in improvement of motor control which affects LBP decreasingly (Tsao, Hodges 2006, 565).

Exercise therapy is the most commonly used method in rehabilitation of LBP. The results have shown the best effect of musculoskeletal training is acquired in the management of chronic LBP. (van Middelkoop, Rubinstein, Verhagen, Ostelo, Koes, Tulder 2010, 193.)

In recent years studies of pilates-based exercises in the management of LBP have emerged. Studies have shown promising results. In their study Rydeard et al. compared efficacy of usual care and pilates-based approach and concluded the pilates-based approach to be more efficacious. The study showed a significant decrease in LBP and disability over a 12- month follow-up period. (Rydeard, Leger & Smith 2006, 479-480.)

6 ULTRASOUND IMAGING

USI has been used in the medical field since the 1950s. From the 1980s the usage of USI has been developing rapidly in musculoskeletal rehabilitation. Now usage of USI is rapidly growing amongst physical therapists. The method and technology has been found safe, relatively inexpensive, portable and objective which has lead to the development of USI applications. (Whittaker, Teyhen, Elliott, Cook, Langevin, Dahl, & Stokes 2007, 434.)

USI also serves as a biofeedback tool and clinicians are increasingly using real time ultrasound imaging as a form of feedback (Henry, Westervelt, 2005, 338). As biofeedback USI might also facilitate the learning process of correct muscle recruitment in people with LBP (Whittaker, Teyhen, Elliott, Cook, Langevin, Dahl, & Stokes 2007, 435).

Currently USI can be divided into two distinct areas of musculoskeletal imaging. These are rehabilitative USI called RUSI and diagnostic imaging. RUSI is, according to the agreement made in the first international meeting on RUSI in San Antonio, Texas, USA in 2006; "a procedure used by physical therapists to evaluate muscle and related soft tissue morphology and function during exercise and physical tasks. RUSI is used to assist in the application of therapeutic interventions aimed at improving neuromuscular function. This includes providing biofeedback to the patient and physical therapist to improve clinical outcomes. Additionally, RUSI is used in basic, applied, and clinical rehabilitative research to inform clinical practice." (Whittaker, Teyhen, Elliott, Cook, Langevin, Dahl, & Stokes 2007, 435.)

Diagnostic imaging includes, according to Whittaker et. al 2007; "measurement of morphological features (morphometry), such as muscle length, depth, diameter, cross-sectional area, volume, and pennation angles; changes in these features and the impact on associated structures (fascia and organs such as the bladder) with contraction; tissue movement and deformation (e.g., high-frame-rate USI and elastography); and qualitative evaluation of muscle tissue density. Alternatively, diagnostic USI involves examining the effects of injury or disease on ligament, tendon, and muscle tissues, which requires different skills and training than those needed for RUSI." (Whittaker, Teyhen, Elliott, Cook, Langevin, Dahl, & Stokes 2007, 435.)

This study used diagnostic imaging in measuring morphological features, muscle thickness and recruitment and rehabilitative USI in teaching subjects the correct recruitment of the TrA muscle. USI was used as a diagnostic tool as well as a form of biofeedback.

7 NORDPLUS-PROJECT

The thesis was a part of the Nordplus - an international project and thesis process. According to the Nordplus project website: "The Nordplus Framework Programme offers financial support to a variety of educational cooperation between partners in the area of lifelong learning from the eight participating countries in the Baltic and Nordic regions." (Risnes 2007). The main objective of the Nordplus development project -Joint Physiotherapy Education in Bachelor Theses Module- in year 2009-2011 is to build up joint education possibility inside Bachelor Theses modules of partner institutions.

The general aims of the programme are:

- To promote Nordic languages and culture and mutual Nordic-Baltic linguistic and cultural understanding
- To contribute to the development of quality and innovation in the educational systems for life-long learning in the participating countries by means of educational cooperation, development projects, exchanges and networking
- To support, develop, draw benefit from and spread innovative products and processes in education through systematic exchange of experiences and best practice
- To strengthen and develop Nordic educational cooperation and contribute to the establishment of a Nordic-Baltic educational area. (Risnes, K. 2007.)

7.1 International cooperation

The work was partly carried out in cooperation with Danish students from the University College Sjælland. USI was the combining factor of the two separate theses. The purpose for the co-operation group is to produce a common technical guideline of the USI procedure.

Imaging standard was produced a result of cooperation between the Finnish and the Danish students. The standard was produced according to the experiences of the students with suggestions from experts which had a strong experience in the field of physiotherapy and USI.

USI was used to authenticate muscle recruitment in the TrA. USI device was also used as biofeedback to teach participants isolated contraction of the TrA (Whittaker et al. 2007, 487).

The choice of the topic was made in Nordplus project by discussing with other Nordplus participants and teachers. After presenting own ideas and discussions the cooperation groups started to form. Danish group had an idea to study LBP by USI method.

The examiners shared a background in sports instruction and were familiar with pilates-based approach. The other examiner had a strong experience in instructing Pilates training method. Both of the examiners shared an interest in musculoskeletal disorders which lead to cooperation with the Danish group.

The research environment in Finland was the facilities of The Lahti University of Applied Sciences. The measurements with the USI device as well as the instructions to the exercises were conducted by the examiners at the facilities of Optiimi learning centre in the Lahti University of Applied Sciences. The USI device Sonosite M-Turbo was provided by the company Tosfin Oy in Vantaa.

8 PURPOSE OF THE STUDY

1. How does specific training of the lumbar area affect Transversus abdominis muscle thickness in young adults during an 8-week intervention period?

2. What are the effects of specific lumbar area training of an 8-week intervention period on low back pain in young adults?

9 SUBJECTS

The intervention group consisted of students from Lahti University of Applied Sciences aged 19 to 33. The subjects were contacted via a discussion board on the intranet page of the faculty of social and health care of Lahti University of Applied Sciences. Later the advertisement was introduced to all the faculties of Lahti University of Applied Sciences to get a wider range of subjects (APPENDIX 2). Subjects filled in a questionnaire concerning basic personal information, medical status, medication, pain and physical activity (APPENDIX 3). Prior to the study, subjects were obligated to sign a permission form (APPENDIX 8) and understand the importance of commitment to the study. The intervention group consisted of nine females and four males, altogether 13 subjects.

Basic information of the subjects such as age, gender, BMI and physical activity level can be seen in TABLE 3.

TABLE 3. Basic information of subjects

Number	Age	Gender	BMI	Phys.act.*
1	22	F	22	6
2	31	M	24	7
3	33	M	25	7
4	23	F	22	7
5	24	M	22	7
6	23	F	21	7
7	25	F	24	7
8	20	F	25	6
9	19	F	23	0
10	25	F	22	7
11	28	F	19	2
12	21	F	23	6
13	26	M	23	7
Average	24,62	M4/F9	22,66	5,85

*see APPENDIX 4

From 13 subjects the activity level was estimated high to six or seven and only two of the subjects the activity level was under three.

9.1 Inclusion and exclusion criteria

The subjects included in the study represented healthy male and female students of Lahti University of Applied Sciences with sub-acute LBP. Sub-acute in this case means that pain has not lasted continuously more than three months. The subjects had to be non-smoking and commit to the study.

The exclusion criteria included smoking, chronic LBP, diagnosed chronic back disorder, tumor, infection, fracture, osteoporosis, para paresis, Cauda equina syndrome, spinal rheumatoid or other infectious disease or neuromuscular disorders.

10 RESEARCH METHODS

The thesis is a quantitative research.

10.1 Research method

Quantitative method was chosen because it is based on the measurement and is characterized by the selection of subjects and the formation of the variables in table format. In addition, it is typical of the material to be treated statistically and to draw conclusions of it based on statistical analysis. (Hirsjärvi, Remes & Sajavaara 2007, 135-136.) In quantitative research measured object should be measured so that the result is the numerical content (Erätuuli, Leino & Yli-Luoma 1994, 35-37).

10.2 Course of study

The initial measurements with USI were conducted in November 2010. Before the commencement of the trial participants filled in an initial questionnaire form with VAS (Visual Analogue) pain scale to ensure that research participation had no medical impediment or other exclusion criteria's for participation. The measurements consisted of measuring the thickness of the TrA muscle in contraction and rest By Sonosite Turbo USI device. In addition to still pictures of TrA in resting and contracted state a video clip of 30 seconds was recorded of each subject's continuous resting-contraction maneuver. This was done at the initial measurements as well as at the final measurements after the intervention. The measurements took place in a peaceful non-stressful environment without distractions. After the initial measurements, the intervention period began with three weeks of instructed training with specific exercises. The specific therapeutic lumbar area exercises were chosen and planned by the examiners based on research information. After three weeks of instructed training the participants continued training unsupervised. Subjects kept an exercise log and wrote down weekly VAS estimate.

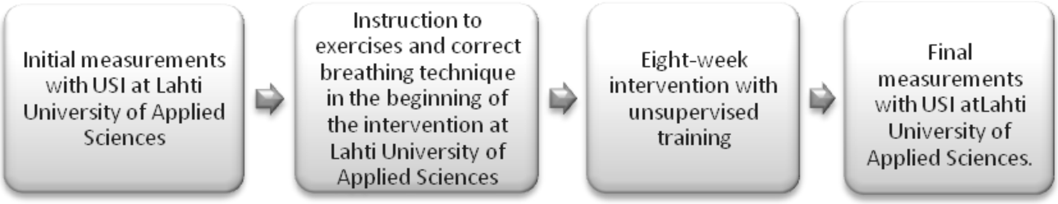


FIGURE 6. Course of study

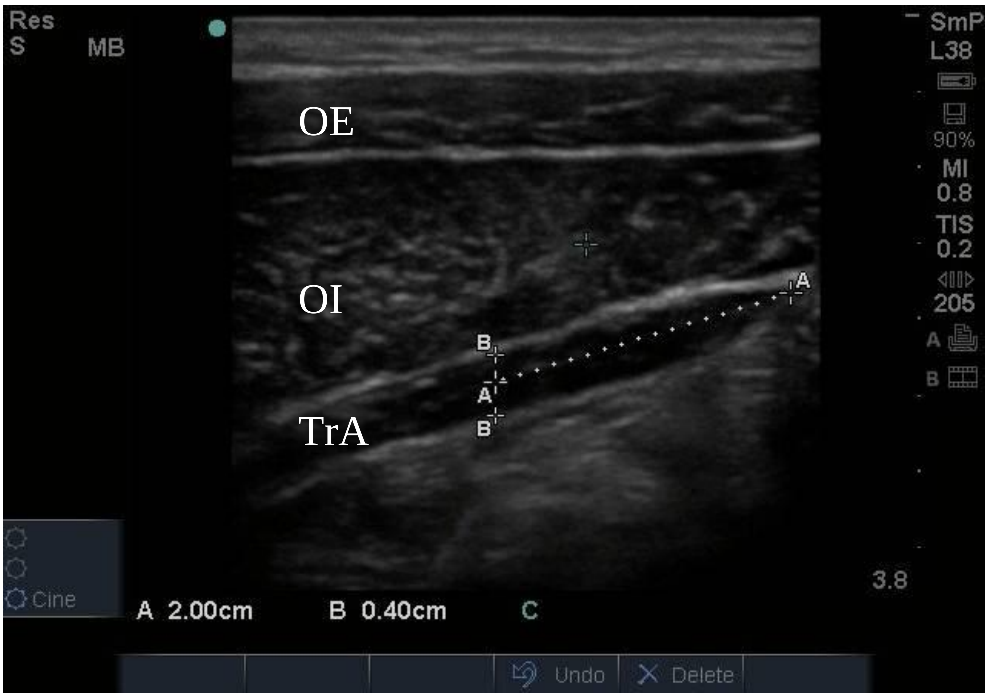


FIGURE 7. TrA, Obliquus Internus and Obliquus Externus in resting state

Measurements with the USI were conducted by the other examiner in order to standardize the procedure. USI device used in the measurements was a Sonosite model M-turbo. Measurements were conducted according to the imaging standard produced by the examiners in international co-operation (APPENDIX 1).

The initial measurement was taken of the TrA in resting state during expiration.

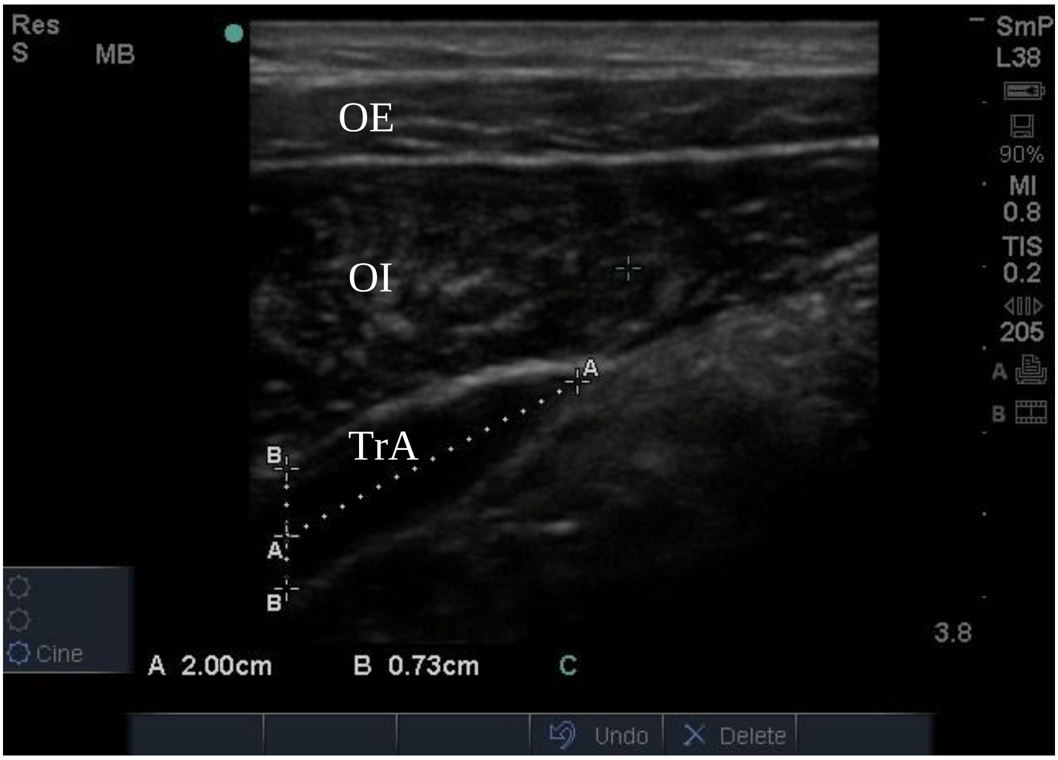


FIGURE 8. TrA, Obliquus Internus and Obliquus Externus recruitment

The subjects were instructed to perform the abdominal drawing- in maneuver. The Instructions translated to English were following: ‘Draw underbelly in and up slowly during expiration by maximum 20% intensity.’ After the first maneuver the subjects received more instructions. Subjects were allowed to do the maneuver three times. After the measurements subjects got biofeedback by USI in order to understand and learn the isolated recruitment of the TrA correctly.

A 30 second video clip was also recorded during the initial and final measurements of recruitment of TrA muscle. This was done the same way with every subject. The video clip helped the examiners in analyzing changes in isolated recruitment of the TrA muscle after the intervention.

10.3 Exercises

Specific lumbar area exercises were implemented in the 8-week intervention period. The exercises were chosen and planned by the examiners based on research information. The exercises were instructed in the first three weeks once a week after which the group carried out the exercises unsupervised. The subjects kept an exercise log (APPENDIX 6).

The subjects were guided in lateral breathing technique which is commonly used in Pilates training method. This was essential in order to carry out the exercises correctly and with correct inhale and exhale technique.

The training program begins with two pain-relieving exercises. These exercises are supine lumbar flexion and side-lying rotation. (Basmajian & Wolf 1990, 311, 316.) These exercises are clinically used to reduce pain. Deformation of the anterior annulus is usually reduced by the supine lumbar flexion exercise, and pain will be reduced or eliminated. Muscle spasm is reduced by stretching the involved muscles or by reducing the mechanical deformation of other non-muscular tissues. These exercises reduce pain by apparently decreasing the concentration of chemicals causing the inflammation. (Basmajian & Wolf 1990, 308.)

Exercises following the pain-relieving exercises focus on the core muscles and the abdominals which work as a functional unit to maintain optimal spinal kinematics (Voight, et al. 2007, 336). (APPENDIX 5).

Instruction to the exercises was offered to the subject’s maximum once a week and three times during first three weeks of the intervention. Subjects got instructions for lateral breathing technique, correct body position and training exercises with progress. Subjects got verbal, visual and manual instructions and exercises were given in writing by explaining the exercises written with images. Training program can be found from appendices. Exercises were recommended to perform pain free. Subjects were encourage and motivated also by e-mail during intervention period.

10.4 Physical activity

Level of physical activity was estimated in order to understand subjects' background for exercising. For this purpose, the questionnaire included a question 'how many times per week do you exercise until sweating and shortness of breath?' Response was then modified by examiners to a 0-7 physical activity scale. This scale is a commonly used scale to estimate level of physical activity. (APPENDIX 4.)

10.5 Body mass index

Body Mass Index (BMI) is a simple index of weight-for-height that is commonly used in measuring overweight, underweight and obesity in adults. It is calculated from the weight in kilograms divided by the square of height in meters. Normal range varies from 18.5 to 24.99. (World Health Organization 2011.)

10.6 Analyzing method

Analysis of basic information of subjects, VAS, thickness of the TrA muscle and physical activity were conducted with Microsoft Excel spreadsheet program. Differences in VAS and TrA muscle thickness were calculated from the initial measurements compared to the measurements after the 8-week intervention period. TrA muscle thickness was analyzed both in resting and contracted state in the initial stage and after the intervention. Percentage calculations of VAS at four weeks and 8 weeks and the occurrence of LBP were made. Tables and charts were created based on the data.

11 RESULTS

13 subjects were chosen for the study, four males and nine females (M=4, F=9). The average age was 24, 62 years. Body Mass Index (BMI) ranged from 19 to 25, average being 22, 66. Physical activity rates ranged from zero to seven and the average was 5, 85.

11.1 Measurement results

According to the final questionnaire (APPENDIX 7) the effects of specific lumbar area training were following; a better recruitment of the local muscles, a more economical breathing technique, a decrease of pain while performing personal training program, relaxation before going to sleep, a decrease in the sensations of stiffness and pressure in low back area, tools in preventing LBP, an increase in pain during the exercises, a decrease in the occurrence of LBP, a decrease in the usage of NSAIDs and better postural control.

From 13 subjects 8 subjects received relief to LBP. Calculation was made based on the difference between the initial and final questionnaires VAS pain scale estimates.

11.2 Transversus abdominis muscle thickness

TABLE 4. Transversus abdominis thickness in centimeters (cm)

No.	Initial resting	8 week resting	Resting differ-ence	Initial contrac-tion	8 week con-traction	Contrac-tion differ-ence
1	0,2	0,24	0,04	0,31	0,3	-0,01
2	0,42	0,47	0,05	0,46	0,55	0,09
3	0,46	0,58	0,12	0,49	0,7	0,21
4	0,3	0,35	0,05	0,36	0,34	-0,02
5	0,4	0,44	0,04	0,63	0,53	-0,1
6	0,2	0,21	0,01	0,35	0,33	-0,02
7	0,29	0,31	0,02	0,43	0,43	0
8	0,33	0,33	0	0,41	0,44	0,03
9	0,2	0,22	0,02	0,28	0,33	0,05
10	0,35	0,35	0	0,4	0,45	0,05
11	0,43	0,44	0,01	0,54	0,49	-0,05
12	0,23	0,3	0,07	0,25	0,37	0,12
13	0,36	0,36	0	0,66	0,62	-0,04
Average	0,32	0,35	0,03	0,43	0,45	0,02

TrA muscle size seemed to increase slightly, but the results show no significant increase in TrA muscle thickness.

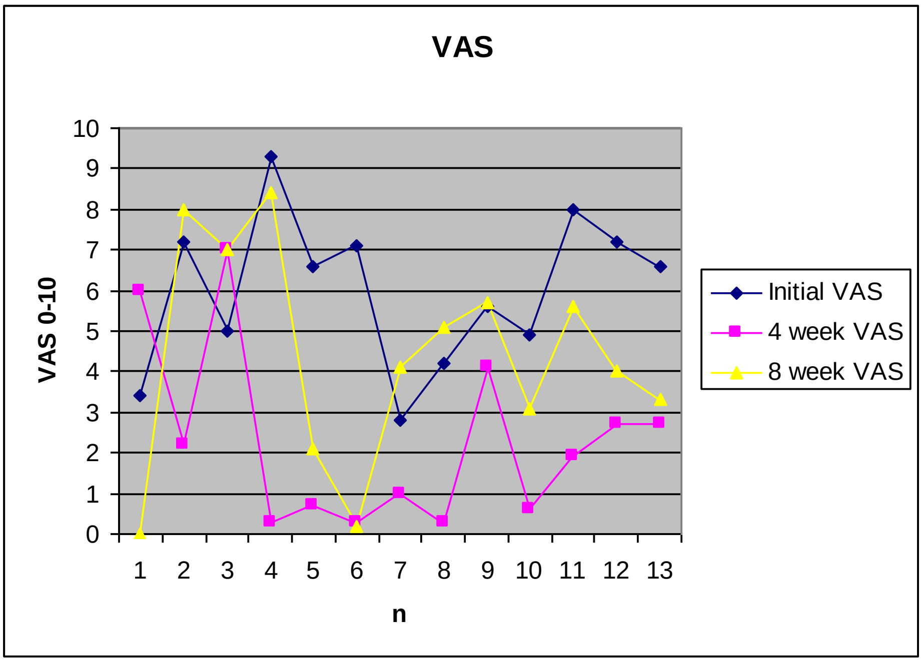
11.3 Pain

The table below shows development of pain of the subjects. After conducting the exercises for four weeks 85% of the subjects had a decrease in pain. At eight weeks 69% of these subjects had an increase in pain. However the pain was de-creased in 69% of all subjects compared to initial VAS.

TABLE 5. VAS measurements

Number	Initial VAS	4 week VAS	8 week-VAS	VAS diff.
1	3,4	6	0	-3,4
2	7,2	2,2	8	0,8
3	5	7	7	2
4	9,3	0,3	8,4	-0,9
5	6,6	0,7	2,1	-4,5
6	7,1	0,3	0,2	-6,9
7	2,8	1	4,1	1,3
8	4,2	0,3	5,1	0,9
9	5,6	4,1	5,7	0,1
10	4,9	0,6	3,1	-1,8
11	8	1,9	5,6	-2,4
12	7,2	2,7	4	-3,2
13	6,6	2,7	3,3	-3,3
Average	5,99	2,29	4,35	-1,64

TABLE 6. VAS measurements



12 CONCLUSIONS

There was no significant increase in TrA muscle thickness. Specific lumbar area exercises affected the local-global muscle recruitment ratio positively. Global muscle hyperactivity decreased in 85% of cases and local stabilizer correct onset prior movement increased.

The subjects gained positive outcomes as a result of training. The effects are listed above. It seems specific lumbar area training has versatile effects on disability caused by LBP if the exercises are conducted with lateral breathing technique.

Eight subjects out of 13 received relief to LBP. Inactivity in following the exercise program seemed to have a connection with a higher VAS measurement. Specific lumbar area and pilates-based exercises seem to have a pain decreasing effect in the management of LBP.

13 DISCUSSION

The results were surprising as the VAS measurement was at its' lowest at four weeks rather than eight weeks. Despite this fact most of the subjects received pain relief. Some of the subjects reported to have suffered from a cold which decreased training frequency. The intervention period was in the middle of the Christmas holiday season which lead to a decrease in exercise frequency. Training frequency was affected decreasingly by illness with three subjects and two reported inactivity in exercising during the Christmas holiday.

The main findings of this study suggest that specific lumbar area exercises have a pain decreasing effect on LBP if they are carried out as planned in the exercise program. Inactivity has a pain increasing effect, but pain decreases when exercises are commenced after an inactive period. Specific lumbar area exercises do not have a significant effect on TrA muscle thickness, but isolated recruitment of TrA improved. This result is consistent with the Crichtley et. al 2011 study.

13.1 Experiences of the subjects

The subjects told they had had difficulties in recognizing the correct recruitment of the TrA, but biofeedback provided by USI made the recognition easier. They felt they got beneficial tools for coping with LBP. Subjects reported a decrease in motivation during the Christmas holiday. Some got ill, which lead to inactivity in training.

13.2 Experiences of the examiners

USI proved to serve as an efficient biofeedback tool in teaching the subjects the correct recruitment of the TrA muscle. In order to use all the application possibilities of the method, one needs to be educated in the area. To reach reliability one also needs to develop a routine in the imaging procedure by practicing frequently and measuring different types of tissue and subjects. In this case the examiners had limited access to the device, which cut down the hours of practice. More practice hours would have benefited this study and increased its' reliability.

Timing of the intervention period turned out not to be convenient. The holiday season in the middle of the intervention affected the training frequency.

The imaging standard produced in the process can be used in the field of physiotherapy to exam lumbar area muscles.

13.3 Further research

USI is a relatively new method in the field of physiotherapy in Finland which makes it a possible research topic especially in Finland. USI proved to be an efficient biofeedback tool which makes it a beneficial method in physiotherapy. As a diagnostic tool it can be used in musculoskeletal diagnostics.

LBP is a growing global problem which makes further research in management of LBP through specific lumbar area exercises advised.

13.1 Our gratitude

We would like to thank Lahti University of Applied Sciences and Optiimi for providing us the facilities for our measurements. We would also like to thank Tosfin Oy for providing us the USI device which made this study possible. The Nordplus participants and staff deserve a big thank you for giving their guidance, tips and support. Especially we would like to thank our Danish fellow students and teacher for the co-operation. For giving us guidance and courage to carry out this process we would like to thank our supervising teacher at Lahti University of Applied Sciences.

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APPENDICES

APPENDIX 1

BA project in physiotherapy

Musculoskeletal Ultrasound Technical Guidelines

M. Transversus Abdominis

BA group *Ultrasound*

Ann-Mari Nordman, Finland
Virpi Helanen, Finland
Júlíus Björnsson, Iceland
Pernille Juul Andersen, Denmark
Kristoffer Phillip Gad, Denmark

1. Positioning

The patient is lying supine on a plinth with a pillow under the head. Arms are placed along side the body and with knees in flexed position approximately in a 80-90° angle.

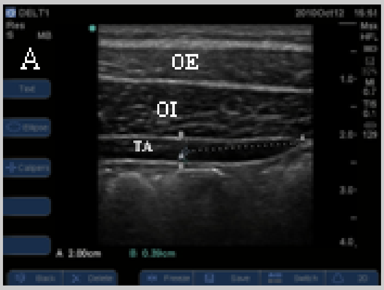
The examiner stands on either side of the patient facing the scanner, which is positioned next to the patients head. The examiner maneuvers the transducer with the right hand when standing on the right side and vice versa.

The transducer is placed on the same side of the patient as the examiner stands.
Use the umbilicus as a reference point and place the transducer right above in a vertical position.
Move the transducer towards yourself in a horizontal line until the musculotendinous junction of TA is visible on the screen. The transducer should be midway between the crista iliaca and the lowest part of the rib cage.

Ultrasound image (left) obtained from the transducer (picture above).
Ultasound image shows m. transversus abdominis (TA), m. obliquus internus (OI) and m. obliquus externus (OE) in a resting position.

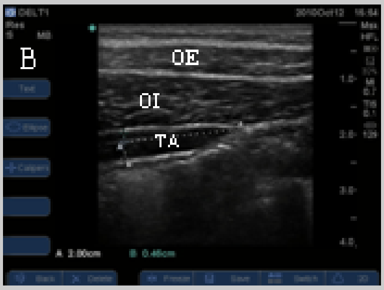
2. Measuring

Measuring thickness of the TA in a resting and contracted position.
After positioning the transducer, freeze the picture using the *freeze* button.
Press caliber and mark point A in the picture at the musculotendinous junction of TA. Then make another referencepoint A 2 cm from the junction in the muscle.



A) Ultrasound image shows TA, OI and OE in a resting position

B) Ultrasound images shows TA in a contracted position with the OI and OE in a resting position



Press caliber again and mark point B right above point A at the muscle fascia (grey area above and below the muscle). Move the cursor vertically through point A in the muscle and mark point B at the muscle fascia below. Now, on the bottom of the screen (picture A), the thickness of TA is displayed (B 0,39 cm).

After the first measurement you ask the patient to do *the abdominal drawing-in maneuver* without contraction of the OI and OE. Then press the freeze button again and repeat the instruction described above.
The thickness of TA (B 0,46 cm) is again displayed on the bottom of the screen (picture B).

APPENDIX 2

Hei sinä Lahden ammattikorkeakoulun sosiaali- ja terveydenhuoltoalan opiskelija!

Haemme sosiaali- ja terveysalan opiskelijoita opinnäytetyöhömme liittyvään tutkimukseen, jonka tarkoituksena on selvittää nuorten aikuisten harjoittelun vaikutusta alaselkäkipuun. Opinnäytetyömme on osa kansainvälistä Nordplus –projektia, jossa työskentelemme yhteistyössä kolmen tanskalaisen fysioterapiaopiskelijan kanssa. Opinnäytetyö toteutetaan työelämälähtöisesti Oppimiskeskus Optiimille.

Tutkimme laitoksemme opiskelijoita. Käytämme ultaäänikuvannusta tutkiessamme yleisesti alaselkäkipuun liittyvän syvän poikittaisen vatsalihaksen toimintaa. Suoritamme interventiotutkimuksessamme valituille henkilöille yksilöllisesti kaksi ultraäänikuvannusta, ensimmäisen juuri ennen harjoitteluajanjakson alkua ja toisen heti sen loputtua. Ultraäänikuvannus on täysin kivuton ja se suoritetaan allekirjoittaneiden toimesta koulumme tiloissa selin makuulla vatsan alue paljaana. Tutkimukseen kuluu aikaa puoli tuntia henkilöä kohden. Tutkimusmateriaali on vain tutkijoiden käytössä ja sen säilytys on lainmukainen. Tutkimukseen kuuluu säännöllinen harjoittelu, joka ohjataan koko valitulle ryhmälle koulumme tiloissa maanantaisin klo 12:00 viikoilla 47 - 49/2010. Harjoittelu tapahtuu viikkojen 47/2010 - 2/2011 aikana. Ohjatun harjoittelun lisäksi edellytämme osallistujia sitoutumaan kotiharjoitteluun kolme kertaa viikossa omalla ajallaan. Varsinainen harjoittelu vie aikaasi yhteensä noin tunnin viikossa. Pyydämme Sinua ottamaan meihin pikaisesti yhteyttä, mikäli seuraavat asiat toteutuvat kohdallasi:

- Olet 18-25 -vuotias sosiaali- ja terveysalan oppilaitoksen opiskelija
- Tupakoimaton
- Alaselkäkipuileva
- Kipu voi olla myös lievää ja ajoittaista tai kipusi ei ole yhtäjaksoisesti kestänyt 3kk pidempään
- Sinulla ei ole diagnosoitua kroonista selkäsairautta, kasvainta, infektiota, murtumaa, osteoporoosia, parapareesia, ratsupaikkaoireyhtymää, selkärankareumaa tai muuta tulehduksellista sairautta tai iskiasoireita (hermojuuren toimintahäiriöön viittaavia alaraajaoireita)
- Olet motivoitunut harjoittelemaan ja sitoutumaan tutkimukseen

Yhteydenotot: Ann-Mari Nordman nordann@lpt.fi tai Virpi Helanen helavirp@lpt.fi.

APPENDIX 3

ESITIETOLOMAKE OPINNÄYTETYÖHÖN

Täytä lomake huolellisesti ennen opinnäytetyömme alkututkimukseen tuloa. Tiedot ovat luottamuksellisia ja tulevat vain opinnäytetyön tekijöiden käyttöön.

HENKILÖTIEDOT		
Sukunimi Syntymäaika	Etunimet	
Kotiosoite		
Puhelinnumero	Sähköpostiosoite	Koulutusohjelma

TERVEYDENTILA		
Oma arvio terveydentilastasi *Hyvä / Kohtalainen / Huono*	Paino kg	Pituus cm
Kuinka monta päivää olet ollut työstä/opinnoista poissa sairauden vuoksi viimeisen vuoden aikana?		
Onko sinulla nyt tai aikaisemmin ollut seuraavia oireita, sairauksia tai hoitoja? Diagnosoitu krooninen selkäsairaus Kasvain Infektio Murtuma Osteoporoosi Parapareesi Ratsupaikkaoireyhtymä Selkärankareuma Muu tulehduksellinen sairaus Iskiasoireita (hermojuuren toimintahäiriöön viittaavia alaraajaoireita) Muuta huomioitavaa:		

LÄÄKITYS:

Käytätkö lääkitystä Kyllä / En

Jos kyllä, mitä ja millainen annostus?

TERVEYSTOTTUMUKSET

Tupakointi / nuuskan käyttö

Käytätkö? En / Kyllä ___ savuketta / päivä Tupakoinut ___vuotta Lopettanut v.___

Käytätkö päihteitä (alkoholi, huumeet, lääkkeiden väärinkäyttö)?

Kyllä / En Jos vastasit kyllä, niin mitä ja kuinka usein?

Liikunta

Kuinka usein harrastat liikuntaa hengästymiseen / hikoilemiseen asti?

krt/vko Lajit:

Muut vapaa-ajan harrastukset:

KIPU

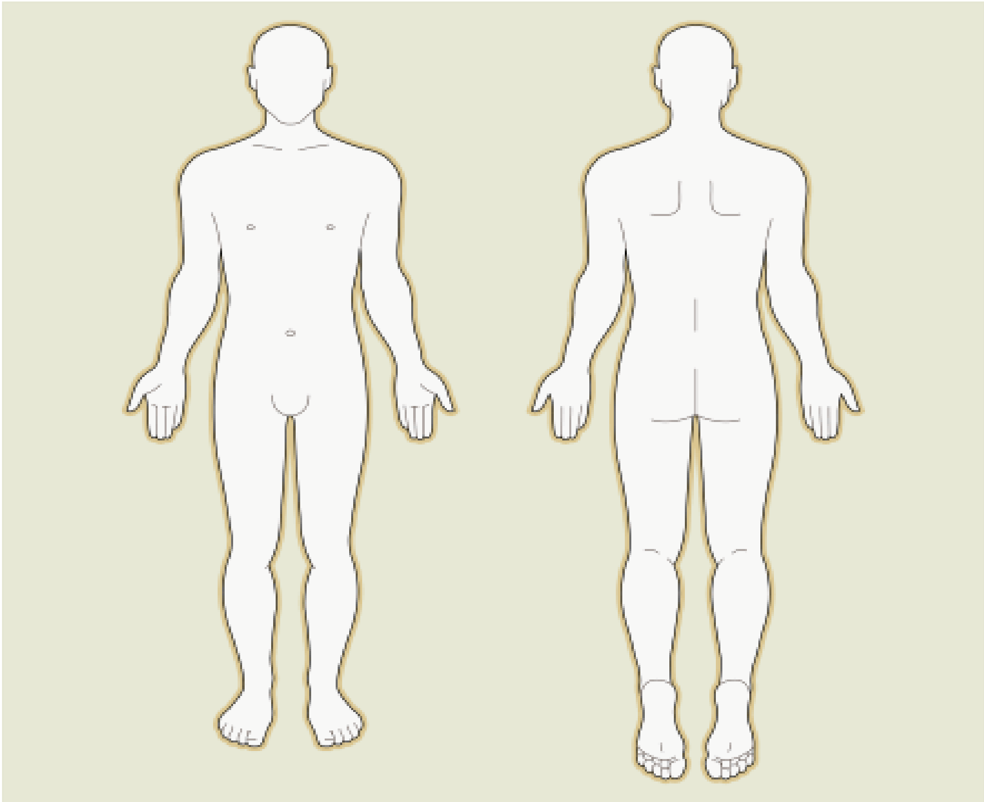
Kuvaile alaselkäkipuasi ja sen ilmentymistä.

Kuinka usein sitä esiintyy ja millaisissa tilanteissa?

Mikä helpottaa / pahentaa alaselkäkipua?

Mitä muuta asiaan liittyvää haluat kertoa?

Missä alaselkäkipu sijaitsee? Merkitse oheiseen piirustukseen kipupaikat:



Kuva: http://www.terveyskirjasto.fi/terveyskirjasto/tk.koti?p_artikkeli=reu00170 6.11.2010

Määritä oheiselle kipujanalle kiputuntemuksesi silloin kun se on pahimmillaan

0 |______________________________| 10

Ei kipua — Pahin mahdollinen kipu

Vakuutan antamani tiedot oikeiksi:

Allekirjoitus ______________________

Päiväys ______________________

APPENDIX 4

Classification of physical activity with N-Ex (Non-Exercise)-method

I do not regularly exercise or physically effort myself during free time.

0= I avoid walking and additional physical efforts, e.g. I always use escalators and instead of walking use the car whenever possible.
1= I walk for fun, mainly use stairs and sometimes take part in physical exercises until I sweat and get out of breath.
I regularly exercise during free time or have a job which requires moderate physical efforts, e.g. golf, horseback riding, gymnastics, table tennis, bowling, gym training and gardening.
2= 10-60 minutes per week.
3= over an hour a week.

I regularly exercise heavily during my free time, e.g. running, jogging, swimming, bicycling, rowing, skip rope or other aerobically straining sport, e.g. tennis, basketball or handball.

4= I run less than 2 km per week or exercise less than 30 minutes in an equivalent sport.
5= I run 2-10 km per week or exercise 30-60 in an equivalent sport.
6= I run 10-15 km per week or exercise 1-3 hours in an equivalent sport.
7= I run over 15 km per week or exercise over 3 hours in an equivalent sport.

Adapted from Jackson, A., Blair, S., Mahar, M., Wier, L., Ross, R. & Stuteville, J. 1990. Prediction of functional aerobic capacity without exercise testing. Medicine & Science in Sports & Exercise 1990/22; 863-870.

APPENDIX 5

INTERVENTION TRAINING EXERCISES

Alaselän kipua helpottamaan:
Selinmakuulla. Ota käsillä polvista kiinni ja vedä kohti rintaa niin, että alaselkä pyöristyy ja keinuttele sivu-suunnassa mahdollisimman rentona.

Alaselän kipua helpottamaan:
Selinmakuulla. Vie jalka koukussa toisen yli. Pidä olkapäät alustassa. Voit avustaa liikettä toisella kädellä. Pyri olemaan mahdollisimman rentona.

LIIKE 1.
Selinmakuulla. Hae syvän poikittaisen vatsalihaksen aktivaatio uloshengityksellä vetämällä alavatsaa sisään ja ylöspäin. Säilytä pinnalliset lihakset rentoina. Voit myös asettaa kädet lantiolle, kuin olisit vihainen ja tunnustella aktivaatiota edestä sormilla ja takaa peukaloilla. Voit sijoittaa alaselän alle pienen pyyhkeen.
Sarjat: 3 Toistot: 10

LIIKE 2.

Sama kuin liikkeessä 1, mutta säilytä aktivaatio 10 sek.

Sarjat: 10 Toistot: 10 s.

LIIKE 3.

Aloita selän neutraaliasennosta. Valmistaudu uloshengityksellä (uh), kierrä lantio ja kädet vastakkaisiin suuntiin kuin korkkiruuvi sisäänhengityksellä (sh), palautus (uh). Kädet pysyy ilmassa koko suorituksen ajan.

Sarjat: 3 Toistot: 10-20

LIIKE 4:

Asetu konttausasentoon ja hae lantion ja lannerangan keskiasento. Ojenna toista jalkaa ja vastakkaista kättä rauhallisesti suoraksi. Säilytä lantion ja lannerangan keskiasento ja vaihda toinen käsi ja jalka.

Sarjat: 3 Toistot: 10-20

LIIKE 5.

Aloita selän neutraaliasennosta. Valmistaudu uloshengityksellä (uh), kierrä lantio ja kädet vastakkaisiin suuntiin kuin korkkiruuvi sisäänhengityksellä ja ojenna päälimmäinen jalka suoraksi (sh) ja palautus (uh). Kädet pysyy ilmassa koko suorituksen ajan.

Sarjat: 3 Toistot: 10-20

LIIKE 6.

Asetu selinmakuulle, polvet koukussa, lantio ja lanneranka keskiasennossa. Pidä jalat yhdessä. Nosta ensin lantio ja sen jälkeen toinen jalka hieman irti alustasta. Säilytä lantion ja lannerangan keskiasento koko ajan hengitellen (sh, uh) ja jalkaa vuorotellen ylös nostaen.

Sarjat: 3 Toistot: 10-20

LIIKE 7A:

Asetu kyynärnojaan, lantio ja lanneranka keskiasennossa. Säilytä lantion ja lannerangan keskiasento staattisessa pidossa 30 sek.

LIIKE 7B:

Tee sama, mutta nosta vuorotellen jalkaa ylös 30 sek. ajan säilyttäen lantion ja lannerangan keskiasento.

LIIKE 8.

Siirry kylkimakuulta kyynärnojaan, pidä lantio irti alustasta ja vartalo suorana. Säilytä asento 30 sek. Toista sama myös toisella puolella. Älä tee liikettä, mikäli olkapääsi ei ole terve.

(PTStudio 2010. Online software. Available at www.ptstudio.fi).

APPENDIX 6

Opinnäytetyö Helanen, Virpi ja Nordman Ann-Mari, Lahden ammattikorkeakoulu, sosiaali- ja terveysala, fysioterapian koulutusohjelma 2010-2011

HARJOITUSPÄIVÄKIRJA JA VAS-KIPUJANA (Merkitse kiputuntemus kyseisen viikon keskiviikkona)

Osallistujan nimi: Progressio, Aluksi liikkeet 1, 2, 3 ja 4. Lisää liikkeet 5 ja 6. Lisää liikkeet 7A, 7B ja 8.

<table>
<tr><th>PVM</th><th>HARJ.KESTO</th><th>TEHDYT HARJOITTEET</th><th>TUNTEMUKSET</th><th>VKO NRO</th><th colspan="2">VAS-KIPUJANA</th></tr>
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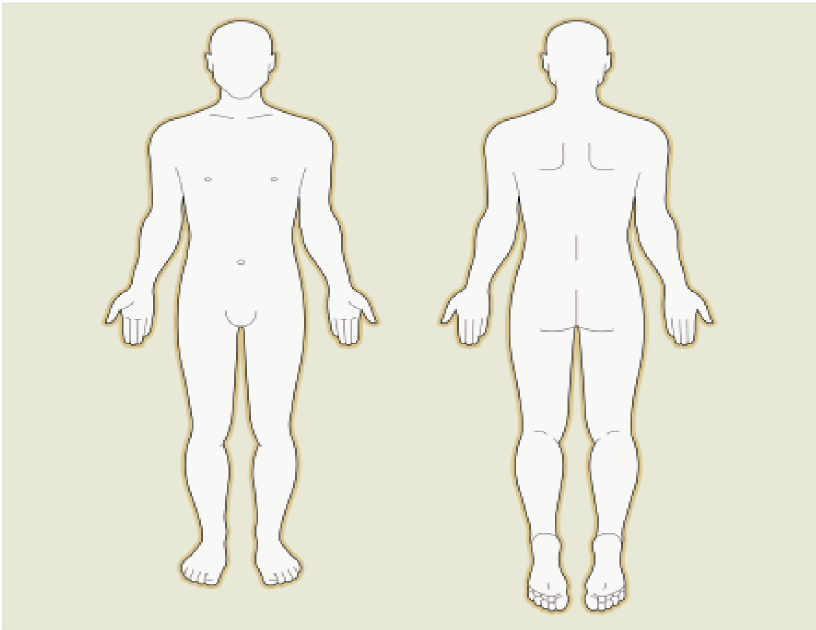
APPENDIX 7

LOPPUKYSELY

Täytä lomake huolellisesti ennen opinnäytetyömme loppututkimukseen tuloa. Tiedot ovat luottamuksellisia ja tulevat vain opinnäytetyön tekijöiden käyttöön.

HENKILÖTIEDOT		
Sukunimi Syntymäaika	Etunimet	
TERVEYDENTILA		
Oma arvio terveydentilastasi *Hyvä / Kohtalainen / Huono*	Paino kg	Pituus cm
Kuinka monta päivää olet ollut työstä/opinnoista poissa sairauden vuoksi viimeisen kolmen kuukauden aikana?		
LÄÄKITYS:		
Käytätkö lääkitystä Kyllä / En Jos käytät, mitä ja millainen annostus lääkityksessäsi on tällä hetkellä? Onko lääkityksessäsi tapahtunut muutosta tilanteeseen kolme kuukautta sitten? Jos, niin kerro millaisia.		
LIIKUNTA		
Onko liikuntatottumuksissasi tapahtunut muutosta tilanteeseen, joka Sinulla oli kolme kuukautta sitten? Jos, niin millaisia muutoksia?		
KIPU		
Kuvaile alaselkäkipuasi ja sen ilmentymistä.		
Kuinka usein sitä esiintyy ja millaisissa tilanteissa?		
Mikä helpottaa / pahentaa alaselkäkipua?		
Onko kiputuntemuksissasi tapahtunut muutosta tilanteeseen, joka Sinulla oli kolme kuukautta sitten? Jos, niin kerro millaisia muutoksia.		

Missä alaselkäkipu sijaitsee? Merkitse oheiseen piirustukseen kipupaikat:



Kuva: http://www.terveyskirjasto.fi/terveyskirjasto/tk.koti?p_artikkeli=reu00170 6.11.2010

Määritä oheiselle kipujanalle kiputuntemuksesi silloin kun se on pahimmillaan.

0 |____| 10

Ei kipua — Pahin mahdollinen kipu

HARJOITTELU

Miten harjoittelu sujui ja miten motivoiduit harjoitteluun?

Koetko saaneesi hyötyjä harjoittelusta? Jos, niin millaista hyötyä?

Vakuutan antamani tiedot oikeiksi:

________________________________ ________________________

Allekirjoitus Päiväys

APPENDIX 8

SUOSTUMUS TUTKIMUKSEEN

Osallistun Lahden ammattikorkeakoulun sosiaali- ja terveysalalla tehtävään alaselkäkipuisten nuorten aikuisten ultraäänikuvantimella suoritettavaan tutkimukseen vapaaehtoisesti ja täysin omalla vastuullani. Tutkimus on osa Virpi Helasen ja Ann-Mari Nordmanin Lahden Ammattikorkeakoulun fysioterapian koulutusohjelmassa tehtävän opinnäytetyön toteutusta. Tutkimukseen sisältyy alkututkimus ultraäänikuvantimella tehtynä. Transversus abdominis- lihaksen aktivaatiota sekä lihaskoon muuttumista ja harjoittelun vaikutusta alaselkäkipuun tutkitaan kahdeksan viikon interventiolla. Tutkittava saa ohjausta stabiloiviin rankaa tukeviin lihasharjoituksiin ja harjoittelee mahdollisuuksien mukaan säännöllisesti ja viikoittain yhdessä sovittavalla harjoitusohjelmalla.

Otan kaiken vastuun itsestäni mahdollisimman tapaturman tai onnettomuuden sattuessa opinnäytetyöhön liittyvissä toiminnoissa. Osallistun alku- ja lopputestaukseen ja harjoitteluun , sekä kuljen matkat (koti-tutkimuspaikka-koti), täysin omalla vastuullani. Matkoista aiheutuvat kustannukset hoidan itse.

Annan luvan käyttää tutkimustuloksiani materiaalina opinnäytetyön raportoinnissa ja työn esityksessä opinnäytetyöseminaarissa. Henkilöllisyyteni ei tule missään opinnäytetyön vaiheessa ilmi. Kysymyskaavakkeiden avulla minusta kysyttyjä tietoja käsitellään luottamuksellisesti ja lain mukaisesti. Kysymyskaavakkeet ja muu mahdollinen materiaali minusta tuhotaan opinnäytetyön valmistumisen jälkeen.

Minulla on oikeus keskeyttää osallistumiseni tutkimukseen milloin tahansa, niin halutessani.

Olen lukenut tämän sopimuksen, ja minulle on kerrottu mitä tutkimus sisältää. Ymmärrän tutkimuksen riskit sekä sen kulun ja tutkimustarkoituksen. Tämän sopimuksen allekirjoitettuani en ole oikeutettu vaatimaan korvauksia opinnäytetyöryhmältä.

Tästä sopimuksesta jää yksi kappale tutkimuksen osallistujalle ja toinen kappale opinnäytetyöryhmälle.

______________________________ ______________________________

Paikka ja päivämäärä Tutkittavan allekirjoitus