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EFFECTIVENESS OF PHYSIOTHERAPEUTIC, NON-INVASIVE
TREATMENT METHODS FOR PAIN, ASSOCIATED WITH
ACTIVE MYOFASCIAL TRIGGER POINTS – A SYSTEMATIC
LITERATURE REVIEW

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The purpose of this thesis was to collect and systematically review evidential research about the effectiveness of non-invasive treatment methods towards managing pain. Articles from 2006 to 2014 were used to make sure the research is most up to date. Articles that offered treatment for only latent trigger points were omitted.

The method used to write this thesis was a systematic literature review. The search was conducted in several databases such as Physiotherapy Evidence Database (PEDro), PubMed, Science Direct, Academic Search Elite (EBSCO). Articles found elsewhere were described as so.

The quality of studies was assessed according to PEDro scale. While some of them already had a score, two of them had to be assessed manually by author of this thesis.

To summarize articles that made it through the selection criteria, PICO model was used. After reviewing the selected studies, it is clear there is considerable amount of non-invasive therapy methods. Physiotherapist can use these tools to relieve symptoms and treat the conditions, which can cause pain for patients affected by active myofascial trigger points. Studies in this thesis show that the majority of manual, ischemic pressure, stretching and ultrasound techniques are effective tools to treat myofascial trigger points and pain caused by them or are worthwhile to add them to the current treatment plan to increase the effectiveness of problem management. However, it is noted, that only 3 out of 9 studies analysed in this thesis were moderate to high quality and therefore the reader has to make his own conscious and critical decisions about the results whether it should be considered as a treatment tool for his own use. Additionally, there might be a number of studies left out from this thesis due to the mere fact of human.

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1 INTRODUCTION

While living conditions are improving, more often people are complaining about various pains, be it back or leg pain. It is affected by passive lifestyle, weak spine stabilizers, overweight, food full of fats and proteins, tendons, ligaments, muscle sprains, spasms caused by an incorrect posture, inappropriate weight lifting, bad ergonomic positions while working, exercising or spending leisure time. Chronic pain is a significant public health disorder (Sikdar, et al. 2009, 1829 – 1838). A common chronic pain cause in muscles is myofascial pain which is the main reason for complaints, because it affects active daily living and function (Eng-Ching 2007; Bron, et al. 2011, 1 – 14). 95% of people having chronic pain are suffering from myofascial pain syndrome (MPS) (Sikdar, et al. 2009, 1829 – 1838).

Eng-Ching (2007) states, that muscles are the biggest organ inside a human being, they make 50% of our body weight. However, we very often are experiencing pain of muscle. It is one of the major causes of sickness. In the past few decades, pain caused by myofascial trigger points (MTrP) and its treatment has received a considerable amount of attention in scientific and clinical literature, due the fact, that more and more people are complaining about their muscle pain because of more sedentary life (Šiupšinskas, Zaveckas, Tamulevičius, Gudaitis 2009, 50).

MPS is a common, musculoskeletal system disorder (Sikdar, et al. 2009, 1829 – 1838). It is defined as sensory, motoric and autonomous symptom caused by MTrP (Vazquez-Delgado, Cascos-Romero & Gay-Escoda 2009, 494 – 498). MTrPs are often found in phasic and postural muscles, but more often in postural (Chaitow & Fritz 2006).

LMTrP characteristics are similar to AMTP (Doraisamy & Anshul 2011, 405 – 409; Bron, et al. 2011, 1 – 14). They are also sensitive to palpation, can cause the freeze of a

muscle and limit the range of motion (ROM), but the difference is that LMTrPs does not cause spontaneous pain or sensitivity, and opposite to AMTrPs – are painful only when palpating (Sikdar, Ortiz, Gebreab, Gerber & Jay 2010, 5302 – 5305; Bron, et al. 2011, 1 – 14). Bron, et al. (2011, 1 – 14) also states, that LMTrPs always has a stiff part of a muscle, which aggravates stiffness and ROM in a whole muscle. LMTrP at any time, affected by any mechanical stimulus might become AMTrP (Ge & Arendt-Nielsen 2011, 386 – 392). It might happen due to overstretch of tissues, overload, low tissue temperature, quick tissue stretch, it's shortening, trauma etc. (Han, et al. 2012, 1 – 9).

When chronic pain occurs, patients most often seek help from health care institutions. Individuals, experiencing chronic pain, are often experiencing depression, sleep disturbances, tiredness, and often reduced overall fitness and mental level. Treatment is prescribed after evaluating patient's functional level. It may be medication, active physiotherapy, and other methods. Pain is not always curable; therefore the main focus of the treatment is to lower the pain levels and to improve physical fitness and mental health (Ashburn & Staats 1999). There is a lot of research done on how physiotherapy methods like massage, heat therapy, cryo-therapy, therapeutic exercises affect the pain. In this thesis, I will review research on how pain is affected by myofascial trigger points (MTrPs) therapy.

2 MUSCLE TISSUE AND FASCIA

Body's musculoskeletal system's active part is formed by muscle tissue, because its cells are capable to contract and relax. Muscle tissue types are smooth, skeletal and cardiac. Skeletal muscles attached to the bones – moves different parts of body, changes their location in space when we walk; chew etc. (Anusevičienė, Cibas & Lilienė 2011).

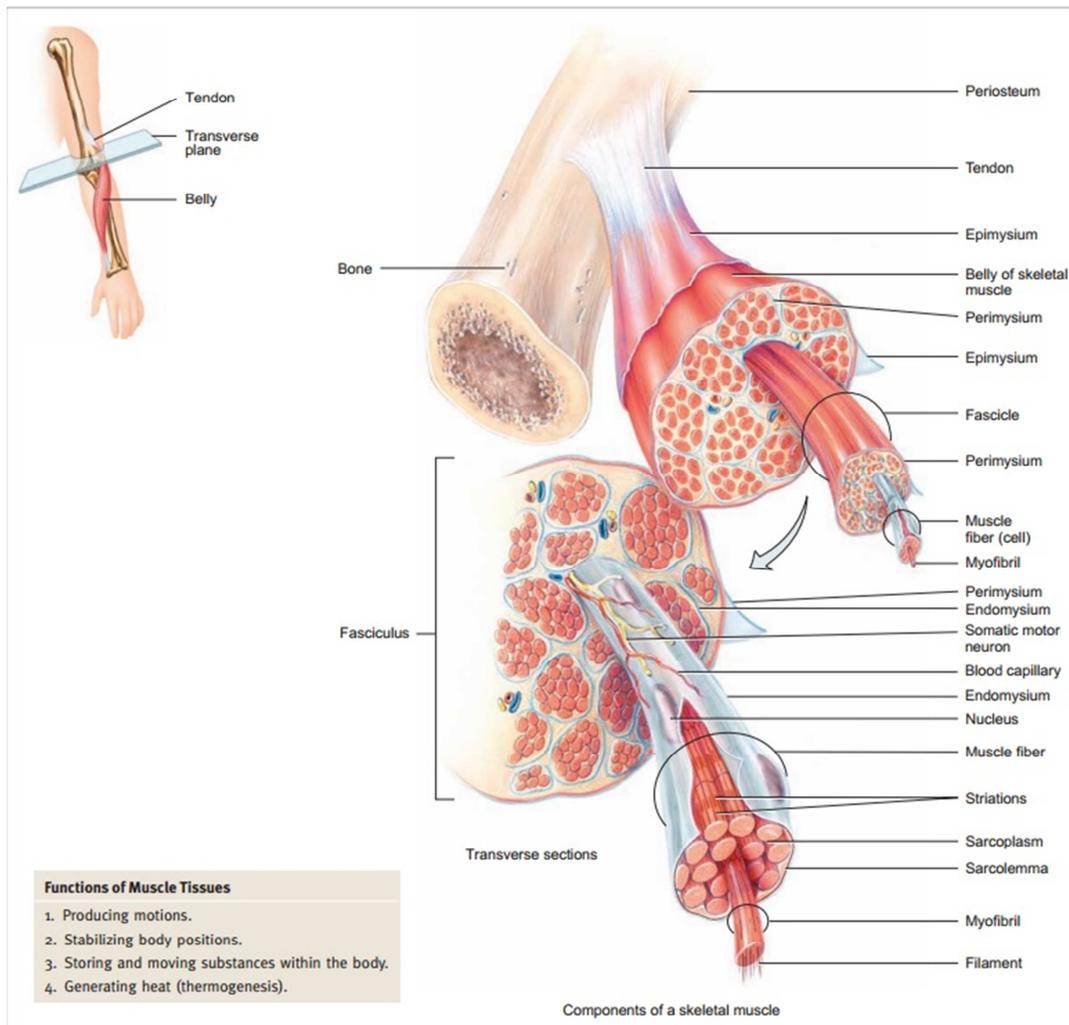


Figure 1. Organization of skeletal muscle and its connective tissue coverings (Tortora & Derrickson 2011, 330).

Every skeletal muscle is a separate organ made of hundreds of thousands of cells, called muscle fibers because of elongated shapes (Tortora & Derrickson 2011, 329). Connective tissue surrounds muscle fibers and whole muscles, blood vessels and nerves (Figure 1.). Tortora & Derrickson (2011, 329) further explains that “the subcutaneous layer or hypodermis, which separates muscle from skin, is composed of areolar connective tissue and adipose tissue”. They define fascia as “a dense sheet or broad band of irregular connective tissue that lines the body wall and limbs and supports and surrounds muscles and other organs of the body”. Fascia holds muscles together that have similar functions. Fascia allows free movement of muscles as well as carries

nerves, blood vessels and lymphatic vessels; fills spaces between muscles (Tortora & Derrickson 2011, 329). Fascia is an uninterrupted, three-dimensional web of tissue that extends everywhere: from head to toe, from front to back, from interior to exterior (Website of Core Concepts 2003 – 2014). In addition to the functions mentioned in Tortora & Derrickson book, there are more functions in the website of Core Concepts (2003 – 2014) which mentions fascia role is to: act as a shock absorber, along with providing support and protection as well as helping to maintain structural integrity. Furthermore, it plays an essential role in hemodynamic and biomechanical processes providing a pathway for cells to communicate with each other, it is very important as a body's first line of defense against pathogenic agents and infections. After an injury, it is the fascia that creates environment for tissue to repair (Figure 2).



Figure 2. Deep fascia. (Website of Fascial Fitness Today 2014)

There are three layers of fascia types; each of it has its own function and properties. Superficial fascia can be found just underneath the skin. In addition to protective padding to cushion and insulate, superficial fascia acts as a passageway for lymph, stores fat and water. Visceral fascia basically holds the organs in their cavities, but the most important fascia is deep fascia, the type of fascia, which covers muscles, bones and

nerves and is called myofascia (Website of Core Concepts 2003 – 2014). This thesis focuses primarily on this type of fascia.

3 MYOFASCIAL TRIGGER POINTS

Trigger points may occur in any soft tissue of the body (skin, ligaments). Trigger points which occur in muscles or muscle fascia are called myofascial trigger points (MTrPs) (Chaitow & Fritz 2006). MTrP most often forms in tired skeletal muscles, causing discomfort and pain. They, MTrP, are most often the cause of long-term pain, and also causes muscle, nerve system and other soft tissue dysfunction. A wide specter of research and experiments results shows that all of the chronic pain conditions affects MTrP occurrence (Šiupšinskas, et al. 2008, 43 – 46).

MTrP is defined as hard, local and sensitive to pressure spot, located in an increased tension place of skeletal muscle. The palpation of this spot often causes local or radiating pain (Bron & Dommerholt 2012, 439 – 444). The most mentioned MTrPs in literature are latent and active (Bron, et al. 2011, 1 – 14; Doraisamy & Anshul 2011, 405 – 409). Latent myofascial trigger points are less common than active myofascial trigger points (Šiupšinskas, et al. 2008, 43 – 46). The average MTrP size is varies between 2 to 10 mm. Most people to have MTrPs are between 27,5 to 50 years old and most of them are working a sedentary job. There is not a lot of difference, but the occurrence of myofascial trigger points is more in women than men (Vazquez-Delgado, et al. 2009, 494 – 498).

MTrPs are found in phasic and postural muscles, but more often in postural (Chaitow & Fritz 2006). Often postural muscles such as neck, shoulder girdle, pelvic muscles, and upper trapezius muscle part, scaleneus muscles, sternocleidomastoid muscles, levator scapula and quadratus lumborum muscle are affected by MTrPs (Alvarez & Rockwell 2002, 653). According to literature, MTrPs most often forms in the upper part of trapezius muscle, and is thought to be most sensitive to pressure out of eight different muscles (m.

trapezius, m. pectoralis major, m. levator scapulae, m. teres major, m. supraspinatus, m. infraspinatus, m. gluteus medius (Ji, Kim & Han 2012, 675 – 680).

Active myofascial trigger points cause pain even at rest (Alvarez & Rockwell 2002, 653). The place of AMTrP might be sensitive without stimulating it and applying pressure AMTrP becomes painful with irradiating feeling of pain further from pressure application. Apart from pain, a person might feel “pins and needles”, burning feeling, itching and other similar sensations (Chaitow & Fritz 2006; Simons, Travell & Simons 1999, Bron, et al. 2011, 1 – 14). Furthermore due to occurrence of AMTrPs it is common for affected muscles to lose some elasticity; muscle also loses strength (Šiupšinskas, et al. 2008, 43 – 46).

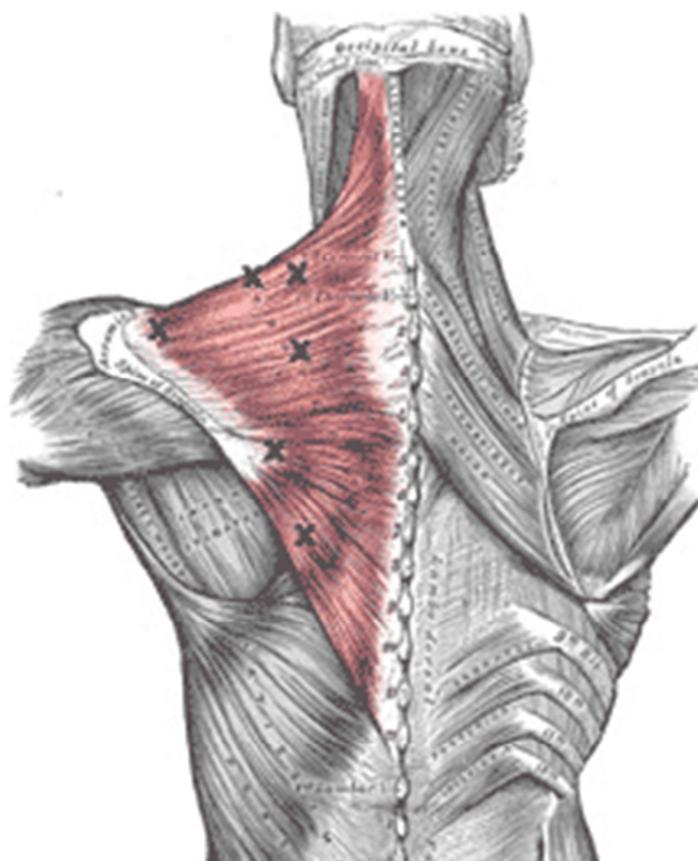


Figure 3. Trigger point places in trapezius muscle (Website of Trigger point relief 2004 – 2013)

It has been studied, that MTrPs that are affecting upper parts of the trapezius muscle (Figure 3), had influence over muscles moving the shoulder joint by disturbing their function (Chaitow & Fritz 2006). Another study also suggests that LMTrPs that are not enough sensitized to cause pain when disturbing the function of muscle (Lucas, Polus & Rich 2004, 160 – 166).

3.1 Myofascial trigger point's signs and symptoms.

If the nerve root travels through areas affected by MTrP and is compressed by it, it might cause sensory and motoric disorders to affected nerves (Vazquez-Delgado, et al. 2009, 494 – 498). Sensory disorders are local sensitization, irradiating pain as well as peripheral and central sensitization. Peripheral sensitization is pain gate reduction and increased response of peripheral nociceptors. Central sensitization is described as the increased sensitivity of neurons of central nervous system. Peripheral and central sensitization signs are pain due to stimulus that otherwise would not cause pain (allodynia) and increased sensitivity to pain (hyperalgesia). Motoric disorders are muscle weakness, increased tonus, limited range of motion (Dommerholt, Bron & Frannsen 2006, 203 – 221). In addition, MTrPs might cause changes in autonomic nervous system. In that case symptoms such as vasodilatation, vasoconstriction, local hyperthermia and outspread skin hypothermia might occur (Vazquez-Delgado, et al. 2009, 494 – 498; Domerholt, et al. 2006, 203 – 221).

There are models (Figure 4) that are typical for irradiating pain caused by myofascial trigger points (Domerholt, et al. 2006, 203 – 221). Pain caused by MTrPs does not irradiate in dermatomes pattern. Rather, it is more associated with an individual muscle (Nguyen 2012, 19 – 28). More than ¼ of patients that has MTrPs in neck area feel sensory symptoms in upper extremities, face. Upper extremities due to MTrP in neck area might develop motoric disorders such as weakness and poor coordination (Hubbard 2010). Myofascial trigger points often affect the occurrence of skeletal muscle disorders such as frozen shoulder, epicondylitis, lower back pain. When non-specific pain in joints is suspected, though is not confirmed visually and diagnostically or by clinical tests and

there is no clear trauma or inflammation – it might tell about existence of MTrP. (Chaitow & Fritz 2006; Nguyen 2012, 19 – 28).

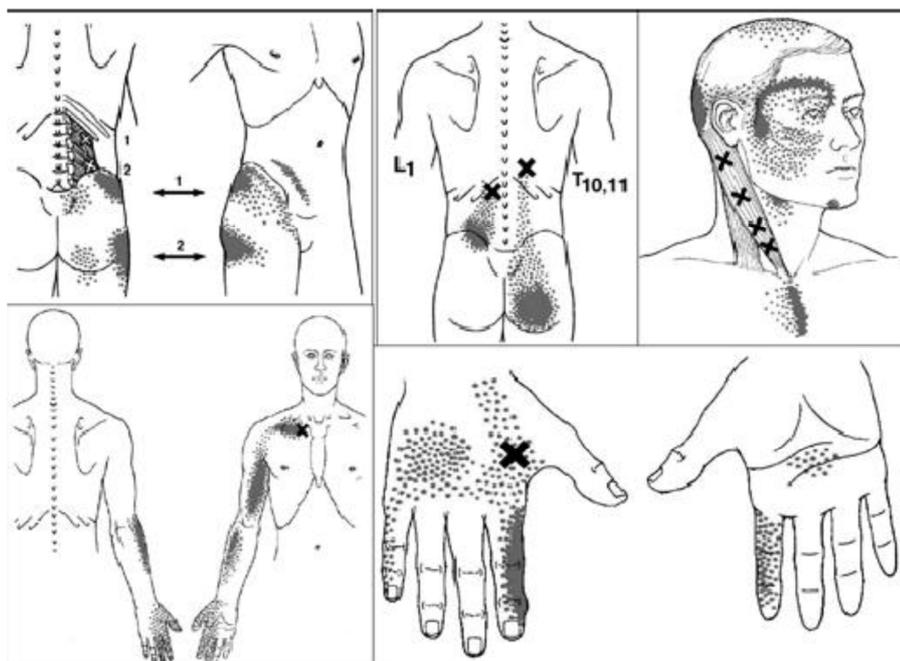


Figure 4. Examples of models of pain that irradiates from myofascial trigger point (Dommerholt et al. 2006, 207).

3.2 Causes of myofascial trigger points

It is highly important to know the causes of MTrPs to be able to prevent their occurrence and repeated formation as well as to know how to eliminate them (Chaitow & Fritz 2006). It has been proven that overuse or direct trauma may cause MTrPs to occur. The overuse of muscle might happen because of long, continuous or frequent repetitive isometric, eccentric, maximal and submaximal concentric muscle contraction (Bron & Dommerholt, 2012 439 – 444). Many researchers think that MTrP formation has a lot to do with heavy trauma or frequent micro traumas and the lack of physical activity, bad posture, lack of vitamins, sleep disturbances, joint problems has an affect for micro traumas to occur (Alvarez & Rockwell 2002, 653). More causes of MTrP might be due to exceeding the capacity of muscles during professional, leisure or sport activities (Bron & Dommerholt 2012, 439 – 444). Lack of physical activity and immobilization (after

surgeries or broken bone casts) also affects the occurrence of MTrPs. Bad posture and bad habits, associated with work and leisure time may cause the Cross syndrome (CS). There are two types of CS – upper and lower syndromes. Upper Cross syndrome (UCS) (Figure 5) signs are round shoulder girdle, chin protruding and stoop back, which together compresses thorax and interferes normal breathing. Because of this posture, neck, shoulders and thoracic part of the back has a great risk of developing pain and reduced range of motion (Chaitow & Fritz 2006).

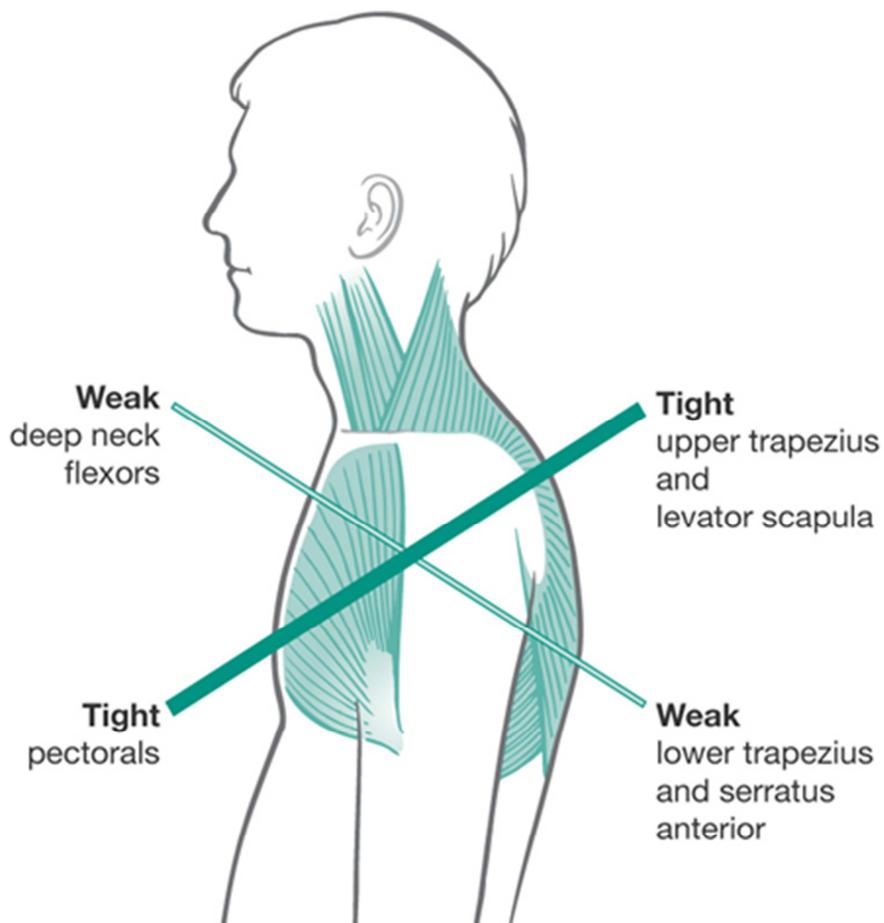


Figure 5. Upper Cross Syndrome (Website of Fredericksburg Chiropractic).

Habits as simple as sleeping have an effect for MTrP to occur (Niel-Asher 2005). Negative psychological and emotional factors such as fear, anger, anxiety or depression, also affects disturbances in musculoskeletal system including myofascial trigger points (Alvarez & Rockwell 2002, 653).

It is thought that MTrPs forms where sarcomere becomes hyperactive, but it is not known for sure the etiology of MTrPs. There are few hypotheses of MTrPs etiology including increased production of acetylcholine; increased loss of calcium, hypertension, as well as stress localized neural hyper stimulation and others (Niel-Asher 2005).

Because any of these factors that were mentioned, actin and myosin myofilament sliding on each other is disturbed. Due to that, sarcomere is temporary stopped in flexion phase. When this flexion phase is sustained for a longer time, it starts to effect on intercellular chemical changes such as local ischemia, increased demand of metabolism and energy needed to maintain flexion. Calcium ions fail to transfer to sarcoplasmic reticulum, local inflammation and vasoconstriction occurs with increased production of inflammatory factors, which sensitizes local autoimmune and nociceptive fibers (Niel-Asher 2005).

If this kind of position of fiber is prolonged, because of the reasons mentioned above calcium is not able to travel towards actin and myosin filaments, and this prevents the normal sarcomere contraction cycle (Niel-Asher 2005). Because the increased tension in muscle fibers, caused by MTrPs, muscles, while palpated are abnormally tensed and have signs of reduced stretching. Due to sarcomere shortening in this kind of muscle fibers, the flexion knot takes place (MTrP). Sarcomeres in this node are contracted maximally, while the rest of muscle fibers are noticeably stretched to compensate the lost length of sarcomeres which are shortened. This kind of shortening of sarcomeres affects the increased tension of muscle fibers at rest (Simons 2002, 81-88).

3.3 Physiotherapeutic examination of MTrPs

3.3.1 Palpation

“Palpation of the affected muscle by applying sustained deep pressure is the method most frequently used in the diagnosis of trigger points. The presence of a taut band containing hypersensitive muscle fibers of harder than normal consistency is a typical

finding” (Stephanie, Han & Harrison 1997, 94). In order to palpate the muscle, it has to be relaxed because it is not possible to do it if muscle is tensed or in spasm. Palpating AMTrP will result in elicit pain and/or radiation of pain towards the zone of reference and may cause visible twitching of the skin and or shortening of muscle (Elliott 1944, 47 – 49). It is advised to ask the patient to direct the examiners and report local or radiating pain then MTrP is touched. Examiner can often feel the “jump sign” when firm pressure is applied on the trigger point (Gutstein 1938, 302 – 311).

3.3.2 Thermography

“Thermography is a noninvasive imaging technique, which detects the temperature distribution of the body surface. Heat is detected and converted into a visual image, which demonstrates the temperature difference over a given body surface” (Stephanie, Han & Harrison 1997, 94). Thermal emission has to be symmetrical in normal individuals under controlled conditions and should not vary by more than a few tenths of Celcius degree at the same place on each side (Feldman & Nickoloff 1984, 235 – 249; Silberstein, Bahr & Kattan 1975, 1506 – 1510). Thermography has been used as a tool to document soft tissue pathology. In myofascial pain syndrome, it has been used as an objective method to confirm the location of trigger points. Observed “hot spots” have corresponded to the location of active and latent MTrPs in 61% cases (Fischer & Chang 1986, 212 – 215). The spots are 0,5 – 1°C higher in temperature.

However, Swerdlow & Dieter (1992, 205 – 213), tested three thermography methods and found no difference in the incidence of hot spots between patients with and without active trigger points, nor did most sports correspond to the location of AMTrPs.

3.4 Non-invasive MTrPs treatment methods

Richter & Hebgen (2009, 121 – 122) describes multiple methods to treat trigger points. Stretch-and-Spray technique is applied in 3 stages: applying cooling spray in parallel

lines to the skin where concerned muscle is. It is applied with a speed of 10 cm/second throughout entire muscle from a 45cm distance and should not cause freezing. After 2 – 3 applications of mentioned spray, muscles are passively stretched by physician up to prevailing tension barrier. Spraying is still applied during the passive stretch stage uninterrupted. Then, the client is instructed to exercise AROM using active stretching. Another technique to treat MTrPs is called postisometric relaxation. Patient is asked to tense a muscle against the therapist's three-dimensional resistance towards the shortening of the muscle without movement. Ischemic compression is applied to the trigger point until the pain threshold is reached. It is manual compression that lasts for 15s to 1min or up to the point when pain disappears. Therapist should continue with this method increasing pressure gradually until the trigger point does not hurt anymore. Finally, one can use deep friction massage to treat patients suffering from MTrPs by applying manual stretch of hypertonic muscle by hand. Stretching is continued until pain disappears.

4 RESEARCH METHOD AND PURPOSE OF THESIS

4.1 Systematic literature review

A systematic literature review was chosen as a research method for this thesis. Systematic literature reviews (SLRs) are a useful tool to promote research and put it into action (Jesson, Matheson & Lacey 2011, 15). The most important features of SLR are that the explicit and transparent methods are used, this kind of research follows a standard set of stages and most importantly – it is accountable, replicable and updateable. SLRs aim to find as much relevant research as possible to relate to particular research questions (Website of EPPI-Centre 2009).

Systematic reviews remain mysterious in some ways, despite the fact that they and meta-analyses are the key element of evidence-based healthcare. A review can be called

systematic if it is based on clearly formulated question, identifies relevant studies, appraises their quality and summarizes the evidence using explicit methodology. To make a good systematic literature review, it is recommended to follow five steps (Khan, Kunz, Kleijnen & Antes 2003, 118 – 121).

First step is to frame the questions for a review. The problems addressed by the review should be specified in clear, unambiguous and structured questions. Second step requires identifying relevant work. Multiple sources should be used preferably without language restrictions. Reasons for inclusion and exclusion should be recorded. Step 3 requires the researcher to assess the quality of studies chosen (for example PEDro scale). There should be a defined minimum acceptable quality level of research. In step 4, researcher is to summarize all the findings of researches chosen in one easy to use table. Lastly, in the fifth step, the researcher has to make the conclusions, outcomes and suggestions for the results of SLR (Khan, Kunz, Kleijnen & Antes 2003, 118 – 121).

4.2 Purpose of thesis

The purpose of this thesis is to gather a scientific and up to date research and systematically summarize it to find out what are the effects of various non-invasive therapy methods on managing pain caused by active myofascial trigger points in the human population.

4.3 Thesis questions

- What kinds of methods are used to treat the problem?
- What are the outcomes of different therapy techniques towards treating pain?
- What is the methodological quality of studies reviewed?

5 SEARCH STRATEGY, STUDY SELECTION, QUALITY ASSESSMENT

5.1 Search strategy used

Search of electronic databases PEDro, EBSCO, PubMed and ScienceDirect was conducted on 6.4.2014. Other sources such as “similar articles”/”suggested articles” provided by some of search databases were also considered as well as articles found in references list while searching for relevant literature for theoretical part of this thesis. For database search, combinations of terms used were: “myofascial trigger point pain” (as a main invariable) AND “effect” AND “effects” AND “therapy AND effectiveness” AND “management” AND “outcomes”. Filters such as date limitation from 1.1.2006 to date, humans only, English only were added to limit research to most up to date and understandable articles. These filters were also applied for articles from other sources like “similar articles”/”suggested articles” and references list to match the ones that were actually searched. In addition, filter “full text available” was used. Due to the fact that “free full text available” filter was not included, to avoid narrowing the search too much, help from Satakunta University of Applied Sciences (SAMK) library workers was needed to get articles of interest in full text and free. The combination of results from all the sources is represented in Table 1.

Table 1. Results of every database and keywords that were used to obtain relevant articles.

Terms entered in search engine		EBSCO	PubMed	Science Direct	PEDro	Other
Myofascial trigger point pain	AND Effects	10	168	26	29	
	AND Effectiveness	7	50	14	21	
	AND Therapy AND Effectiveness	6	49	20	13	
	AND Managment	0	161	11	17	
	AND Outcomes	11	43	19	12	
Articles found through "similar articles" or while searching for literature		0	9	0	0	2
Total		34	480	90	92	2

5.2 Selection of studies

From total of 698 studies searched, 22 studies made it through the first filter of selection. Studies that did not make through first filter were renounced due to reasons such as: it was not about myofascial trigger points; it was not about effectiveness of therapy methods, it was invasive treatment methods, it was not available in full text PDF even through SAMK library services. 5 studies dropped out due to article fee. 7 studies dropped out because of that fact that it was focusing primarily on latent myofascial trigger points. 1 article dropped out due to unknown reason associated with internet servers and could not been downloaded and accessed anymore. After all of the exclusion criteria's there were 9 articles to review.

5.3 Quality assessment of selected studies

The quality of selected articles in this thesis was assessed using PEDro scale – a tool which helps to assess the methodological quality of studies conducted in physiotherapy field around the world. In this scale, there are 10 methodological aspects that are assessed to be absent or present in a piece of research and they are provided in APPENDIX 1. According to PEDro website, a study must meet 7 out of 10 criteria aspects to be considered as moderate to high quality. Article number chosen for this study that met this requirement was 3. It is important to have this fact in mind before continuing to interpret the results and conclusions of this thesis. Furthermore, it is advised to note that two of the articles in Table 2 were assessed manually by author of this thesis which may lead to inadequate results due to the lack of experience of the author.

Table 2. PEDro scale summary of selected articles.

Author/s, publication year.	Method	Score in PEDro scale	Confirmed by PEDro
Gulick et al. 2011	CT	3/10	Yes
Bron et al. 2011	RCT	6/10	Yes
Renan-Ordine et al. 2011	RCT	5/10	Yes
Lluch et al. 2013	Single Group Design	3/10	No
Blikstad & Gemmell, 2008	RCT	7/10	Yes
Shabrun et al. 2012	RCT	8/10	Yes

Ghanbari et al. 2012	CT	4/10	Yes
Srbely et al. 2009	RCT	7/10	Yes
Ge et al. 2006	Single Group Design	3/10	No

6 RESULTS

In this thesis, PICO model to summarize articles was used. Website of University of Southern California (2014) explains the abbreviation of PICO to stand for P as patient problem or population; I for Intervention that was done to population of interest; C for comparison (to what/whom treatment group was compared to) and O for outcome measures that were used to measure the effectiveness/result of treatment. PICO summary is found in Table 3.

Table 3. PICO model summary of selected articles.

Author/s and publication year	Patients	Intervention	Control	Outcome measures
Gulick et al. 2011	28 patients 10 male and 18 female over the age of 18 with two MTrPs in upper back musculature	Ischemic compression for 30s with Backnobber II following 30s of "rest" period	Non-treated MTrPs	Pre- and post-test PPT of MTrPs using JTECH algometer
Bron et al. 2011	72 patients from 18 to 65 years old	Once a week for 12 weeks.	"Wait and see" group that	Disabilities of Arm,

	<p>randomly assigned. Self-referred or referred by GP. Were eligible if had unilateral non-traumatic shoulder pain for at least 6 months.</p>	<p>Inactivation of active, pain producing MTrPs by manual compression gradually increasing pressure. Combined with deep stroking or strumming. Patients were to perform simple gentle static stretch at home several times during the day and apply heat, such as shower or hot packs twice a day.</p>	<p>remained in waiting list for 3 months.</p>	<p>Shoulder and Hand (DASH) questionnaire, Visual Analogue Scale for Pain (VASP), Global Perceived Effect (GPE) scale, PROM, MTrPs number</p>
<p>Renan-Ordine et al. 2011</p>	<p>Sixty patients with primary report of unilateral plantar heel pain with following features: 1) insidious onset of sharp pain under</p>	<p>Group 1: Self stretching protocol, including calf muscles and plantar-fascia specific exercises. Stretching 2</p>	<p>Same treatment as group 1 plus TrP manual interventions</p>	<p>SF-36 questionnaire: physical function and bodily pain domains. PPT,</p>

	<p>plantar heel surface upon weight bearing.</p> <p>2) plantar heel pain that increases in the morning with first steps, 3) symptoms decreasing with slight levels of activity, 18 to 60 years old.</p>	<p>times per day 20s following by 20s rest for a total of 3 min for each stretch.</p> <p>Group 2: Same as group 1 plus TrP manual interventions</p>		
Lluch et al. 2013	<p>30 patients (completed 22), age between 18 and 60, with chronic idiopathic neck pain with score of 5/50 in Neck Disability Index (NDI) with active or latent MTrPs in upper trapezius, levator scapulae or splenius capitis.</p>	<p>Active craniocervical flexion performed 2 times per day (10-20min) for the duration of trial.</p>	N/A	NDI, PPT

Blikstad & Gemmell 2008	45 subjects between 18 and 55 years old, with non-specific neck pain of at least 4 on an 11-point numerical rating scale (NRS), and upper trapezius TrP and decreased cervical lateral flexion to the opposite side of the active upper trapezius TrP.	Activator trigger point therapy, myofascial band therapy.	Sham ultrasound.	11-point NRS for self-reported neck pain, PPT, cervical range of motion (CROM).
Schabrun et al. 2012	23 adult patients having pain and MTrPs in the neck or shoulder lasting for more than 2 weeks.	Interactive Neurostimulation (INS) using InterX 5002, delivered for 12 participants for 10 minutes in a single session over the MTrP are in each patient.	Sham INS of 11 participants.	PPT immediately after intervention and VAS scale for pain intensity. At 5 day follow-up two other tests: NDI and patient specific functional scale (PSFS) for function.

Ghanbari et al. 2012	30 patients with AMTrPs in cervical muscles.	5 sessions of PRT (positional release therapy) in 2 weeks	Medical therapy group	Daily headache diary with frequency, intensity and duration. Pressure algometry and numeric pain intensity (NPI)
Srbely et al. 2009	50 subjects with identifiable MTrPs in supraspinatus, infraspinatus and gluteus medius muscles randomly assigned to treatment and control groups	Therapeutic dose of ultrasound (US) to the right supraspinatus TrP to test group.	Sham US to right infraspinatus.	PPT readings recorded at 1, 3, 5, 10 and 15 minutes intervals from ipsilateral infraspiantus and gluteus medius.
Ge et al. 2006	21 female 24 - 60 years old patients with chronic unilateral myofascial shoulder pain with an ATrP in infraspinatus.	Maneuver of elevated intrathoracic pressure (EITP) with randomization in both the point sequence and respiration status	No control group. Control points used in tibialis anterior of the same subjects.	PPT and PTRP (pressure threshold for eliciting referred pain)

Gulick, Palombaro & Lattanzi (2011) study about effectiveness of ischemic pressure of Backnobber II device resulted in an increase of pressure pain threshold in patients that were treated with it. Subjects reported a significantly reduced sensitivity of MTrPs after four sessions of using Backnobber II. This study is the first step to set a protocol for using this tool at its best potential towards managing myofascial trigger points. More studies should be done with varying the parameters like number of repetitions, amount of pressure, duration, to establish the most potential of this device, which could potentially be one of the tools for patients to manage MTrPs at home conditions.

Compared with control group, Bron et al (2011) reports that the intervention group showed significant improvement on the DASH questionnaire score after 12 weeks. Most importantly for this thesis, significant improvement was also showed in VAS-P1 for current pain, VAS-P2 for pain in past 7 days and VAS-P3 for most severe pain in last 7 days. Moreover, after 12 weeks of intervention, 55% of patients in treatment group reported “improvement (from slightly improved to completely recovered) versus 14% in the control group”. Furthermore, mean number of muscles affected by AMTrPs decreased in the intervention group. This method, therefore, might be considered as an effective treatment for patients suffering from shoulder pain.

In a study conducted by Renan-Ordine et al (2011), it was concluded that patients that received combination of self-stretching and TrP intervention experienced a greater improvement in physical function and greater reduction in pain comparing to those receiving only self-stretching protocol. Furthermore, the combination group showed a greater improvement in PPT as compared to only-stretch group and has superior short-term effects compared to self-stretching alone in individuals suffering from plantar heel pain. Authors suggest considering using TrP in addition to stretching of calf musculature and plantar fascia for the treatment of plantar heel pain.

Lluch et al. (2013) conducted a study about the effects of deep cervical flexor training on pressure pain threshold over MTrPs in patients with chronic neck pain. In this study,

a 6-week intervention of DCF training resulted in significantly lower values of NDI in pain and disability. However, there were no changes in PPT over MTrPs in splenius capitis, levator scapulae or upper trapezius muscles.

Blikstad & Gemmell (2008) reports that in their study, there was no statistically significant differences between groups at baseline in age, pain level, lateral cervical flexion or PPT which was indicated by on-way ANOVA (analysis of variance between groups). This fact is to be noted, as the results showed activator trigger point therapy to the upper trapezius has an immediate effect in reducing pain in patients suffering from sub-acute non-specific neck pain. Having in mind the fact that the ATrPT was found to be effective in this study, authors discuss that the effect size may be imprecise due to the small sample size and suggests that more data should be collected before anything definite can be said about effect size.

In a preliminary randomized, sham-controlled study, conducted by Schabrun et al (2012), it was concluded that this trial demonstrates improvements in function in individuals with MTrPs using INS therapy, but has no significant effect in pain levels (VAS, PPT) or NDI scores comparing to sham group.

Ghanbari et al. (2012), after conducting their clinical trial that wanted to figure the effect of trigger point management by positional release therapy (PRT) on tension type headache, found, that both groups (PRT and medical therapy group) showed significant reduction in headache frequency and duration and tablet count, used to suppress pain, after treatment phase. However, after the follow up phase, only PRT group had persistent study variables. Both groups did not show significant reduction in headache intensity. Trigger point sensitivity, however, was significantly reduced. Comparing the two groups, there were no significant difference between headache frequencies, intensity, duration and tablet count between them, therefore, authors suggest that both procedures (medical treatment and PRT) were equally effective in their study and can be treatment of choice for patients suffering from tension type headache.

In Srbely et al (2009) study revealed that ultrasound test group demonstrated statistically significant increases in PPT values at 1 and 5 minutes compared to sham ultrasound group. There were no significant differences in PPT values between two groups at 10 and 15 minutes. Moreover, compared to sham US, treatment group showed significant improvement at PPT levels at all-time points that were measured in infraspinatus muscle. These results suggest that ultrasound treatment of supraspinatus TrP had a greater short-term decrease in pain sensitivity in infraspinatus trigger point compared to gluteus maximus. It is important to know here, that insolated supraspinatus TrP and infraspinatus TrP are innervated by the same section at C5,6 spinal levels, whereas gluteus maximus is not. Authors conclude, that these findings support their hypothesis that a low-dose exposure of US to a MTrP evokes systematic segmental antinociceptive effects.

Ge, Fernandez-de-las-Penas & Arendt-Nielsen (2006) were studying the effects of sympathetic facilitation of hyperalgesia evoked from myofascial tender and trigger points in patients with unilateral shoulder pain. They found out, that increasing sympathetic outflow to the muscle, decreases PPT at both tender and TrPs. EITP also decreases referred pain threshold and increases local and referred pain intensities. Authors state that “these results provide evidence of sympathetic facilitation of mechanical sensitization and facilitation of the local and referred pain reactions in myofascial pain syndrome.

7 DISCUSSION

Before concluding the results of this thesis, I would like to point out some of the factors that may have had an impact for the quality and reliability of this thesis. First of all, this thesis was done by me, an inexperienced physiotherapy student. This might have affected the quality and reliability of this systematic literature review in all available aspects: topic selection, formulation, study search and selection, quality assessment and evaluation of studies. Furthermore, English language is not my mother tongue; therefore

there might be factual misunderstandings in analysis of collected literature. The fact that this was my first piece of research also contributes to the reliability of it.

The process of this thesis was very slow at first. To begin, it was supposed to be written about myofascial release techniques effects on pain. I was not familiar with this concept at all, and it was still quite a new concept in the world of physiotherapy. Therefore, searching for adequate literature was extremely confusing as I could not find any decent information and moreover, it was not very systematic. I started to search for similar concept still containing pain as a main problem and fascia as a main anatomical factor. I eventually formulated the current topic as it is presently. After writing my theoretical part, I found a very similar study that was already written in much higher quality. It was fortunate because I then got a timeframe of which articles should be included in my thesis and which shouldn't. The above mentioned systematic literature review was conducted in 2006; therefore articles conducted prior to 2006 were not included while searching and were prevented from showing up by filters in search engines/databases used.

The most consuming part was searching for articles and summarizing them. It was also difficult to understand some of the terms and scientific aspects in some of the studies. Additionally, a greater understanding in the use of Microsoft Word and Excel should be known to make writing and combining this thesis more fluent and with less time constraints.

Further, a more detailed systematic review could be very well written on this topic, possibly, but not necessarily including latent trigger points, more databases, articles that have to be paid for or more assessors and/or researchers. Summarization, article inclusion and exclusion criteria could be done in more detailed and reader-friendly way. Furthermore, the results could be synthesized more specifically by outcome measures to make it easier for a reader to pick the results he/she is particularly interested in.

8 CONCLUSION

In conclusion, after reviewing the selected studies, it is clear that there is a considerable amount of non-invasive therapy methods, that physiotherapist can use as tools to relieve symptoms and treat the conditions, which cause pain for patients affected by active myofascial trigger points. Studies in this thesis show that the majority of manual, ischemic pressure, stretching and ultrasound techniques are effective tools to treat myofascial trigger points or are worthwhile to add them to the current treatment plan to increase the effectiveness of problem management. However, it has to be noted, that only 3 out of 9 studies analyzed in this thesis were moderate to high quality and therefore the reader has to make his own conscious and critical decisions about the results, and whether it should be considered as a treatment tool for his own purposes. Additionally, there might be a number of studies left out from this thesis due to the mere factor of human being.

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APPENDIX 1

PEDro scale

1. eligibility criteria were specified where:	no	yes
2. subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received) where:	no	yes
3. allocation was concealed where:	no	yes
4. the groups were similar at baseline regarding the most important prognostic indicators where:	no	yes
5. there was blinding of all subjects where:	no	yes
6. there was blinding of all therapists who administered the therapy where:	no	yes
7. there was blinding of all assessors who measured at least one key outcome where:	no	yes
8. measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups where:	no	yes
9. all subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by “intention to treat” where:	no	yes
10. the results of between-group statistical comparisons are reported for at least one key outcome where:	no	yes
11. the study provides both point measures and measures of variability for at		

- Criteria 4, 7-11 *Key outcomes* are those outcomes which provide the primary measure of the effectiveness (or lack of effectiveness) of the therapy. In most studies, more than one variable is used as an outcome measure.
- Criterion 5-7 *Blinding* means the person in question (subject, therapist or assessor) did not know which group the subject had been allocated to. In addition, subjects and therapists are only considered to be “blind” if it could be expected that they would have been unable to distinguish between the treatments applied to different groups. In trials in which key outcomes are self-reported (eg, visual analogue scale, pain diary), the assessor is considered to be blind if the subject was blind.
- Criterion 8 This criterion is only satisfied if the report explicitly states *both* the number of subjects initially allocated to groups *and* the number of subjects from whom key outcome measures were obtained. In trials in which outcomes are measured at several points in time, a key outcome must have been measured in more than 85% of subjects at one of those points in time.
- Criterion 9 An *intention to treat* analysis means that, where subjects did not receive treatment (or the control condition) as allocated, and where measures of outcomes were available, the analysis was performed as if subjects received the treatment (or control condition) they were allocated to. This criterion is satisfied, even if there is no mention of analysis by intention to treat, if the report explicitly states that all subjects received treatment or control conditions as allocated.
- Criterion 10 A *between-group* statistical comparison involves statistical comparison of one group with another.
- Depending on the design of the study, this may involve comparison of two or more treatments, or comparison of treatment with a control condition. The analysis may be a simple comparison of outcomes measured after the treatment was administered, or a comparison of the change in one group with the change in another (when a factorial analysis of variance has been used to analyse the data, the latter is often reported as a group \times time interaction). The comparison may be in the form hypothesis testing (which provides a “p” value, describing the probability that the groups differed only by chance) or in the form of an estimate (for example, the mean or median difference, or a difference in proportions, or number needed to treat, or a relative risk or hazard ratio) and its confidence interval.
- Criterion 11 A *point measure* is a measure of the size of the treatment effect. The treatment effect may be described as a difference in group outcomes, or as the outcome in (each of) all groups. *Measures of variability* include standard deviations, standard errors, confidence intervals, interquartile ranges (or other quantile ranges), and ranges. Point measures and/or measures of variability may be provided graphically (for example, SDs may be given as error bars in a Figure) as long as it is clear what is being graphed (for example, as long as it is clear whether error bars represent SDs or SEs). Where outcomes are categorical, this criterion is considered to have been met if the number of subjects in each category is given for each group.