

# **THE EFFECT OF KINESIO ® TAPING SPACE-CORRECTION- TECHNIQUE ON POST-NEEDLING SORENESS IN THE TRAPEZIUS MUSCLE TRIGGER POINT TWO.**

By

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Dissertation submitted in partial compliance with the requirements for the Master's  
Degree in Technology: Chiropractic at the Durban University of Technology.

I, Mark Zuidewind, do declare that this dissertation is representative of my own work  
in both conception and execution.

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Date:

## **DEDICATION**

I dedicate this dissertation to the four most important people in my life.

To Kerry, thank you for being patient while I have been pursuing my dreams, for always being there to support, encourage, console and celebrate with me throughout the past 6 years. Having you in my life motivates me to be a better person every day.

See you soon.

To my mom, Jayne and my dad, Andre. Thank you for making it possible for me to pursue my dreams, for always being right behind me and always believing in me. I would not be where I am today without the two of you.

To my brother, Peter. Thank you for showing me the value of dedication and hard work. I am so proud of you for finding what makes you happy and being courageous enough to believe in yourself.

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## **ABSTRACT**

### **Background:**

Dry needling (DN) fanning technique is an effective treatment for myofascial trigger points (MTP), however, it causes swelling and intramuscular haemorrhage which results in post-needling soreness (PNS). Kinesio ® taping space-correction-technique (KTSC) is claimed to aid in reducing pain by decreasing inflammation, increasing circulation and lymphatic drainage. This in theory indicates that Kinesio ® taping could reduce/alleviate PNS pain after DN.

### **Objective:**

The purpose of this study was to determine the effectiveness of KTSC utilizing Kinesio ® Tex Gold tape in reducing the level of PNS associated with DN a trapezius muscle trigger point two.

### **Method:**

Forty five patients with active trapezius muscle MTP two were randomly allocated into one of three treatment groups. All groups received a standardized DN treatment. Thereafter, group one received no further treatment and acted as the control group, group two received an application of KTSC utilizing Kinesio ® Tex Gold tape, while group three received a non-proprioceptive hypoallergenic tape application. Assessments were made pre-, post-treatment and at a follow-up consultation on the following day once the taping application was removed. Assessments included numerical pain rating scale-101 (NRS-101), a pain diary and algometer readings.

### **Results:**

Group three showed an improvement over the control group, however, it was not a statistically significant improvement in any of the assessments. Group two showed statistically significant improvement over the control in the pain diary and algometer readings overall. Results from the NRS-101, showed that group two had a statistically significant improvement when compared to the control group over the time interval when the Kinesio ® Tex Gold tape was applied to the patient.

**Conclusion:**

KTSCCT utilizing Kinesio® Tex Gold tape had a greater effect in reducing the level of PNS associated with DN a trapezius muscle trigger point two, when compared with either a non-proprioceptive hypoallergenic tape application or a control group.

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## **DEFINITION OF TERMS**

**Acute pain:** Refers to pain duration of less than 4 weeks and prior to this episode, the patient must be pain free for at least 3 months (Roelofs *et al.*, 2005).

**Chronic pain:** Refers to pain lasting longer than three months (Silfies *et al.*, 2004).

**Incidence:** Incidence is the rate at which healthy people develop a sickness or symptom over a projected period of time within a given population. Lifetime incidence reflects the number of individuals who will be affected by a condition at some point in their lives (Borenstein *et al.*, 1995).

**Kinesio ® taping technique:** The tape application techniques designed specifically for Kinesio ® Tex Gold tape ([www.kinesiotaping.co.uk](http://www.kinesiotaping.co.uk), 2010).

**Kinesio ® taping space-correction-technique:** A Kinesio ® taping technique that utilizes the elastic qualities of the Kinesio ® Tex Gold tape to lift fascia and soft tissue, creating more space and thereby decreasing pressure directly above an area of pain, inflammation, swelling, or oedema (Kase *et al.*, 2003).

**Kinesio ® Tex Gold tape:** A proprioceptive hypoallergenic tape that is said to increase the lymphatic and venous microcirculation, reducing the accumulation of lymph/exudate in intercellular space (Kase *et al.*, 2003; Osterhues, 2004; Kataoka, 2005; Lipińska *et al.*, 2007; Szczegieliński *et al.*, 2007), facilitating mechanoreceptor function, improving postural/alignment awareness and assisting in proper muscle/joint positioning ([www.kinesiotaping.co.uk](http://www.kinesiotaping.co.uk), 2010).

**Myofascial pain:** This is pain arising from muscles or related fascia (Bennett, 2007).

**Prevalence:** Prevalence is the number of people in a given population who are suffering from that condition at a specific time (Borenstein *et al.*, 1995).

**Trigger point:** Is a foci of hyperirritable spots found within a taut band of skeletal muscle or in its fascia. (Travell *et al.*, 1999).

**Trigger point - Active:** An active trigger point causing spontaneous pain at rest; range of motion is often decreased and pain intensity can increase on palpation, contraction or stretching of the affected muscle (Bennett, 2007).

**Trigger point - Latent:** A latent trigger point is a trigger point that does not result in spontaneous pain. A latent trigger point may, however, restrict range of motion and cause weakness of the affected muscle (Bennett, 2007).

## **LIST OF ABBREVIATIONS**

<b>ADP:</b>	Adenosine diphosphate
<b>ATP:</b>	Adenosine triphosphate
<b>Ca<sup>2+</sup>:</b>	Calcium ions
<b>DN:</b>	Dry needling
<b>DUT:</b>	Durban University of Technology
<b>GLM:</b>	Generalised Liner Modelling
<b>KT SCT:</b>	Kinesio ® taping space-correction-technique
<b>LLLT:</b>	Low level laser therapy
<b>LTR:</b>	Local twitch response
<b>MPS:</b>	Myofascial pain syndrome
<b>MTP:</b>	Myofascial trigger points
<b>NRS-101:</b>	Numerical pain rating scale-101
<b>NSAIDs:</b>	Non-steroidal anti-inflammatory drugs
<b>PNS:</b>	Post-needling soreness
<b>SR:</b>	Sarcoplasmic reticulum
<b>TENS:</b>	Transcutaneous electrical nerve stimulation

# **CHAPTER ONE**

## **INTRODUCTION**

### **1.1 The problem and its setting**

Myofascial pain syndrome (MPS) and the associated myofascial trigger points (MTP) are one of the most common causes of pain and dysfunction in the musculoskeletal system (Han and Harrison, 1997; Cummings and Baldry, 2007). There are many options for the treatment of MPS and MTP (Travell *et al.*, 1999; Alvarez and Rockwell, 2002). The success of these treatment outcomes is varied, however, Dry needling (DN) has been found to be beneficial in the short and long term for the treatment of MPS and MTP (Hong, 1994; Rowley, 2001; Vernon and Schneider, 2009).

There are various DN techniques currently employed, including single insertion and fanning (Baldry, 2002). Single needle insertion involves inserting the needle directly into the most painful site and leaving it unstimulated for a few minutes (Travell *et al.*, 1999). The fanning technique involves inserting the needle, then partially withdrawing and re-inserting the needle repeatedly from different angles to inactivate all the MTP while maintaining the original insertion point (Travell *et al.*, 1999).

A common side effect occurring in the majority of patients following treatment with DN for myofascial pain conditions is post-needling soreness (PNS) (Hong, 1994; Rowley, 2001).

PNS is a mild local discomfort at the site of the DN insertion that does not exhibit any pain referral or limitation of movement (Travell *et al.*, 1999; Alvarez and Rockwell, 2002). It commonly begins immediately after DN (Ferreira, 2006; Manga, 2008), usually causes maximal pain within twenty four hours of treatment (Huguenin, 2004), but can last for up to four days (Travell *et al.*, 1999) and may be accompanied by unsightly ecchymosis (Alvarez and Rockwell, 2002). Travell *et al.* (1999) believed that PNS was related to



intramuscular haemorrhage, while Hong (1994) had previously noted a correlation between the occurrence of PNS when the patient experienced inflammation and haemorrhage at the DN site.

Travell *et al.* (1999) stated that while the fanning technique had a greater chance of treating MTP, it also caused a higher incidence of blood vessel penetration as a result of the number of insertions. Thus, it can be postulated that DN fanning technique should elicit a higher incidence of PNS. The occurrence of PNS and ecchymosis may cause decreased compliance among patients with regards to attending follow-up treatments with their practitioner (Kirwan *et al.*, 2002). This technique was utilized in this study as it would elicit a high incidence of PNS in the study participants.

Treatment options for PNS have been recommended as moist heat, stretching and pressure application to the needled area by Travell *et al.* (1999), although there is no specific evidence to confirm the effectiveness of these treatment options. Despite cryotherapy being the mainstay of acute injury treatment (MacAuley, 2001), it was found to have no significant effect in reducing PNS (Chonan, 2008).

Action potential therapy, a form of neuromuscular stimulation, has also been investigated as a treatment option for PNS, but was found to have no statistically significant effect (Manga, 2008). As PNS is associated with inflammation and haemorrhage (Hong, 1994; Travell *et al.*, 1999), any proposed treatment modality should have attributes that address these aspects of PNS.

Kinesio ® taping, utilizing Kinesio ® Tex Gold tape and the KTSCT, is thought to decrease pain by increasing lymphatic drainage, increasing venous microcirculation, thereby decreasing inflammation and removing exudates (Kase *et al.*, 2003; Lipińska *et al.*, 2007). Specific investigations on the likely mechanisms of action of the Kinesio ® taping are required. Anecdotal observation and some small clinical studies have suggested that Kinesio ® taping could have a positive effect in reducing PNS by removing the

inflammation and haemorrhage associated with the occurrence of PNS. By addressing these factors attributable to PNS, Kinesio ® taping could aid in alleviating the pain that patients experience after injury and after the application of treatments such as dry needling. While there has been limited research conducted into the postulated efficacy of Kinesio ® taping, specifically in the reduction of inflammation and haemorrhage, Tsai *et al.* (2009) noted that Kinesio ® taping could be used as an alternative treatment for lymphedema. The paucity in the literature shows that there is an opportunity for research to be conducted into whether Kinesio ® taping is a viable treatment option for PNS.

## **1.2 Aims of the study**

The aim of this study was to determine the relative effectiveness of KTSCT utilizing Kinesio ® Tex Gold tape in reducing the level of PNS associated with DN a trapezius muscle trigger point two versus a non-proprioceptive hypoallergenic tape application, compared with DN alone.

## **1.3 Objectives of the study**

### **Objective One:**

To subjectively and objectively measure the level of PNS associated with DN a trapezius muscle trigger point two using the fanning technique.

### **Objective Two:**

To subjectively and objectively determine the effectiveness of KTSCT utilizing Kinesio ® Tex Gold tape, when applied after DN treatment, in reducing the level of PNS associated with DN a trapezius muscle trigger point two using the fanning technique.

### **Objective Three:**

To subjectively and objectively determine the effectiveness of a non-proprioceptive hypoallergenic tape application, when applied after DN

treatment, in reducing the level of PNS associated with DN a trapezius muscle trigger point two using the fanning technique.

#### **Objective Four:**

To compare the groups in terms of subjective and objective data.

- **Null hypothesis:** It was hypothesized that Kinesio ® Taping space-correction-technique would not be an effective intervention for patients experiencing PNS following DN, in terms of both subjective and objective findings, when applied post-DN.

### **1.4 Rationale**

DN fanning technique is an effective treatment modality for MTP (Rowley, 2001), however, PNS occurs in the majority of patients receiving this treatment (Hong, 1994). This is believed to be due to swelling and intramuscular haemorrhage at the DN site (Hong, 1994; Travell *et al.*, 1999).

Kase *et al.* (2003) states that Kinesio ® taping aids in reduction of pain by increasing circulation and lymphatic drainage to remove exudates, and decreasing pressure due to inflammation. However, there is currently limited research available to prove this statement.

If the statement of Kase *et al.* (2003) is assumed correct, this in theory indicates that Kinesio ® taping may reduce/alleviate the pain felt by patients after DN due to PNS.

There is a paucity of published research conducted into the efficacy of Kinesio ® taping in reducing pain specifically due to PNS, so knowledge of the effectiveness of Kinesio ® taping in reducing PNS may assist the practitioner in achieving a higher level of patient compliance to follow-up treatments and thus, increasing treatment success (Arbuthnott and Sharpe , 2009).

## **1.5 Conclusion**

Chapter Two will review the latest literature on MPS, MTP, PNS and Kinesio® taping.

Chapter Three will describe in detail the methodology of this study.

Chapter Four will present the statistical analysis of the results.

Chapter Five will offer a discussion of the results.

Chapter Six will provide the conclusion, and recommendations for the management of PNS and future studies.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter reviews the literature concerning the MPS, MTP, the trapezius muscle and its MTP, PNS, the effects of Kinesio ® taping and how it may aid in the treatment of PNS.

##### **2.1.1 Definition of myofascial pain syndrome**

MPS is the occurrence of pain due to a disorder in a muscle or its related fascial components (Bennett, 2007). MPS commonly occurs due to the presence of MTP in skeletal muscles and their ligaments (Alvarez and Rockwell, 2002; Bennett, 2007).

#### **2.2 Epidemiology of myofascial pain syndrome**

##### **2.2.1 Incidence and prevalence of myofascial pain syndrome**

MTP are one of the most common causes of pain and dysfunction in the musculoskeletal system (Han and Harrison, 1997; Cummings and Baldry, 2007). There is a paucity of literature regarding the incidence or prevalence of MTP in South Africa, however, it has been estimated that approximately 44 million Americans have MTP related disorders (Bennett, 2007).

MPS commonly presents between 27 and 50 years of age, with a high prevalence in sedentary individuals (Delgado *et al.*, 2009).

The incidence of MTP has been found to vary from 30% to 95% of people who have presented to pain treatment clinics (Han and Harrison, 1997; Borg-Stein and Simons, 2002; Bennett, 2007; Delgado *et al.*, 2009; Partanen *et al.*, 2010; Tough *et al.*, 2010). These studies covered a variety of general medical, specialist and pain management clinics. In addition, Travell *et al.* (1999) states that latent MTP, which do not present with spontaneous pain are more common than active (painful) MTP and thus may be unreported.

MTP are commonly found in the muscles of mastication, neck, shoulders, low back, upper and lower extremities (Han and Harrison, 1997; Bennett, 2007; Delgado *et al.*, 2009).

### **2.2.2 Gender and myofascial pain syndrome**

MTP have been found to be more prevalent in women than in men (Han and Harrison, 1997; Cummings and Baldry, 2007). This has been attributed to the higher proportion of women in sedentary occupations (typing/desk work) than men, as physical activity decreases the occurrence of MTP (Cummings and Baldry, 2007).

## **2.3 Aetiology of myofascial pain syndrome and myofascial trigger points**

To understand the development and perpetuation of MTP, it is necessary to have a basic understanding of muscle structure and physiology.

### **2.3.1 Muscle structure and physiology**

Muscles that cause movement in the body are termed skeletal muscles (Moore and Agur, 2002). These are attached either directly or indirectly through tendons to bones, cartilage, ligaments, fascia, organs or the skin (Moore and Agur, 2002).

The structural unit of the muscle is called a muscle fibre (Moore and Agur, 2002). The muscle fibre is innervated by a motor neuron nerve cell which attaches to the muscle at the motor endplate and forms a functional connection with the central nervous system (Stedman's Medical Dictionary for the Health Professions and Nursing, 2005). When combined, the muscle fibre and motor neuron form the muscles functional unit (Moore and Agur, 2002). Each muscle fibre is surrounded by a connective tissue sleeve called the endomysium (Moore and Agur, 2002). Parallel muscle fibres are grouped together to form a muscle fascicle and invested by the perimysium connective tissue sheet (Moore and Agur, 2002). The whole muscle is then enveloped by a coarse epimysium connective tissue covering (Moore and Agur, 2002).

The endomysium, perimysium and epimysium connective tissue layers extend beyond the muscle to form the connective tissue tendon that anchors the muscle to its origin and insertion points (Tortora and Derrickson, 2006).

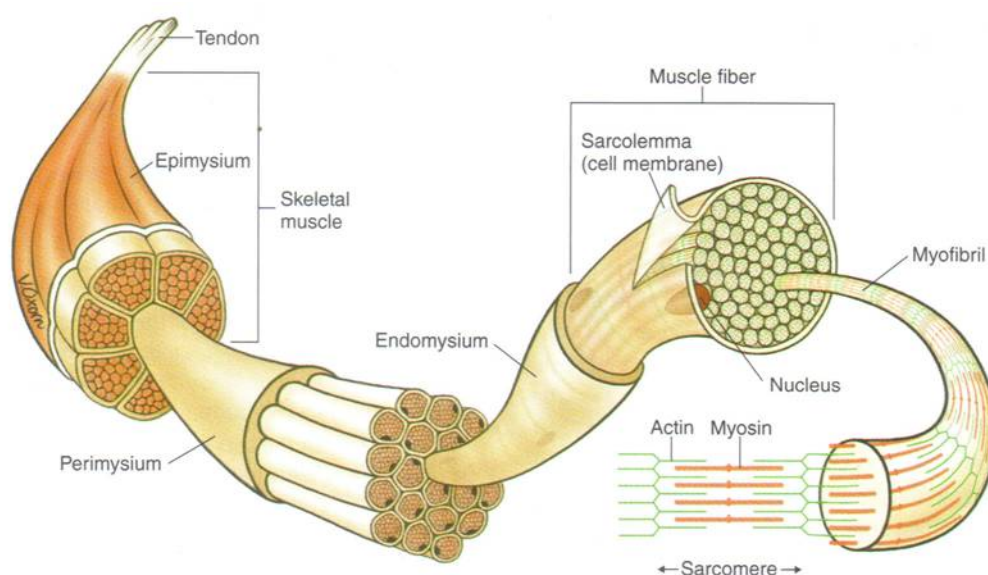


Figure 2.1: Skeletal muscle structure (Moore and Agur, 2002)

Each muscle fibre contains between one and two thousand myofibrils (Travell *et al.*, 1999). These myofibrils contain the muscle cells contractile organelle, the sarcomere (Tortora and Derrickson, 2006). Each sarcomere consists of an array of overlapping actin and myosin protein filaments (Tortora and Derrickson, 2006). When stimulated, these filaments interact and slide along

each other to produce the muscles contractile force (Tortora and Derrickson, 2006). The sarcomeres are connected longitudinally into chains that extend the length of the myofibril (Travell *et al.*, 1999; Tortora and Derrickson, 2006).

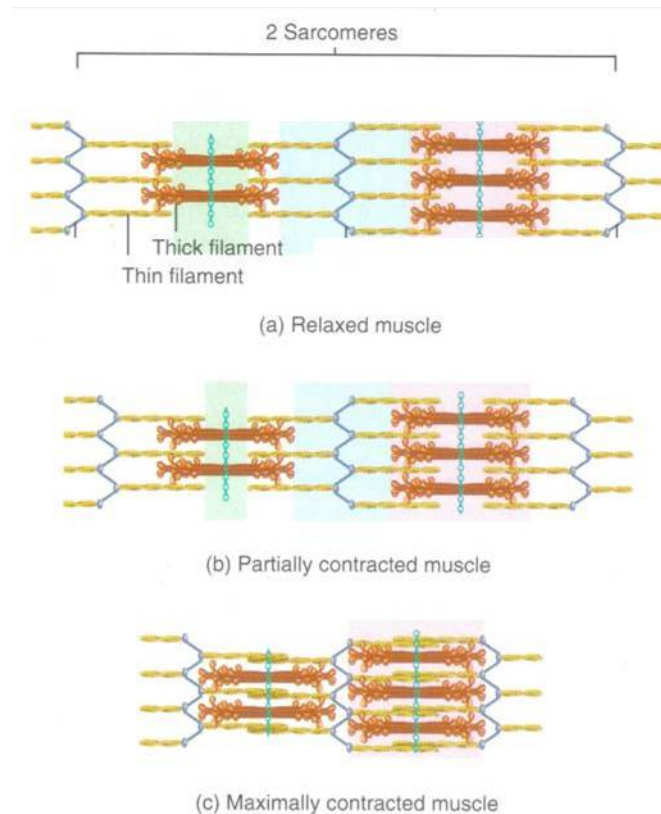


Figure 2.2: Muscle contraction (Tortora and Derrickson, 2006).

The muscle fibres are also enveloped by a plasma cell membrane, called the sarcolemma (Tortora and Derrickson, 2006). The sarcolemma forms a reservoir within which the sarcoplasm (the muscles cytoplasm) is stored (Tortora and Derrickson, 2006). This sarcoplasm contains all the glycogen, myoglobin, calcium ions ( $\text{Ca}^{2+}$ ) and mitochondria organelles required for muscle contraction (Tortora and Derrickson, 2006). Connected to the sarcolemma is an extensive network of tubules, called the sarcoplasmic reticulum (SR), which functions to transport the molecules and ions from the sarcolemma to the areas on the myofibrils where they are required (Travell *et al.*, 1999; Tortora and Derrickson, 2006).



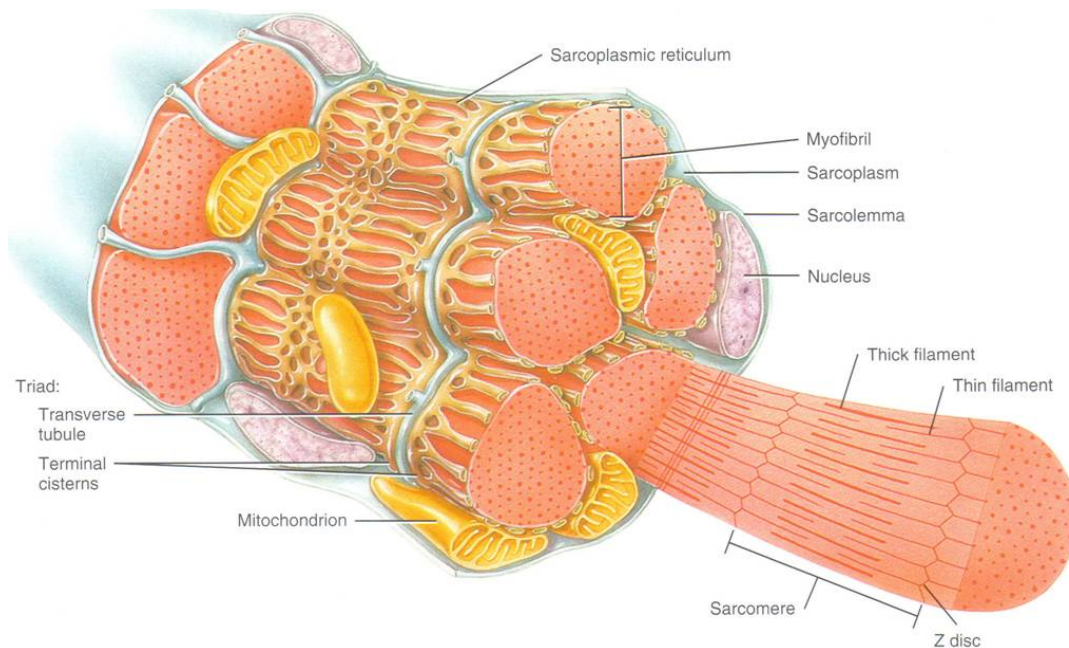


Figure 2.3: Microscopic organization of skeletal muscle  
(Tortora and Derrickson, 2006).

Glycogen is a large storage form of glucose, which is used by the muscles mitochondria to form adenosine triphosphate (ATP). ATP is the energy unit of the body and powers virtually all of the body's functions, including muscle contraction. As such, one of the primary functions of the SR is to ensure ATP availability at the muscle's motor unit (Tortora and Derrickson, 2006).

When a nerve impulse is transmitted from the central nervous system, along the motor neuron to the motor endplate, it triggers a release of  $\text{Ca}^{2+}$  from the SR into the myofibrils. The influx of  $\text{Ca}^{2+}$  triggers the interaction between the actin and myosin filaments which initiates muscle contraction. Once the nerve impulse stops, the free  $\text{Ca}^{2+}$  is pumped back into the SR by ATP powered active transport pumps, the actin and myosin filaments release, returning the sarcomere to its original relaxed state (Travell *et al.*, 1999; Tortora and Derrickson, 2006).

The SR also is responsible for ensuring removal of adenosine diphosphate (ADP) and lactic acid from the muscle. These substances are the waste products of muscle contraction and contribute to muscle fatigue. An increase

of lactic acid can also affect the cells pH, which has a detrimental effect on cell functioning (Tortora and Derrickson, 2006).

### **2.3.2 Myofascial trigger point development**

According to Han and Harrison (1997), Travell *et al.* (1999), Alvarez and Rockwell (2002) and Cummings and Baldry (2007), the postulated causes of MTP include:

- Climatic causes (including excessive cold, heat, draughts and damp).
- Osteoarthritis and disorders of bones and/or joints.
- Psychological factors such as emotional stress and anxiety.
- Metabolic deficiencies and endocrine disorders.
- Motor nerve radiculopathy.
- Muscle atrophy and ischemia.
- Poor posture and environmental ergonomics.
- Sedentary lifestyles and/or a lack of exercise.
- Trauma (including contusions, sprains, overuse and overloading).
- Visceral pain referral.
- Vitamin and mineral deficiencies.

Despite these causative factors being identified, there remains no consensus on the aetiology of MTP. There are several theories that have been proposed, including the radiculopathic pain model, the muscle spindle concept, the energy crisis theory, the motor endplate hypothesis and the integrated hypothesis. The integrated hypothesis is currently the most credible and utilized hypothesis (Simons, 2008).

### **2.3.2.1 The radiculopathic pain theory**

The radiculopathic pain model, as suggested by Gunn (1997), states that intervertebral disc degeneration and paraspinal muscle spasm causes entrapment and compression of the nerve root. This sensitizes the distal part of the nerve causing spasms in the muscles that are innervated by the nerve, which initiates the formation of MTP. Further studies have not been able to confirm this theory and it is no longer widely used (Huguenin, 2004).

### **2.3.2.2 The muscle spindle theory**

The muscle spindle concept was proposed when Travell *et al.* (1999) noted that there was a localized increase in electrical activity in MTP. This activity originates from dysfunctional muscle spindles and results from a mechanically induced release of acetylcholine. This theory, however, remains unproven.

### **2.3.2.3 The energy crisis theory**

The energy crisis theory postulates that an increased physical demand, macrotrauma or recurrent microtrauma to the muscle fibers leads to an increased release of calcium and prolonged shortening of the sarcomeres. This, in turn, compromises local circulation, leading to a reduction in oxygen supply and subsequently insufficient ATP synthesis to initiate relaxation of the muscle fibres (Huguenin, 2004). This prolonged contraction can result in an accumulation of metabolic waste products (Tortora and Derrickson, 2006), which can sensitise nerves and cause pain (Huguenin, 2004). This theory, however, remains unproven.

#### **2.3.2.4 The motor endplate hypothesis**

The motor endplate hypothesis states that there is a pathological increase in the release of acetylcholine from abnormal motor endplate nerve terminals, even during their resting state (Borg-Stein and Simons, 2002). This increase concentration of acetylcholine could produce sustained sarcomere shortening and contracture (Borg-Stein and Simons, 2002; Tortora and Derrickson, 2006). This theory, however, remains unproven.

#### **2.3.2.5 The integrated hypothesis**

The integrated hypothesis, as proposed by Travell *et al.* (1999), accounts for all the major MTP characteristics by incorporating the energy crisis and motor endplate hypotheses. It accounts for changes that occur in: the local myofascial tissues; the central nervous system; myofascial biomechanics and expands on the previously proposed hypotheses (Rickards, 2006).

The integrated hypothesis states that an injury to the muscle fibres disrupts the SR, which allows for an abnormal increase in the release of calcium that initiates a sustained sarcomere contraction. This sustained contraction consumes the local ATP reserves and compromises local circulation. When the circulation is compromised, there is a shortage of oxygen and ATP at the contraction knot. This energy crisis prevents the sarcoplasmic reticulum from reabsorbing the excess calcium that was released and thereby perpetuates the abnormal muscle contraction (Travell *et al.*, 1999; Tunks and Crook, 1999; Rickards, 2006; Shah and Gilliams, 2008; Simons, 2008). Additionally, the local energy crisis may initiate an increase in pH, a release of metabolic by-products and neuroreactive substances (including bradykinins, substance P, calcitonin gene-related peptide, tumor necrosis factor, interleukin 1/6/8, serotonin, prostaglandins and norepinephrine). The elevation of these noxious elements can perpetuate and intensify the pain felt at the MTP (Shah *et al.*, 2005; Shah and Gilliams, 2008; Shah *et al.*, 2008; Simons, 2008).

The integrated hypothesis is supported by available electro diagnostic and histopathological evidence and provides the basis for a plausible pathogenesis of MTP (Rickards, 2006).

### **2.3.3 Clinical characteristics of myofascial trigger points**

Travell *et al.* (1999) described a MTP as a foci of hyperirritable spots found within a taut band of skeletal muscle or in its fascia. The MTP can either be active or latent, with active MTP causing spontaneous pain at rest, while latent MTP do not.

MTP commonly present with the following clinical characteristics:

- Poorly localized, regional, aching pain or paraesthesia in any skeletal muscle or joint (Travell *et al.*, 1999; Alvarez and Rockwell, 2002; Partanen *et al.*, 2010).
- MTP pain is perceived as a dull, non-pulsating pain, which can vary from mild discomfort to incapacitating pain (Delgado *et al.*, 2009).
- The pain intensity can increase on palpation, contraction or stretching of the affected muscle (Bennett, 2007).
- A taut band in the muscle (Alvarez and Rockwell, 2002; Bennett, 2007; Partanen *et al.*, 2010).
- A local twitch response (LTR) within the taut band of muscle upon palpation (Partanen *et al.*, 2010)
- Decreased range of motion in the affected muscle (Bennett, 2007; Partanen *et al.*, 2010).
- Autonomic abnormalities including sweating, persistent lacrimation, coryza, excessive salivation, and pilomotor activities (Travell *et al.*, 1999).
- Proprioceptive disturbances including imbalance, dizziness, tinnitus, and distorted weight perception of lifted objects (Travell *et al.*, 1999).
- Motor function disturbances including adjacent muscle spasms, weakness, decreased coordination and decreased endurance of the involved muscle (Travell *et al.*, 1999).
- Sleep disturbance (Travell *et al.*, 1999)

### 2.3.4 Locating myofascial trigger points

A sound knowledge of the referred pain patterns and symptoms of the body's MTP is essential to aid in identifying the muscle that contains the offending MTP. Once the muscle is located, the examiner must then utilise either flat or pincer palpation technique to locate the MTP (Travell *et al.*, 1999).

Flat palpation involves sliding the fingertips over the patient's skin to detect changes in fibre tension under the skin (Figure 2.4). The taut band containing the MTP will feel like a cord of one to four millimetre diameter under the skin (Travell *et al.*, 1999).

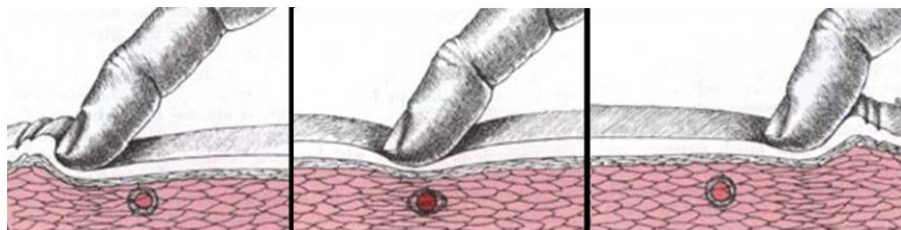


Figure 2.4: Flat palpation (Travell *et al.*, 1999).

Pincer palpation is performed by grasping the muscle belly between the forefinger and thumb, then rolling the muscle belly back and forth (Figure 2.5) to locate the taut band (Travell *et al.*, 1999).

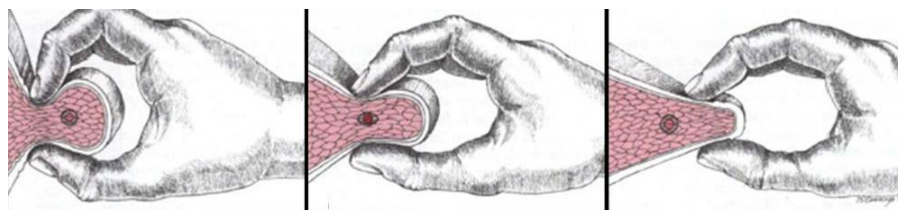


Figure 2.5: Pincer palpation (Travell *et al.*, 1999).

Travell *et al.* (1999) advises that once the taut band has been identified, the location of the MTP can be located by exploring the length of the taut band for the nodule and point of maximal tenderness. Application of pressure to this point may elicit local twitch response and / or exacerbate the referred pain pattern and symptoms of the patient (Travell *et al.*, 1999; Bennett, 2007).

In a small scale, descriptive study by Sikdar *et al.* (2009), it was shown that MTP, surrounding tissue abnormalities and morphological changes could be located utilizing 2D US imaging. Sikdar *et al.* (2009), however, did state that further investigation was required to develop the imaging technique.

## **2.4 Trapezius muscle overview**

The trapezius muscle is a diamond shaped tripartite muscle divided into upper, middle and lower sections, with the distinction based on muscle fibre directions and function (Travell *et al.*, 1999). As it is not possible to distinguish the boundaries between the individual muscle segments by palpation, the upper, middle and lower sections are commonly defined by their anatomical attachment alone (Travell *et al.*, 1999).

### **2.4.1 Attachments of the trapezius muscle**

The proximal attachments of the trapezius run from the medial third of the occiputs nuchal line, the external occipital protuberance, the nuchal ligament, the spinous processes and interspinous ligaments of the seventh cervical to the twelfth thoracic vertebrae (Travell *et al.*, 1999; Moore and Agur, 2002; Vizniak, 2010). The muscle fibres then extend laterally to their distal attachments at the lateral third of the clavicle, the acromion and the spine of the scapula (Travell *et al.*, 1999; Moore and Agur, 2002; Vizniak, 2010) (Figure 2.6).

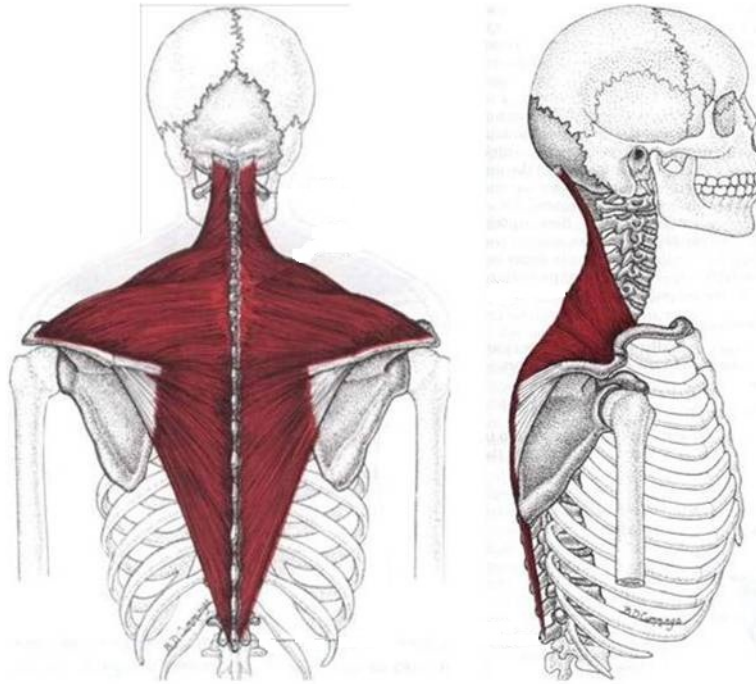


Figure 2.6: Trapezius attachments (Travell *et al.*, 1999).

### 2.4.2 Actions of the trapezius muscle

Acting unilaterally, the upper trapezius fibres extend and laterally flex the neck to the same side, aids in end range rotation to the opposite side, rotates and elevates the distal side clavicle (and indirectly the scapula). The middle trapezius fibres adduct and can assist with upward rotation of the lateral side of the scapula. The lower trapezius fibres stabilize upward rotation of the scapula (caused by the upper trapezius fibres) and depress the scapula. Acting bilaterally, the entire muscle aids in extension of the cervical and thoracic spine (Travell *et al.*, 1999; Moore and Agur, 2002).

### 2.4.3 Innervation and blood supply of the trapezius muscle

The motor innervation of the trapezius is supplied by the spinal part of the accessory nerve (cranial nerve XI), while the sensory innervation is supplied by the second to fourth cervical nerves (Travell *et al.*, 1999; Moore and Agur, 2002; Vizniak, 2010). The trapezius muscle receives its blood supply from the transverse cervical and dorsal scapula arteries (Vizniak, 2010).



#### 2.4.4 Trigger point locations and pain referral patterns of the trapezius muscle

According to Travell *et al.*, (1999), the trapezius muscle contains 7 trigger point locations on both sides of the paired trapezii. MTP symptoms primarily involve pain referral characteristic patterns and minor limitations in range of motion.

Trapezius MTP1 is located in the middle of the vertical fibres of the upper trapezius (Travell *et al.*, 1999). The pain referral zone extends superiorly from the MTP to the mastoid process, around the side of the head and into the temple and posterior orbit (Travell *et al.*, 1999) (Figure 2.7).

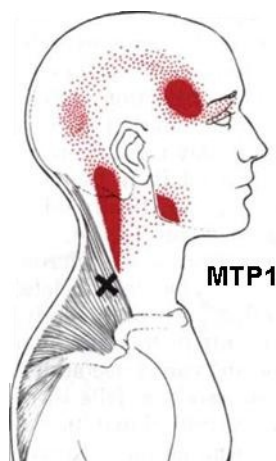


Figure 2.7: Trapezius MTP1 (Travell *et al.*, 1999).

[Note: MTP location shown by black cross and pain referral zone indicated by red shaded area on the side of the trigger point]

Trapezius MTP2 is located in the middle of the horizontal fibres of the upper trapezius (Travell *et al.*, 1999). The pain referral zone lies over the lateral aspect of the upper trapezius fibres and superiorly to the ipsilateral occiput (Travell *et al.*, 1999) (Figure 2.8).

Trapezius MTP3 is located in the mid fibre region of the lower trapezius, just medially to the scapular inferior angle (Travell *et al.*, 1999). The pain referral zone extends superiorly from the MTP to the ipsilateral occiput and superolaterally to the acromion ipsilaterally (Travell *et al.*, 1999) (Figure 2.8).

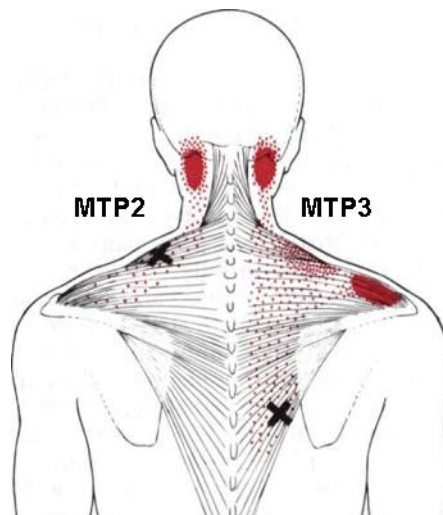


Figure 2.8: Trapezius MTP2 and 3 (Travell *et al.*, 1999).

Trapezius MTP4 is located just inferiorly to the medial end of the spine of the scapula (Travell *et al.*, 1999). The pain referral zone is centred over the MTP location and extends along the medial scapular border (Travell *et al.*, 1999) (Figure 2.9).

Trapezius MTP5 is located over the scapular superior angle (Travell *et al.*, 1999). The pain referral zone extends from the MTP location medially to concentrate ipsilaterally adjacent to the lower cervical and upper thoracic spinous processes (Travell *et al.*, 1999) (Figure 2.9).

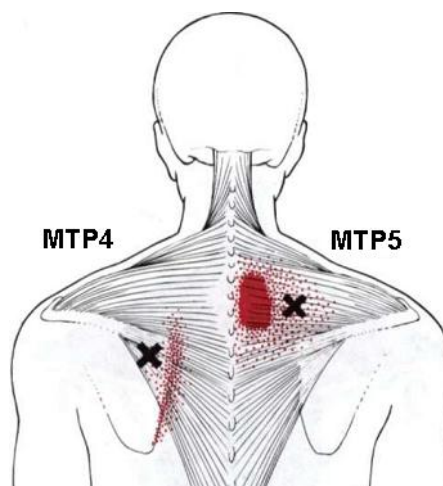


Figure 2.9: Trapezius MTP4 and 5 (Travell *et al.*, 1999).

Trapezius MTP6 is located in the distal fibres of the middle trapezius, adjacent to their insertion at the acromion (Travell *et al.*, 1999). The pain referral zone is concentrated over the MTP location ipsilaterally (Travell *et al.*, 1999) (Figure 2.10).

Trapezius MTP7 is located in the mid fibre region of the middle trapezius, (Travell *et al.*, 1999), represented by the encircled area of Figure 2.10. The MTP produces a 'shivery' sensation with pilomotor erection (gooseflesh) on the lateral aspect of the ipsilateral arm (Travell *et al.*, 1999) (Figure 2.10).

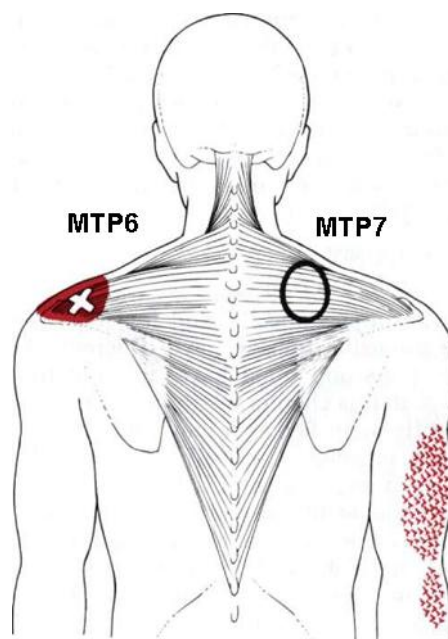


Figure 2.10: Trapezius MTP6 and 7 (Travell *et al.*, 1999).

## **2.5 Management of myofascial trigger points**

The effective management of MTP does not only involve eliminating the MTP but also addressing and correcting the underlying cause of the MTP (Travell *et al.*, 1999). Any lifestyle or ergonomic factors that could be perpetuating the MTP, should also be identified and addressed during the management of the MTP. By managing the patient as such, the practitioner will treat the MTP effectively, aid in returning the patient to normal muscle functioning and decrease the chance of reoccurrence of the MTP (Travell *et al.*, 1999).

## **2.5.1 Non-invasive techniques**

Various non-invasive techniques have been suggested for the treatment of MTP. These include stretch and spray, cryotherapy, transcutaneous electrical nerve stimulation (TENS), ultrasound, low level laser therapy (LLLT), pharmacological intervention, muscle strengthening, massage and ischaemic compression (Travell *et al.*, 1999; Huguenin, 2004; Brukner and Khan, 2006; Bennett, 2007).

### **2.5.1.1 Stretch and Spray**

Travell *et al.*, (1999) popularized the use of stretching the affected muscle following the application of a vapocoolant spray as a treatment option for MTP and noted that it was the most effective non-invasive MTP treatment technique. Travell *et al.*, (1999) explained the technique as placing the affected muscle in the stretched position and applying a few sweeps of a vapocoolant spray along the length of the muscle. It is believed that the vapocoolant spray reduced the discomfort of the subsequent stretch and thus improved its efficacy (Huguenin, 2004; Cummings and Baldry, 2007).

### **2.5.1.2 Cryotherapy**

Cryotherapy provides analgesia by decreasing sensory and motor nerve conduction velocity. This decreases muscle tension, spasm and, therefore, pain (Brukner and Khan, 2006).

Brukner and Khan (2006) describes cryotherapy as placing either reusable cold packs or crushed ice bags onto the affected area or immersing the affected area into an ice bath.

### **2.5.1.3 Transcutaneous electrical nerve stimulation**

TENS is a commonly used electro-modality in the treatment of sporting injuries, that utilizes a direct current applied to the skin via the application of electrode pads to the affected area, causing electrical stimulation of the underlying muscle tissue (Brukner and Khan, 2006; Gemmell and Hilland, 2011).

However, studies into its effectiveness have shown conflicting results (Borg-Stein and Simons, 2002; Hou *et al.*, 2002; Huguenin, 2004; Brukner and Khan, 2006).

### **2.5.1.4 Ultrasound**

Ultrasound therapy utilizes high frequency sound waves to treat acute and chronic musculoskeletal disorders. The sound waves stimulate the tissue at a molecular level, causing vibration of the molecules which results in heat generation. The molecular vibration may also elicit certain chemical changes, although these are not clearly understood (Gam *et al.*, 1998; Travell *et al.*, 1999).

There has, however, been conflicting results regarding the use of ultrasound therapy alone, in the treatment of myofascial pain patients (Huguenin, 2004; Brukner and Khan, 2006; Cummings and Baldry, 2007; Sarrafzadeh *et al.*, 2012).

### **2.5.1.5 Low level laser therapy**

Laser is an acronym for 'Light Amplification by Stimulated Emission of Radiation'. It utilizes a specific wavelength of light, generated by high-intensity electrical stimulation of a gas, liquid, crystal, dye, or semiconductor medium to stimulate nerve fibres, in either a continuous, wave or pulsed mode (Brukner and Khan, 2006; Chow *et al.*, 2009).

LLLT has shown mixed results regarding its therapeutic effect on MTP and there is no plausible mechanism of action given the limited penetration of LLLT into the muscle tissue (Huguenin, 2004; Brukner and Khan, 2006; Cummings and Baldry, 2007; Chow *et al.*, 2009).

#### **2.5.1.6 Pharmacological intervention**

Numerous pharmacological interventions have been utilized in the treatment of MTP. These include orally administered non-steroidal anti-inflammatory drugs (NSAIDs), antidepressants, anticonvulsants, corticosteroids and topical analgesics (Borg-Stein and Simons, 2002; Brukner and Khan, 2006).

Currently, there is no evidence that any form of oral or topically administered drug treatment eliminates myofascial trigger points, however, antidepressants can aid patients with associated sleep disturbances, while NSAIDs and other analgesics may provide moderate symptomatic relief (Bennett, 2007).

#### **2.5.1.7 Muscle strengthening**

The presence of MTP in a muscle commonly causes weakness due to the inhibitory effects of pain (Travell *et al.*, 1999). Thus, a strengthening programme can aid in restoring full function to the affected muscles (Brukner and Khan, 2006). A strengthening programme can also increase the muscles functional capacity, which will minimize the risk of recurrence and perpetuation of MTP due to muscle overload (Travell *et al.*, 1999; Bennett, 2007).

### **2.5.1.8 Massage and Ischemic compression**

Massage and ischemic compression aids in the reduction of muscle spasm and deactivation of MTP by mechanically breaking down fibrous bands in muscle, improving circulation and stimulating muscle sensory receptors (Travell *et al.*, 1999; Brukner and Khan, 2006; Trampas *et al.*, 2010).

Massage and ischemic compression has been shown to be beneficial in the treatment of MPS when combined with other treatment protocols (Brukner and Khan, 2006; Trampas *et al.*, 2010).

## **2.5.2 Invasive techniques**

### **2.5.2.1 Trigger point injection**

Trigger point injection, as advocated by Travell *et al.* (1999) involves the injection of either a local anaesthetic or saline substance into the loci of the MTP. MTP injection may utilize several medications, including Procaine, Lidocaine, isotonic saline solution, corticosteroids, Botulinum toxin A, Diclofenac Bupivacaine and Mepivacaine (Hong, 1994; Han and Harrison, 1997; Travell *et al.*, 1999; Borg-Stein and Simons, 2002; Malanga and Wolff, 2008).

Han and Harrison (1997) proposed the following mechanisms for the inactivation of MTP by trigger point injection:

- Mechanical disruption on the nerve endings.
- Mechanical disruption of the muscle fibres causing an increase of extracellular potassium, which causes nerve fibre depolarization.
- Interruption of the positive feedback pain mechanism.
- Dilution of nociceptive substances by the injected substance.
- Vasodilatation, which increases the removal of nociceptive substances and metabolites.

Cummings and White (2001) found that the composition of the injected substance makes no difference to the outcome of the MTP treatment and that trigger point injection had no therapeutic advantages over DN.

Borg-Stein and Simons (2008) postulated that the mechanical stimulation of the needle disrupts and terminates the dysfunctional activity of involved motor endplates, with or without an injection.

Han and Harrison (1997) stated that trigger point injection is an effective and popular treatment approach for MTP due to the analgesic effect of the injected substances, however, patients are at risk for becoming dependent on the analgesic substances for pain relief (Borg-Stein and Simons, 2002).

Brukner and Khan (2006) concluded that repeated injections to one site should be limited and only employed for conditions that have not responded to other forms of treatment.

### **2.5.2.2 Dry needling**

DN of MTP is one of the most commonly used treatment methods for MPS in the world (Cummings and Baldry, 2007), and according to Dommerholt *et al.* (2006), DN is used by over seventy five percent of South African physical therapists on a daily basis. Its origins are based in Chinese acupuncture, which is a traditional form of healing used for over 2 500 years (van der Ploeg and Yi, 2009). Acupuncture differs from DN in that acupuncture utilizes needle insertion into specific fixed sites on the body, whereas DN involves needle insertion in MTP that can occur in any muscle of the body (Han and Harrison, 1997).

DN involves either single or multiple insertions of a solid thin gauge stainless steel filiform acupuncture needle into the most tender spot /nodule of the taut band (Lewit, 1979; Travell *et al.*, 1999; Huguenin, 2004; Yap, 2007). Various



techniques may be used to stimulate the MTP once the needle has been inserted, including fanning, rotation, snapping, thrusting, twirling and vibration (Baldry, 1993).

The fanning DN technique involves repeatedly withdrawing and re-inserting the needle tangentially at different orientations. The needle should only be withdrawn to the skin's subcutaneous layer, thus maintaining the original entry point into the skin. This technique has a high success rate at deactivating the MTP due to the multiple advances of the needle increasing the chance of stimulating the MTP loci (Travell *et al.*, 1999).

Bubnov (2010), proposed the use of ultrasound imaging guidance for deep DN, as it could improve the effectiveness and safety of the DN treatment.

DN is believed to deactivate MTP due to the following postulated mechanisms:

- The needle causes disruption and release of the contraction knot in the muscle. This removes the stimulus of the local nerve ending sensitization and the local energy crisis, both of which contribute to the perpetuation of MTP (Travell *et al.*, 1999).
- Mechanical disruption of muscle tissue causes an increased level of extracellular potassium, this causes depolarization and resultant desensitization of the adjacent nerve fibres (Han and Harrison, 1997; Travell *et al.*, 1999).
- The removal of nerve sensitizing substances and metabolites by local vasodilatation and haemorrhage (Hong, 1994; Travell *et al.*, 1999).
- DN causes generalized neurohumoral stimulation and release of endorphins. The endorphin secretion inhibits nociception and provides pain relief by way of spinal cord pathway modulation (Yap, 2007).
- Mechanical disruption of local nerve endings to cause hyper stimulation analgesia, interrupting the positive central feedback mechanism that perpetuates pain (Gatterman and Goe, 1990; Han and Harrison, 1997).

Hong (1994), Han and Harrison (1997), Travell *et al.* (1999), Borg-Stein and Simons (2002) and Brukner and Khan (2006) have found that DN is most effective at treating MTP if the exact site of maximal tenderness is needled and a painful, transient muscle fibre contraction, known as a LTR, is elicited.

If a LTR is elicited, immediate analgesia can be expected. This is termed the 'needle effect' (Lewit, 1979; Travell *et al.*, 1999; Huguenin, 2004; Yap, 2007).

DN has been found to be as effective as trigger point injection in deactivating the MTP, however, it does result in a longer duration and increased intensity of PNS due to the lack of local anaesthetic agents (Hong, 1994; Han and Harrison, 1997; Travell *et al.*, 1999; Borg-Stein and Simons, 2002).

Despite the increased duration and intensity of PNS, DN is recommended as a safer option for the patient (Rickards, 2006), as trigger point injections are associated with any potential unwanted side effects of medicinal substances that are injected. These include allergic reactions, muscle necrosis, skin depigmentation and tendon atrophy (Travell *et al.*, 1999; Baldry, 2002).

The commonly accepted technique utilized for DN was explained by Travell *et al.* (1999) as follows:

- When flat palpation was used to locate the MTP, the nodule can be fixed in position by pinning it between the practitioner's two fingers. The needle can then be aimed midway between the fingers and inserted to whatever depth is necessary (Figure 2.11).

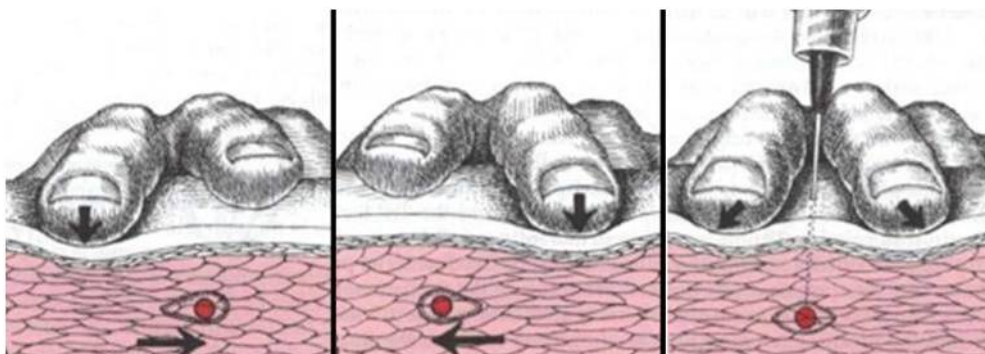


Figure 2.11: Flat palpation dry needling (Travell *et al.*, 1999).

- When pincer palpation was used, the nodule can be held tightly in place by the thumb and finger tips in the same manner as the MTP was located. The practitioner can accurately insert the needle into the nodule by aiming between the thumb and finger tips (Figure 2.12).



Figure 2.12: Pincer palpation dry needling (Travell *et al.*, 1999).

For the purpose of consistency, pincer palpation DN technique was used during the course of this study, for DN trapezius MTP2.

A variation of DN, known as electroacupuncture, which involves the passage of an electrical current through the DN needle is used among some practitioners. There has, however, been limited research into the efficacy and safety of electroacupuncture and further studies are required (Aranha *et al.*, 2011).

### **2.5.3 Post-needling soreness**

PNS is a localized constant pressure or a dull aching sensation at the site of the needle insertion following DN treatment of MTP (Hong, 1994; Alvarez and Rockwell, 2002), that the patient will perceive as a different entity from either MTP or MPS (Lewit, 1979).

### 2.5.3.1 Post-needling soreness incidence

PNS is a common side effect, occurring in the majority of patients following DN treatment for MPS conditions (Hong, 1994; Rowley, 2001).

PNS commonly begins immediately after DN (Ferreira, 2006; Manga, 2008), usually causes maximal pain within 24 hours of treatment (Huguenin, 2004) but can last for up to 4 days and may be accompanied by unsightly ecchymosis (Travell *et al.*, 1999).

### 2.5.3.2 Post-needling soreness aetiology

Travell *et al.* (1999) believed that PNS was related to intramuscular haemorrhage, while Hong (1994) had previously noted a correlation between the occurrence of PNS when the patient experienced swelling and haemorrhage at the needling site.

Gatterman and Goe (1990) explained that tissue damage leads to the development of local pain as illustrated in the following way.

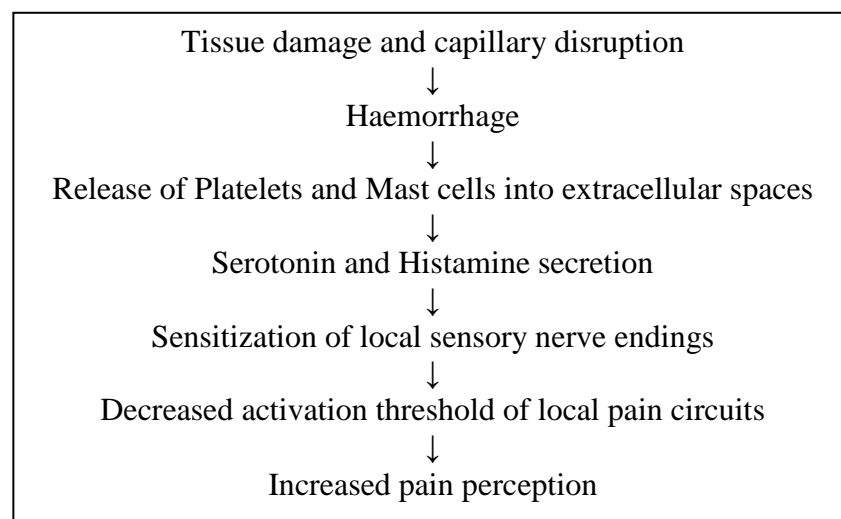


Figure 2.13: Flow diagram of pain production following tissue damage  
(Adapted from Gatterman and Goe, 1990).

Travell *et al.* (1999) stated that while the DN fanning technique had a greater chance of treating MTP, it also caused a higher incidence of blood vessel penetration as a result of the number of advances of the needle. Thus, it can be postulated that DN fanning technique should elicit a higher incidence of PNS. Rowley (2001) confirmed this by showing that patients receiving the DN fanning technique experienced greater levels of PNS when compared to patients receiving the single DN insertion technique.

### **2.5.3.3 Effects of post-needling soreness on myofascial trigger point management**

The occurrence of PNS with ecchymosis may be disagreeable to the patient and cause decreased compliance with regards to following advice from or attending follow up treatments with their practitioner (Kirwin *et al.*, 2002; Huguenin, 2004).

### **2.5.3.4 Post-needling soreness management**

Travell *et al.* (1999) recommended the following management options for PNS: moist heat, stretching and pressure application to the needled area, although there is very little available evidence to confirm the effectiveness of these treatment options. Despite cryotherapy being the mainstay of acute injury treatment (MacAuley, 2001), it was found to have no significant effect in reducing PNS (Chonan, 2008). Action potential therapy has also been investigated as a treatment option for PNS, but was found to have no statistically significant effect (Manga, 2008).

As PNS is associated with swelling and haemorrhage (Hong, 1994; Travell *et al.*, 1999), any proposed treatment modality should have attributes that address these aspects of PNS.

## **2.6 Kinesio Taping**

### **2.6.1 Introduction**

In 1973, Dr Kenzo Kase, D.C. developed the Kinesio® taping techniques and Kinesio® Tex Gold tape as an alternative to standard athletic taping that could aid the lymphatic and muscle systems to help promote recovery from injuries ([www.kinesiotaping.co.uk](http://www.kinesiotaping.co.uk), 2010). Kinesio® taping gained worldwide exposure during the 1988 Seoul Olympics and subsequently has become one of the fastest growing and most visible treatment modalities for sporting injuries in the world ([www.kinesiotaping.co.uk](http://www.kinesiotaping.co.uk), 2010).

Kinesio® Tex Gold tape was designed to mimic the epidermis of the skin, thus avoiding any unwanted sensory stimuli when properly applied (Kase *et al.*, 2003). To achieve this, the tape is constructed of polymer elastic strands wrapped by one hundred percent cotton fibres, allowing for a longitudinal stretch of fifty five to sixty percent of its resting length and having a thickness approximately the same as the epidermis (Kase *et al.*, 2003). The cotton fibres used in the tapes construction allow for evaporation of body moisture and quick drying (Kase *et al.*, 2003). The tapes adhesive, which is one hundred percent acrylic, is activated by heat (Kase *et al.*, 2003) and is laid onto the tape in a distinctive wave-pattern ([www.kinesiotaping.com](http://www.kinesiotaping.com), 2011).

The wave-pattern differentiates Kinesio® Tex Gold tape from standard non-proprioceptive tape which has a uniform adhesive application ([www.kinesiotaping.com](http://www.kinesiotaping.com), 2011). The tapes adhesive, together with the elastic polymers are designed to remain attached and be effective for three to five days (Kase *et al.*, 2003).

## **2.6.2 Applications and Effects**

Kinesio ® taping has a number of corrective techniques, including mechanical, fascia, lymphatic, ligament/tendon, functional and space-correction (Kase *et al.*, 2003). These techniques allow the practitioner to tape the patient in such a way that it assists the body in correcting the condition affecting the patient (Kase *et al.*, 2003).

### **2.6.2.1 Kinesio ® taping space-correction-technique**

According to Kase *et al.* (2003), the space-correction-technique utilizes the elastic qualities of the Kinesio ® Tex Gold tape to lift fascia and soft tissue, creating more space and thereby decreasing pressure directly above an area of pain, inflammation, swelling, or oedema. The decrease in pressure has a number of proposed effects on the area being taped:

- Reducing the amount of irritation on the chemical receptors, thus decreasing pain.
- Increasing the level of circulation in the area, allowing for increased removal of exudates.
- Stimulation of the mechanoreceptors that can aid in decreasing pain.
- By increasing sensory stimulation, the gate control theory of pain inhibition may be initiated.

There is, however, currently a paucity of scientific research to prove the claims of Kase *et al.* (2003).

The KTSCT utilizes the elastic qualities of the Kinesio ® Tex Gold tape to pull the connective tissue toward the desired area. This is achieved by applying the tape in such a way that there is tension in the middle of the strip but with no tension on either ends, which act as anchors. Multiple layers can be applied utilizing the same technique depending upon the size of the area (Kase *et al.*, 2003).

The proposed ability of Kinesio ® taping to increase lymphatic and venous microcirculation; reduce the accumulation of lymph/exudates in intercellular spaces (Kase *et al.*, 2003; Osterhues, 2004; Kataoka, 2005; Lipińska *et al.*, 2007; Szczegielniak *et al.*, 2007); facilitate mechanoreceptor function; improve postural/alignment awareness and assist in proper muscle/joint positioning (www.kinesiotaping.co.uk, 2010) sets it apart from other athletic taping techniques that only offer support and limited tactile feedback. Kinesio ® taping also has advantages over treatments such as cryotherapy, stretching or massage in that it can be applied during the consultation and it continues to work after the completion of the consultation, for as long as it remains applied to the affected area. Kinesio ® taping, as such, does not rely upon patient compliance for its ongoing effect and thus can increase the probability of treatment success (Arbuthnott and Sharpe, 2009).

## **2.7 Summary**

MPS is a common pain disorder that affects many people (Han and Harrison, 1997; Cummings and Baldry, 2007). It is caused by MTP located within taut bands of dysfunctional muscle fibres of any of the body's skeletal muscles (Alvarez and Rockwell, 2002; Bennett, 2007). DN has been shown to be effective modality for inactivating MTP (Hong, 1994; Rowley, 2001; Vernon and Schneider, 2009), however, the associated development of PNS has demonstrated to be a hindrance to the treatment of MPS (Hong, 1994; Rowley, 2001). Kinesio ® taping has been shown to decrease pain by proposedly increasing lymphatic and venous microcirculation (Kase *et al.*, 2003; Lipińska *et al.*, 2007). Therefore, Kinesio ® taping, in theory, could have a positive effect in reducing the swelling and haemorrhage associated with PNS. If correct, by addressing these factors attributed to PNS, Kinesio ® taping could aid in alleviating the pain that patients experience with PNS.

As there is a paucity of research into the claim that Kinesio ® taping could aid in alleviating PNS, the aim of this study is to determine the relative effectiveness of Kinesio ® taping in the reduction of PNS.



## **CHAPTER THREE**

### **MATERIALS AND METHODS**

#### **3.1 Introduction**

This chapter discusses the methods used in the data collection from the participants and the intervention utilized, as well as the methods of statistical analysis and the process of the evaluation of the data.

#### **3.2 Study design**

This study was a quantitative, single blinded, randomized clinical trial.

Subjective (NRS-101 and pain diary) and objective (algometer) readings were taken at both consultations in order to gather empirical data on the participants' response to the treatment intervention.

This study was approved by the Durban University of Technology (DUT) Faculty of Health Sciences ethics clearance committee (Appendix A).

#### **3.3 Advertising**

Advertising was carried out via convenience sampling, utilizing word of mouth, printed adverts and leaflets (Appendix B) placed at the DUT and local sports clubs in the greater Durban area.

#### **3.4 Telephonic interview**

People who responded to the advert were screened by telephonic interview with the researcher, where pertinent questions were asked to determine if the interested participant would be eligible for this research. The following four questions were asked, with the expected answers listed below each question:

- Are you between the age of 18 and 45?
  - Yes
- Do you have pain between the base of the neck and upper shoulder?
  - Yes
- Do you have any chronic diseases?
  - No
- Are you needle phobic?
  - No

These questions decreased the chance of accepting participants into the study who did not satisfy the research inclusion and exclusion criteria.

Those participants that met the criteria in the telephonic interview were booked in for an initial consultation at the DUT Chiropractic Day Clinic.

### **3.5 Sampling**

#### **3.5.1 Size**

The research required a total of forty five participants suffering from pain between the base of the neck and upper shoulder. All participants volunteered to take part in this study, however, only once the study criteria were met were they eligible to take part in the study, this was explained in the Letter of Information and Informed Consent form (Appendix C).

#### **3.5.2 Method**

At the initial consultation, the participants were further screened as to their suitability with a patient case history (Appendix D), senior physical examination (Appendix E) and cervical spine regional examination (Appendix F) in order to assess whether the participants qualified for the study according to the inclusion and exclusion criteria. All the relevant patient information was noted in the SOAPE Note (Appendix G).

### **3.5.2.1 Inclusion criteria**

The inclusion criteria were as follows:

- The participant must agree to sign the Letter of Information and Informed Consent form.
- Participants must be suffering from myofascial pain syndrome with an active trigger point at their trapezius MTP2 on either the left or right side. This was established based on the location and pain referral pattern of the trapezius MTP2 as explained in Chapter Two.
- Have none of the exclusion criteria listed below.

### **3.5.2.2 Exclusion criteria**

The exclusion criteria were as follows:

- Participants with contra-indications to dry needling including those under the influence of alcohol, suffering from systemic illness (e.g. cancer and haemophilia), fever or anxiety (Travell *et al.*, 1999).
- Participants who are needle phobic.
- Participants who were allergic to athletic taping.
- Participants who have taken anticoagulant medication during the three days prior to the initial consultation (Travell *et al.*, 1999).
- Participants who intend to take analgesic medication during the course of the research period (Travell *et al.*, 1999).
- Participants must not have received dry needling to the trapezius TP2 up to 72 hours prior to treatment (Travell *et al.*, 1999, Alvarez and Rockwell, 2002).
- Participants who were unable to commit to the 24 hour follow-up appointment.
- Participants diagnosed with Frozen Shoulder, Chronic Fatigue Syndrome and Nerve Root Entrapments were not considered in this study.

### **3.5.3 Allocation**

The 45 participants who met the requirements for the research, according to the inclusion and exclusion criteria, were randomly allocated into one of the three treatment groups, with each group containing a minimum of 15 participants in order to achieve statistical validity.

Randomization of the research participants was carried out by requesting that the participants draw a number ("1", "2" or "3") written on a folded piece of paper from a container. The paper was folded to ensure that the researcher and participant were blinded as to which letter would be pulled out of the container.

Each number represented a group:

Group One, received DN only and they formed the control group.

Group Two, received DN and KTSCT utilizing Kinesio ® Tex Gold tape.

Group Three, received DN and a non-proprioceptive hypoallergenic tape application.

### **3.6 Intervention procedure**

#### **Initial Consultation**

Once it was established that the participant met *all* of the study criteria, the case history, senior physical examination, cervical spine regional examination and SOAPE note were completed for the participant by the researcher, and the participant had signed the Letter of Information and Informed Consent Form, the treatment procedure commenced.

The researcher's hands were cleaned with an alcohol swab. The location of the trapezius MTP2 was noted by pincer palpation, the area to be needled was cleaned with an alcohol swab and then marked with a fibre tip body marker by the researcher. Subjective measurements in the form of a Numerical Pain Rating Scale-101 (NRS-101) and objective measurements in the form of Algometer readings (Appendix I) were taken over the trapezius MTP2 by the researcher.

The participant was then positioned in a prone position for the duration of the DN treatment.

DN needles in the form of Ø0.25 x 30mm sterile, single use, disposable acupuncture needles were used for all participants. The needles and alcohol swabs were opened in front of the participants by the researcher.

All groups received DN administered by the researcher, using the fanning technique as explained by Travell *et al.* (1999), with the needle being inserted roughly  $\frac{3}{4}$  of its shaft length, tangentially into the trapezius trigger point two, and then withdrawn to the subcutaneous layer before being re-inserted. This was performed a total of twenty times (Hong, 1994) over a four minute treatment duration for the sake of consistency. Once the DN was completed, the used needles and alcohol swabs were disposed of into a medical waste container by the researcher, as per the DUT Chiropractic Day Clinic's policy.

Ten minutes following the DN treatment, NRS-101 and algometer readings were taken again by the researcher. Once the readings were recorded, different interventions for PNS were given to the participants, depending on which group they were allocated.

- **Group one**

Group one participants received no PNS prevention/treatment therapy to the area that received DN.

Group one served as the control group in the study.

- **Group two**

Group two participants received two strips of Kinesio® Tex Gold tape applied by the researcher utilizing the KTSCT immediately after the post-DN NRS-101 and algometer measurements were taken. The Kinesio® Tex Gold tape was cut to approximately ten centimeters in length, five centimeters in width with rounding of the corners to prevent lifting of the tape.

The paper backing was torn in the middle of the Kinesio® Tex Gold tape and peeled back to expose only the middle third of the tapes adhesive side. The patient was asked to slightly flex and rotate their neck away from the side that received the DN so as to put the Trapezius muscle in a stretched position (illustrated by Figure 3.1A). The first strip of Kinesio® Tex Gold tape was centered over the area that received the DN (illustrated by Figure 3.1B) and applied with light [twenty five percent] tension in the middle third of the tape. The outer thirds of the tape were then applied with no tension to provide anchors for the space-correction-technique application (illustrated by Figure 3.1C).

The second strip of Kinesio ® Tex Gold tape was then applied at ninety degrees to the first strip of Kinesio ® Tex Gold tape, with the center of the tape centered over the area of DN. The middle third of the tape was applied at twenty five percent tension and the outer thirds with no tension (illustrated by Figure 3.1D).

Once the application of the second strip was finalized, an “X” formation centered over the DN area was formed (illustrated by Figure 3.1E).

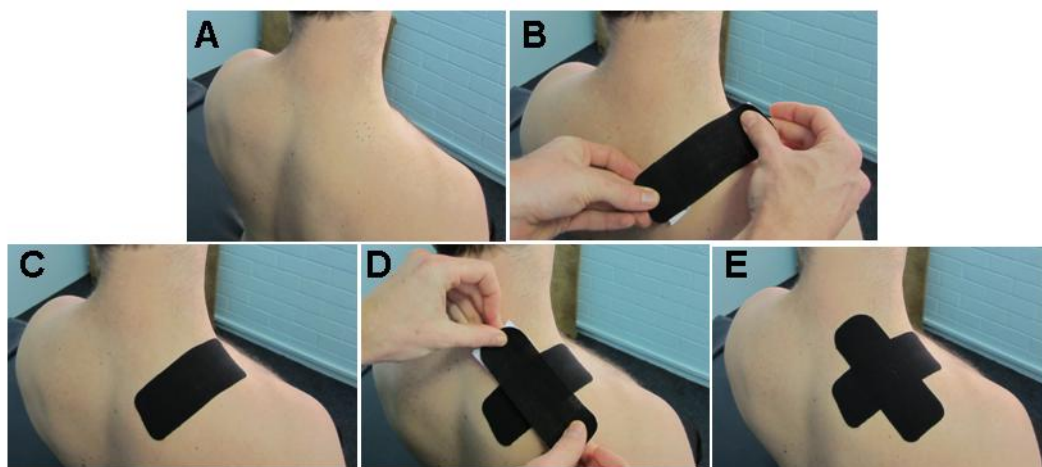


Figure 3.1: Kinesio ® taping space-correction-technique application

The participant was requested not to remove the tape before the follow-up consultation which was the following day. However, the participants were advised that if the taping application became unbearable for any reason, they could remove the tape.

- **Group three**

Group three participants received an application of a non-proprioceptive hypoallergenic tape, applied by the researcher over the DN area immediately after the post-DN NRS-101 and algometer measurements were taken. The non-proprioceptive hypoallergenic tape, which had a similar appearance to the Kinesio® Tex Gold tape, was cut by the researcher to approximately ten centimeters in length, five centimeters in width with rounding of the corners to prevent lifting of the tape.

The paper backing was torn in the middle of the non-proprioceptive hypoallergenic tape and peeled back to expose only the middle third of the tapes adhesive side. The patient was asked to slightly flex and rotate their neck away from the side that received the DN so as to put the trapezius muscle in a stretched position (illustrated by Figure 3.1A). The first strip of the non-proprioceptive hypoallergenic tape was centered over the area that received the DN (illustrated by Figure 3.1B) and applied to the participant (illustrated by Figure 3.1C). The second strip of the non-proprioceptive hypoallergenic tape was then applied at ninety degrees to the first strip of the non-proprioceptive hypoallergenic tape, with the center of the tape centered over the area of DN (illustrated by Figure 3.1D). Once the application of the second strip was finalized, an “X” formation centered over the DN area was formed (illustrated by Figure 3.1E).

The same application technique was used for the non-proprioceptive hypoallergenic tape as for the Kinesio® Tex Gold tape, for the purposes of consistency. However, the non-proprioceptive hypoallergenic tape does not have the same stretch properties as the Kinesio® Tex Gold tape and thus it was not possible to apply the middle third of the non-proprioceptive hypoallergenic tape with the same tension as the Kinesio® Tex Gold tape.

The participant was requested not to remove the tape before the follow-up consultation which was the following day. However, the participants were advised that if the taping application became unbearable for any reason, they could remove the tape.



- **Pain diary**

All groups were given a twenty four hour pain diary (Appendix J) in order to monitor the development of PNS in the twenty four hours between the initial and follow-up consultations. The participants were instructed to complete the pain diary and bring the completed pain diary to the follow-up consultation.

### **Follow-up Consultation**

A follow-up consultation was made for the participant approximately twenty four hours after their initial consultation.

At the follow-up consultation, the taping utilized on the participants in groups two and three was removed one piece at a time as demonstrated by de Jager (2010). The tape was rolled off by the researcher with one hand in the direction of hair growth, while the participants skin was supported by the researchers other hand (de Jager, 2010).

Once the tape had been removed, NRS-101 and algometer readings were taken at the DN site and the twenty four hour pain diaries were collected.

## **3.7 Data collection**

### **3.7.1 Frequency**

Subjective and objective measurements were made on all three research groups at both consultations. Assessments were made at the initial consultation immediately prior to DN and ten minutes following DN (allowing for the possible immediate onset of PNS to commence in all patients). Subjective and objective measurements were again recorded at the follow-up consultation approximately twenty four hours after the participant received the DN treatment, following removal of the tape. This follow-up time frame was based on the methodology utilized by Chonan (2008) and Manga (2008), who performed similar studies and allowed for possible development of PNS to its maximum intensity (Huguenin, 2004).

## 3.7.2 Data collection instruments

### 3.7.2.1 Subjective measures

#### 1) Numerical pain rating scale-101 (NRS-101)

(Appendix I)

A printed version of a standard 0–100 numeric rating scale and 100 mm horizontal visual analogue scale was utilized. A zero rating was described as having “no pain” and a rating of one hundred was described as a “pain as bad as it could be” (Miro *et al.*, 2009).

Flaherty (2007), Miro *et al.* (2009) and Hjermstad *et al.* (2011) asserted that the numerical pain rating scale has an acceptable level of reliability and is the most popular pain rating scale currently in use.

The participant used these measurements to rate the pain intensity that they felt before the DN, ten minutes after the DN treatment and then at the follow-up consultation.

#### 2) Pain diary

(Appendix J)

Owing to the uncertainty regarding the onset and evolution of intensity of PNS pain, all participants were required to complete a twenty four hour pain diary.

The diary consisted of a three, six, nine, twelve and twenty four hour time intervals, based on the observations of Morren *et al.* (2009), assessing whether the participants were experiencing any post-needling soreness following the DN treatment. The participants were required to tick ‘yes’ or ‘no’ to indicate whether they were experiencing pain at these time intervals. The participants were then asked to note the time, in hours following the DN treatment, when the PNS pain was at its most intense.

### **3.7.2.2 Objective measures**

#### **1) Algometer**

(Appendix I)

The algometer used in this study is an apparatus designed to objectively measure the participant's pressure pain threshold at the area of treatment.

Potter *et al.* (2006), Jones *et al.* (2007) and van Wilgen *et al.* (2011) found the pressure algometer to be a reliable tool for objectively measuring the pressure pain threshold of patients with myofascial pain conditions.

The algometer was positioned on the participant's skin, directly over the area containing the trapezius trigger point two. The participant was instructed to say when they felt pain and then the examiner gradually increased the pressure. Once the participant advised that they felt pain, the reading on the algometer was noted. This was repeated three times and an average pressure was recorded.

The algometer readings were taken immediately prior to DN, ten minutes after DN and then at the follow-up consultation.

The algometer utilized in this study was a Force Dial <sup>TM</sup> FPK 20 algometer manufactured by Wagner instruments: P.O. Box 1217, Greenwich, CT 06836-1217, USA.

### **3.8 Statistical methodology**

Data collected from the NRS-101, Pain Diary and algometer readings for each patient was logged into a data collection sheet (Appendix K) and sent to a statistician from the University of Kwa-Zulu Natal Medical School for statistical analysis.

SPSS version 18 (SPSS Inc.) was used to analyse the data. A  $p$  value  $<0.05$  was considered as statistically significant. Chi square test was used to compare gender between the three groups, and ANOVA tests were used to compare continuous variables and baseline values between the three groups. Generalized estimating equations were used to assess the effect of the intervention over time on all outcome measures. For the two continuous measures, a normal probability distribution function with an identity link was specified, and for the binary pain outcome, a binomial distribution with a logit link was specified. A significant time\*group interaction effect indicated a significant effect of the intervention. Profile plots were used to assess the trend and direction of the effect (Esterhuizen, 2011).

## **CHAPTER FOUR**

### **STATISTICAL ANALYSIS OF THE RESULTS**

#### **4.1 Introduction**

A discussion of the collected data, results of both the subjective (NRS-101 and twenty four hour pain diary) and objective data (algometer) readings and the relation of the results to the objectives of the study follows in this chapter.

##### **4.1.1 Abbreviations**

GLM: Generalized linear modeling

Group one: DN only group [control group]

Group two: DN and KTSCT utilizing Kinesio ® Tex Gold tape

Group three: DN and non-proprioceptive hypoallergenic tape

Hrs: Hours

Min: Minutes

N: Sample size

Std.: Standard

$p$ : Probability

$\beta$ : Beta coefficients

<: Less than

## 4.2 Demographics

### 4.2.1 Demographics by age

There was no difference between the treatment groups in terms of age ( $p=0.710$ ). The mean age of the sample was 29.53 years. The mean age was highest in group one with 30.40 years and lowest in group two with 28.47 years. This was a random event as participants were randomly allocated into the different treatment groups.

**Table 4.1: Comparison of age between the three groups (ANOVA test)**

Age				$p$ value
Group	Mean	N	Std. Deviation	
Group one	30.40	15	6.379	0.710
Group two	28.47	15	6.545	
Group three	29.73	15	6.508	
Total	29.53	45	6.380	

#### 4.2.2 Demographics by gender

There was no significant difference between the groups in terms of gender distribution ( $p=0.701$ ). The sample population was comprised of 51.1% female and 48.9% male participants. This difference in gender distribution was not significant in each of the treatment groups.

**Table 4.2: Cross tabulation of sex and group (Chi square test)**

			Group one	Group two	Group three	Total
Gender	F	Count	9	7	7	23
		% within group	60.0%	46.7%	46.7%	51.1%
	M	Count	6	8	8	22
		% within group	40.0%	53.3%	53.3%	48.9%
Total		Count	15	15	15	45
		% within group	100.0%	100.0%	100.0%	100.0%

### 4.2.3 Demographics by occupation

No single occupation group formed a majority amongst the population sample, however, students formed the largest occupation group with 22.2% of the population sample.

**Table 4.3: Occupation of study participants (n=45)**

Occupation	Number	Percent
Student	10	22.2%
Administrator	4	8.9%
Salesman	4	8.9%
Chiropractor	3	6.7%
Estate Agent	2	4.4%
Mechanic	2	4.4%
Store Manager	2	4.4%
Architect	1	2.2%
Beauty Therapist	1	2.2%
Catering Manager	1	2.2%
Designer	1	2.2%
Draughtsman	1	2.2%
Driver	1	2.2%
Financial Advisor	1	2.2%
Gallery Curator	1	2.2%
Homeopath	1	2.2%
Logistic Manager	1	2.2%
Marine Biologist	1	2.2%
Public Relations Officer	1	2.2%
Personal Assistant	1	2.2%
Self Employed	1	2.2%
Somatologist	1	2.2%
Teacher	1	2.2%
Unemployed	1	2.2%
Warehouse Supervisor	1	2.2%
Total	45	100.0%



### 4.3 Baseline outcomes

Baseline outcomes are an assessment of the initial NRS-101 and algometer measurements, before the DN treatment commenced. This analysis identifies if all the groups begin the study with similar pain ratings and thus can be used for statistical analysis.

Group three had a smaller mean and standard deviation then the other two treatment groups in terms of the initial baseline outcomes. However, there was no significant difference between any of the three treatment groups in terms of the baseline outcome measurements, as shown in Table 4.4. Therefore, all groups had similar results at the initial NRS-101 and algometer measurements and thus can be used for statistical comparison.

**Table 4.4: Comparison of baseline outcome measurements between groups (ANOVA test)**

Group		Baseline NRS-101	Baseline Algometer (kg)	Baseline Algometer (lbs)
Group one	Mean	50.4000	2.0400	4.4974
	N	15	15	15
	Std. Deviation	19.36695	0.95603	2.10769
Group two	Mean	50.9667	2.1267	4.6885
	N	15	15	15
	Std. Deviation	21.69387	0.65788	1.45038
Group three	Mean	41.2667	1.6333	3.6009
	N	15	15	15
	Std. Deviation	17.32346	0.61895	1.36454
Total	Mean	47.5444	1.9333	4.2623
	N	45	45	45
	Std. Deviation	19.61586	0.77313	1.70446
<i>p</i> value		0.322	0.177	0.177

## 4.4 Assessment of intervention effects

### 4.4.1 Subjective outcomes

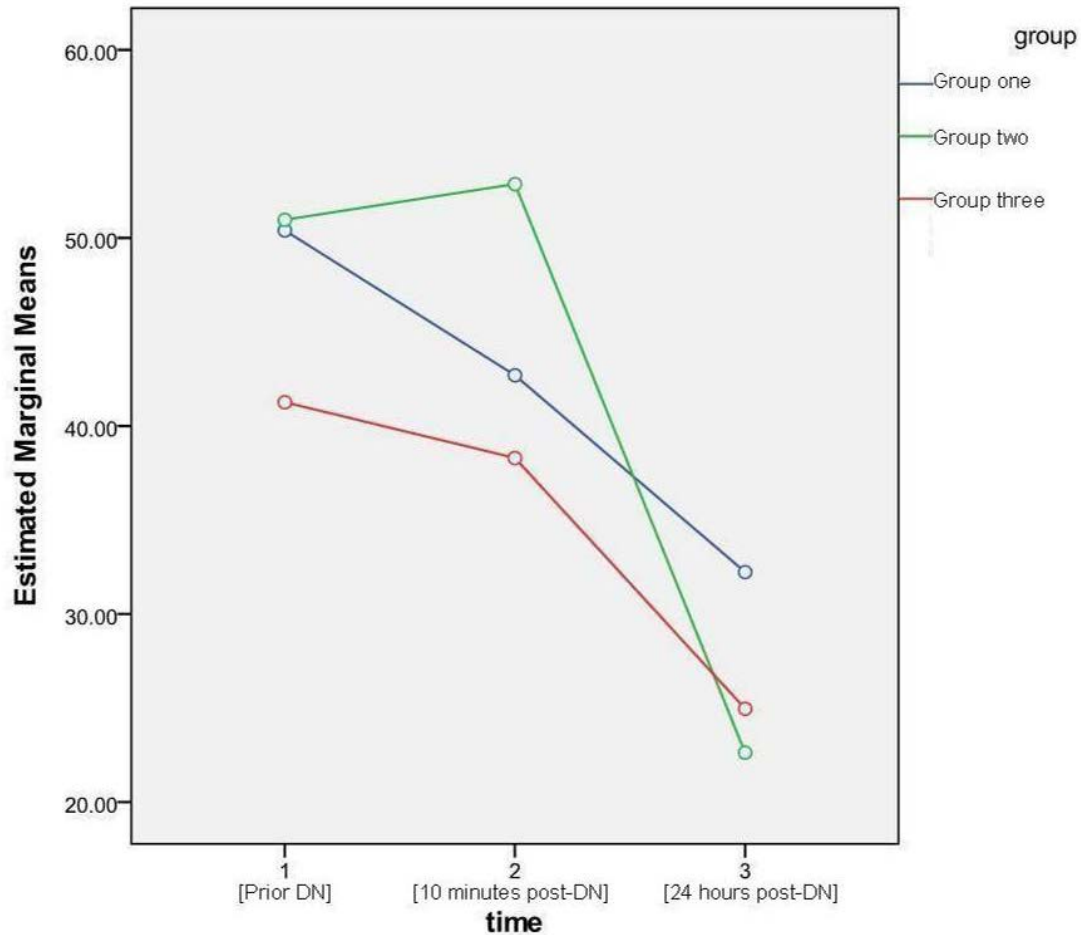
#### 4.4.1.1 Numerical pain rating scale-101

While there was a significant overall time effect among all treatment groups in the NRS-101 measurements ( $p < 0.001$ ), when all three time points were taken into account, the rate of decrease was not significantly different between either group two and three when compared to group one. Therefore, neither intervention group was better than the control group at reducing pain according to NRS-101 during the overall time.

**Table 4.5: GLM model of between and within-subjects effects for NRS using all three time points**

Effect	$\beta$	<i>p</i> value
Time	-9.083	<0.001
Group two (vs group one)	10.5	0.296
Group three (vs group one)	-8.8	0.315
Group two*time (vs group one*time)	-5.1	0.127
Group three*time (vs group one*time)	0.93	0.807

However, the profile plot (Figure 4.1) shows that the rate of decrease between group one and three were similar, but that group two showed an initial increase in NRS-101 followed by a steep decrease.



**Figure 4.1: Profile plot of mean NRS-101 by time and group**

Therefore, examining only time intervals two and three (Table 4.6), there was a statistically significant rate of reduction in NRS-101 in group two compared with group one ( $p=0.008$ ), however, while group three also showed a better improvement than group one between time intervals two and three, this improvement was not significant in group three when compared with group one ( $p=0.677$ ). Therefore, after an initial increase in pain, only group two showed a statistically significant decrease in pain compared with group one.

**Table 4.6: GLM model of between and within-subjects effects for NRS using time points 2 and 3**

Effect	$\beta$	<i>p</i> value
Time	-10.46	0.028
Group two (vs group one)	10.17	0.290
Group three (vs group one)	-4.4	0.585
Group two*time (vs group one*time)	-19.77	0.008
Group three*time (vs group one*time)	-2.87	0.677

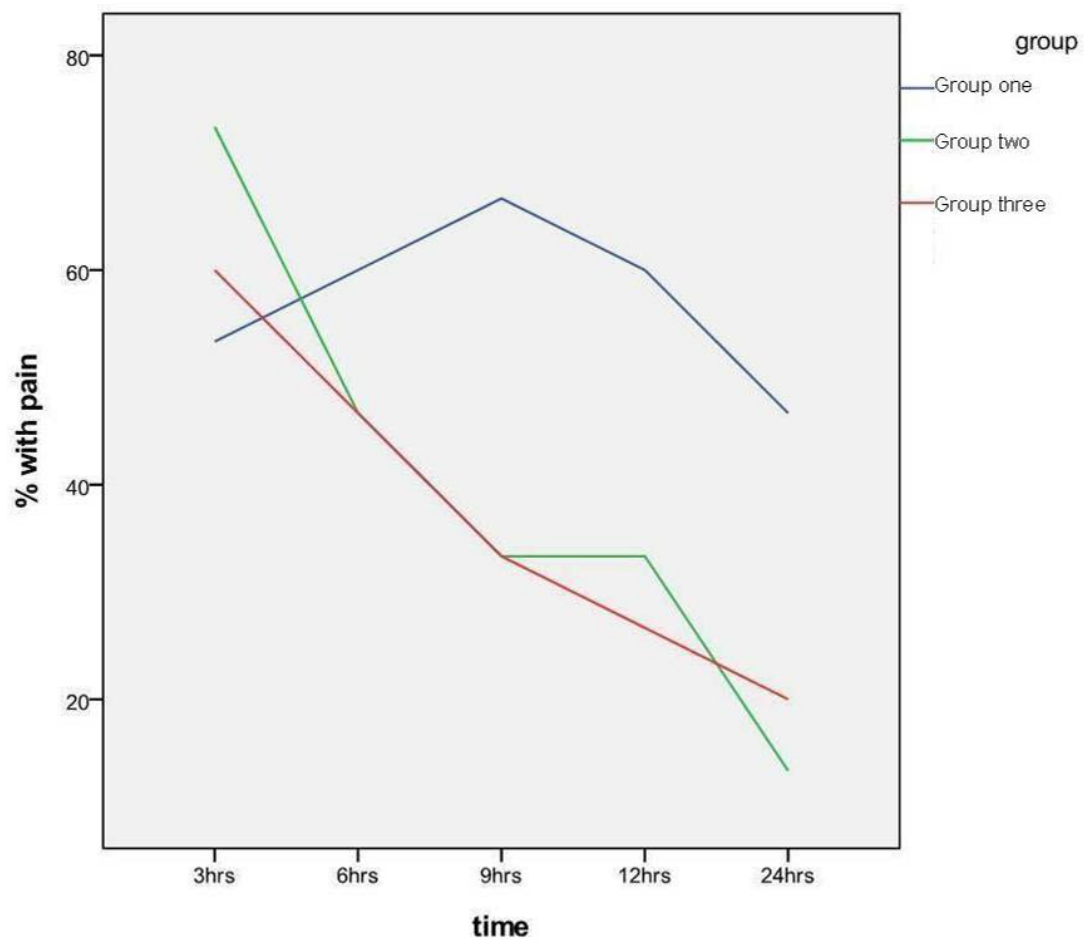
#### 4.4.1.2 Pain diary

The trend was that both groups two and three participants showed a decrease in the presence of pain, while there was no difference for group one participants. However, only group two showed a statistically significantly reduced rate of pain compared with group one ( $p=0.019$ ).

**Table 4.7: Inter- and intragroup effects for pain diary**

Effect	$\beta$	<i>p</i> value
Time	-0.105	0.544
Group two (vs group one)	0.976	0.166
Group three (vs group one)	0.153	0.861
Group two*time (vs group one*time)	-0.564	0.019
Group three*time (vs group one*time)	-0.331	0.222

Figure 4.2 shows that while a higher percentage of group two participants experienced pain in the first three hours, when compared with groups one and three, group two showed a sharper rate of decline and a better outcome than either of group one or three by the end of the twenty four hour pain diary period.



**Figure 4.2: Profile plot of percentage with pain by time and group**

#### 4.4.1.3 Worst pain as reported in pain diary

Overall the mean time of worst pain was five hours and thirty one minutes across all three intervention groups. There were slight variations between the different treatment groups, with group two having the lowest time (four hours and forty minutes) and group one having the longest time (six hours and fifty six minutes).

There were also minor variations in the minimum and maximum time to worst pain. Minimum time to worst pain was lowest in group three (zero minutes) and longest in group two (one hour). The maximum time to worst pain was longest in group three (twenty hours) and shortest in group two (fifteen hours).

**Table 4.8: Time of worst pain reported in pain diary**

<b>Group</b>	<b>Mean (hrs:min)</b>	<b>Minimum (hrs:min)</b>	<b>Maximum (hrs:min)</b>
Group one	6:56	0:30	18:00
Group two	4:40	1:00	15:00
Group three	4:58	0:00	20:00
Total	5:31	0:00	20:00

## 4.4.2 Objective outcomes

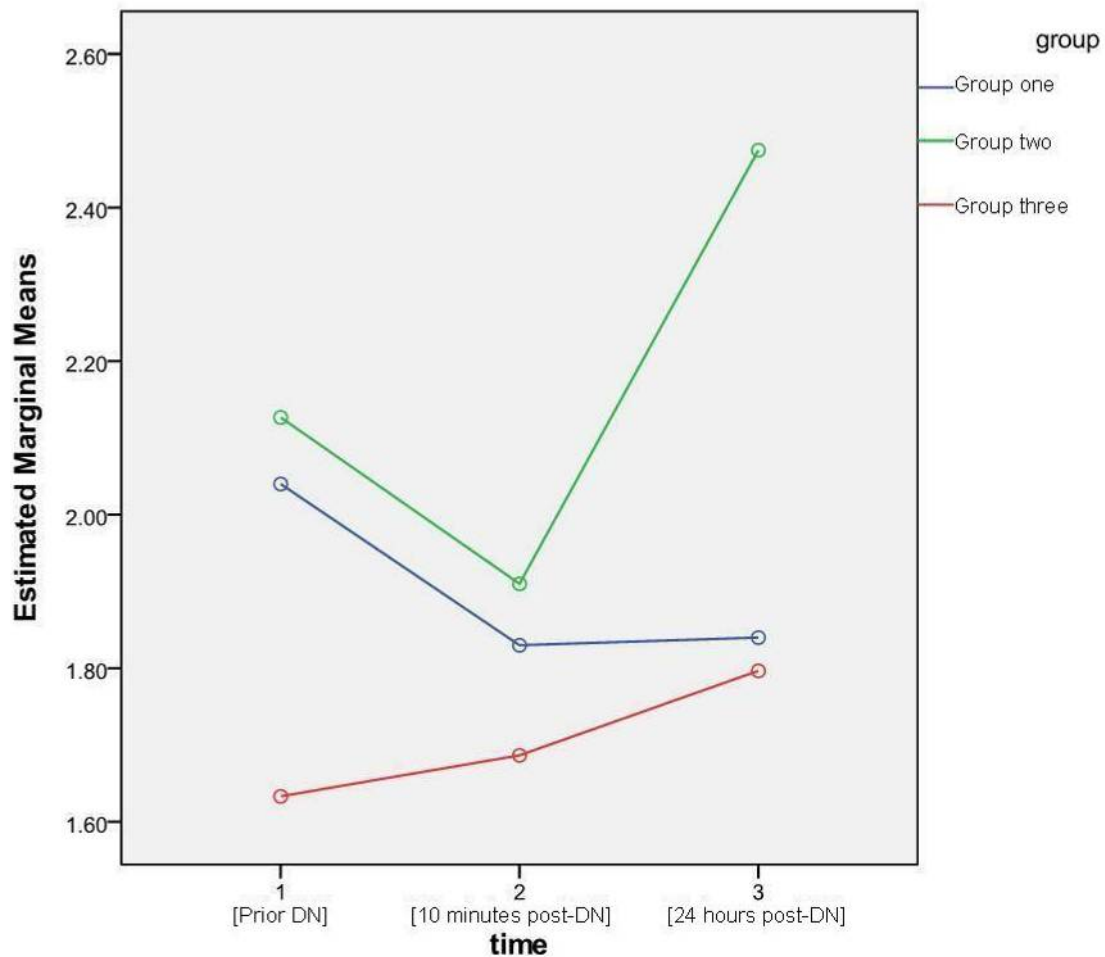
### 4.4.2.1 Algometer reading outcome

Group two produced a highly significant increased algometer measurement over time compared with group one ( $p < 0.001$ ). However, group three did not show any significant increase in algometer measurements ( $p = 0.485$ ). This indicates that group two could endure significantly more pressure in the algometer test before reporting any pain, when compared with the other groups.

**Table 4.9: Inter- and intragroup effects for algometer measurements**

Effect	$\beta$	$p$ value
Time	-0.007	0.957
Group two (vs group one)	-0.69	0.087
Group three (vs group one)	-0.442	0.267
Group two*time (vs group one*time)	0.511	<0.001
Group three*time (vs group one*time)	0.113	0.485

Figure 4.3 illustrates that although group three did show increased algometer measurements over time, this was not to the same extent as group two. Therefore, in terms of algometer measurements, group two showed a statistically significant improvement over group one.



**Figure 4.3: Profile plot of mean algometer by time and group**



## 4.5 Intra-group correlations between changes in outcome variables

**Table 4.10: Correlations between changes in outcomes by group**

Group			Change in algometer
Group one	change in NRS-101	Pearson correlation	0.190
		Sig. (2-tailed)	0.499
		N	15
Group two	change in NRS-101	Pearson correlation	-0.470
		Sig. (2-tailed)	0.077
		N	15
Group three	change in NRS-101	Pearson correlation	-0.476
		Sig. (2-tailed)	0.073
		N	15

[Note: Intra-group correlation test was not possible with the pain diary data, as this test is for continuous data only]

### 4.5.1 Group one: DN only

Table 4.10 shows that there was no correlation between the changes in NRS-101 and algometer readings within group one ( $r=0.190$ ,  $p=0.499$ ). Thus there is no apparent association between the changes in the readings of the NRS-101 readings and algometer measurements.

### 4.5.2 Group two: DN and KTSCT utilizing Kinesio® Tex Gold tape

Table 4.10 shows that within group two, there was a negative and moderate strength Pearson correlation ( $r=-0.470$ ). Although this was not quite statistically significant ( $p=0.077$ ), it implied that as NRS-101 readings decreased, so algometer measurements increased. This indicates that as the

participant experienced less pain when the DN area was unstimulated, they were also able to withstand more pressure from the algometer in the same area before registering any pain, which would be expected if the interventions had helped to alleviate the participants PNS.

#### **4.5.3 Group three: DN and a non-proprioceptive hypoallergenic tape application**

Table 4.10 shows that within group three, there was a negative and moderate strength Pearson correlation ( $r=-0.476$ ). Although this was not quite statistically significant ( $p=0.073$ ), it implied that as NRS-101 readings decreased, so algometer measurements increased. The same assertions as described above for group two apply here.

#### **4.6 Other findings: Wave-pattern on participants' skin**

A separate finding, which was identified during the course of the study, was that when patients in group three had the non-proprioceptive hypoallergenic tape application removed, 86.7% exhibited a similar wave-pattern on the area of the skin that was taped to that which was found on patients with Kinesio® Tex Gold tape applications. The wave pattern in group three was not as clearly defined as that found in group two.

## **CHAPTER FIVE**

### **DISCUSSION OF THE RESULTS**

#### **5.1 Introduction**

This chapter includes a discussion of the results from the statistical analysis of both the subjective (NRS-101 and pain diary) and objective (algometer) data.

#### **5.2 Subjective data**

##### **5.2.1 Numerical pain rating scale-101**

The results from the NRS-101 measurements found that all groups had a significant decrease in perceived pain over the three time intervals. Evaluating the individual group measurements in Figure 4.1 illustrates that group one (DN only) and group three (DN and non-proprioceptive hypoallergenic tape) were similar in their rate of decline, however, group two (DN and KTSCT utilizing Kinesio ® Tex Gold tape) showed an initial increase from interval one (pre-DN) to two (ten minutes post-DN), followed by a rapid decrease from interval two to three (twenty four hours post-DN).

Given that the KTSCT utilizing Kinesio ® Tex Gold tape, for group two, and the non-proprioceptive hypoallergenic tape, for group three, was only applied to the participants after the second NRS-101 measurement (interval two) was taken. As such, during the period of the intervention study when the KTSCT utilizing Kinesio ® Tex Gold tape was actually applied to the participant, there was a rapid decrease in the pain experienced by group two. Upon further analysis of the three intervention groups, it was found that when examining the time interval between measurements two and three, there was a statistically significant decrease in pain in group two compared to group one. The same was not evident when comparing group three to group one.

According to Lewit (1979), PNS can occur even when a trigger point is not precisely needed. As such, the pain that the patient perceives may arise from the preexisting trigger point, or from the PNS as a result of the needle insertion causing tissue damage. Travell *et al.* (1999) stated that DN fanning technique caused a higher incidence of blood vessel penetration and this would result in increased occurrences of swelling and haemorrhage. The increased swelling, haemorrhage, combined with the release of Serotonin, Histamine (Gatterman and Goe, 1990) and metabolites (Travell *et al.*, 1999) will result in increased PNS. Thus, given the small sample size utilized in this study, the variation in NRS-101 response between measurement times one and two, could be due to inter-participant variations in the immediate response to the DN treatment.

When looking at the time period when groups two and three had their respective taping applied, group two showed a significantly larger decrease in pain rating when compared with groups one or three, indicating that the KTSCT utilizing Kinesio ® Tex Gold tape had a positive effect in relieving the PNS. This result appears to support the claims of Kase *et al.* (2003) that KTSCT utilizing Kinesio ® Tex Gold tape can help to reduce pain. However, given the small sample size utilized in this study, a larger scale investigation would be warranted to validate these findings.

Kase *et al.* (2003) claims that the mechanism of action of the KTSCT utilizing Kinesio ® Tex Gold tape, is in the lifting of the fascia and soft tissue, thereby creating more space to reduce irritation on the chemical receptors, increase local circulation and local lymphatic drainage to aid in exudates removal. This was not the area of examination for this study and as such no conclusions on the validity of these claims can be drawn, however, the results of this study may warrant for future investigation into the proposed mechanisms of action of the KTSCT utilizing Kinesio ® Tex Gold tape.

### 5.2.2 Pain diary

As illustrated in Figure 4.2, groups two and three showed higher pain ratings at the three hour mark than group one. This could be attributed to variations among the sample population in the number of blood vessels in the area that received the DN, or the extent to which the MTP was de-activated by the DN.

Another possible reason for this variation between the groups during this time interval is that, if KTSCT could increase circulation, as proposed by Kase *et al.* (2003), it could be hypothesized that the KTSCT may have caused an increase in the accumulation of extracellular fluid and blood at the DN area. This increase of swelling and blood in the DN area could have caused increased pressure in the area and a greater perception of PNS among the participants. As the views of Kase *et al.* (2003) have yet to be either proven or disproven, there is no way in this study to be certain of the variation in the initial 3 hour time interval.

When assessing the profile plots in Figure 4.2, it is apparent that group one showed an initial increase of pain until nine hours and then a decrease at the twenty four hour mark that was marginally better than the initial reading. Both group two and group three demonstrated a continuous and marked decrease in pain ratings over the twenty four hours following the DN treatment, despite beginning with pain ratings that were 20% and 7% respectively, which was higher than group one. Based upon this data, it appears that the application of KTSCT, utilizing either Kinesio ® Tex Gold tape or the non-proprioceptive hypoallergenic tape, over the treatment area had a greater effect in relieving PNS when compared with no PNS treatment being provided.

Upon statistical analysis of the pain diary data, it was found that only group two, utilizing Kinesio ® Tex Gold tape, showed a statistically significant improvement when compared to group one. The improvement in group three was found to not be statistically significant. The analysis of the pain diary data for group two appears to indicate that the Kinesio ® Tex Gold tape provided a

greater benefit than the non-proprioceptive hypoallergenic tape, which was applied utilizing the same KTSCT. However, given the small sample size utilized in this study, a larger scale investigation would be warranted to validate these findings.

The Kinesio Taping Association International ([www.kinesiotaping.com](http://www.kinesiotaping.com), 2011) claims that the correct application of the KTSCT is a key component in the efficacy of the treatment, however, the full benefits of the treatment are only possible when utilizing Kinesio ® Tex Gold tape. While the analysis of the pain diary data appears to support this assertion, further investigation would be required to validate these findings.

### **5.2.3 Worst pain as reported in pain diary**

The mean time for worst pain exhibited characteristics that appeared to support the conclusions drawn from the pain diary and NRS-101 data. Group two had the lowest mean time with four hours and forty minutes, group three followed with four hours and fifty eight minutes, while group one had a mean time of six hours and fifty six minutes. While both groups that received KTSCT showed a smaller time then group one, there was no statistical significance attributable to this.

## **5.3 Objective data**

### **5.3.1 Algometer readings**

The results from the algometer readings (Table 4.9) show that group one experienced a decrease in tolerable pressure from immediately prior DN to ten minutes following the DN treatment. In addition, the tolerable pressure readings for group one did not improve in the twenty four hours after the DN. This indicates that the PNS that participants were experiencing had not improved over the twenty four hours following the DN treatment.

Both groups two and three showed an improvement in algometer readings compared to group one. However, while the improvement in group three was not statistically significant, the improvement in group two showed a highly statistically significant increase when compared to group one ( $p < 0.001$ ). In addition, the majority of the improvement for group two occurred between algometer measurements two and three, coinciding with the time that the Kinesio® Tex Gold tape was applied to the patients. This supports the claim made by the Kinesio Taping Association International ([www.kinesiotaping.com](http://www.kinesiotaping.com), 2011), that the correct application of the KTSCT is the key component in the efficacy of the treatment, however, the full benefits of the treatment are only possible when utilizing Kinesio® Tex Gold tape.

#### **5.4 Other findings: Wave-pattern on participants skin**

The wave-pattern found on the skin of the area that was taped of all group two participants and 86.7% of group three participants is a common occurrence among patient with Kinesio® Tex Gold taping applications. The wave-pattern on the skin mimics the wave-pattern on the adhesive side of the Kinesio® Tex Gold tape.

Given that the pattern occurred in participants from both group two and three, it is a possibility that the KTSCT used to apply the respective tapes was responsible for the wave-pattern effect on the skin. When the wave-pattern presented in group three participants, it was not as clearly defined as those in group two. This could be due to the decreased amount of stretch possible in the non-proprioceptive hypoallergenic tape when compared to the Kinesio® Tex Gold tape, which could limit the effectiveness of the KTSCT. Alternately, it could be due to the lack of a wave-pattern adhesive application on the non-proprioceptive hypoallergenic tape itself, or a combination of these factors. This could only be clarified if further investigations investigated the occurrence of the wave-pattern on the skin and what significance may be attributed to it.

Kinesio Taping International Association make the assertion that the correct application of the KTSCT is a key component in the efficacy of the treatment, however, but that the full benefits of the treatment are only possible when utilizing Kinesio ® Tex Gold tape ([www.kinesiotaping.com](http://www.kinesiotaping.com), 2011). The results of this study would suggest that KTSCT, especially when utilized with Kinesio ® Tex Gold tape, had a positive effect in reducing the participant's pain. However, this could only be fully explored if the study design had included a fourth intervention group that had the non-proprioceptive hypoallergenic tape applied in a standard manner with no/minimal tension.



## **CHAPTER SIX**

### **CONCLUSION AND RECOMMENDATIONS**

#### **6.1 Conclusion**

The aim of this study was to determine the relative effectiveness of KTSCT utilizing Kinesio ® Tex Gold tape in reducing the level of PNS associated with DN a trapezius muscle trigger point two versus a non-proprioceptive hypoallergenic tape application, compared with DN alone.

The results of this study revealed that for pain measured by NRS-101, pain diary and the algometer, there was a decrease in pain over time in both group two (DN and KTSCT utilizing Kinesio ® Tex Gold tape) and group three (DN and non-proprioceptive hypoallergenic tape). However, only the improvements in group two, and not group three, were statistically significant in the NRS-101, pain diary and the algometer assessments, when compared against group one.

Therefore, this result of this study appear to support the claims of Kase *et al.* (2003) that KTSCT utilizing Kinesio ® Tex Gold tape can help to reduce pain, specifically PNS in an area that has received DN.

Therefore, this study concludes that KTSCT utilizing Kinesio ® Tex Gold tape had a positive effect in reducing the level of PNS associated with DN a trapezius muscle trigger point two, when compared with either a non-proprioceptive hypoallergenic tape application or a DN only group.

## **6.2 Recommendations**

This research thesis was conducted utilizing reliable data collection tools (Potter *et al.*, 2006; Flaherty, 2007; Jones *et al.*, 2007; Miro *et al.*, 2009; Morren *et al.* (2009); Hjermstad *et al.*, 2011; van Wilgen *et al.*, 2011), and an appropriate research methodology. However, certain trends were observed during the course of the study which could have altered the results and, therefore, could be improved upon in future studies.

Due to time and financial constraints, the sample size for this study was limited to forty five participants. While the use of a statistical analysis package yielded statistically significant results, a larger sample size could have shown any variance in the results relating to differences in gender, ethnic group or age.

Future studies could use two different population samples with regards to MTP, one with symptomatic patients and another that are asymptomatic. This could further the knowledge on the effect that the KTSCT utilizing Kinesio ® Tex Gold tape has on the tissue damage caused by DN.

Follow-up consultations could be conducted more frequently and for a longer time period than twenty four hours. This would allow the researcher to gain further insight into the evolution of PNS and how this can be affected by KTSCT.

The pain diary could include a NRS-101 rating of the pain instead of the 'Yes' / 'No' criteria utilized in this study. This could provide further insight into the intensity of pain experienced by the participant's in the time periods between the appointments.

Future studies could be conducted to assess the effect of KTSCT on PNS in different muscle groups to determine if particular muscles are more prone to developing PNS or more responsive to KTSCT.

Future studies could be conducted to compare the effect of KTSCT and other forms of pain treatment on PNS.

Future studies could use a double blinded procedure, whereby the researcher is not aware which participants receive the KTSCT utilizing Kinesio ® Tex Gold tape, to increase the studies validity by reducing the chance of any researcher bias towards a favoured treatment protocol.

Future studies could investigate whether there is any statistical difference between the applications of the non-proprioceptive hypoallergenic tape, utilizing the KTSCT technique or simple laying the tape onto the skin with no stretch. This could further illustrate the importance of the correct application of the KTSCT technique.

Future studies could assess whether KTSCT utilizing Kinesio ® Tex Gold tape is functionally able to increase lymphatic and venous microcirculation and thereby reduce the swelling and haemorrhage associated with PNS. This could provide further validation for this study.

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# APPENDICES

## Appendix A: Ethical Clearance Certificate


**DURBAN  
UNIVERSITY OF  
TECHNOLOGY**

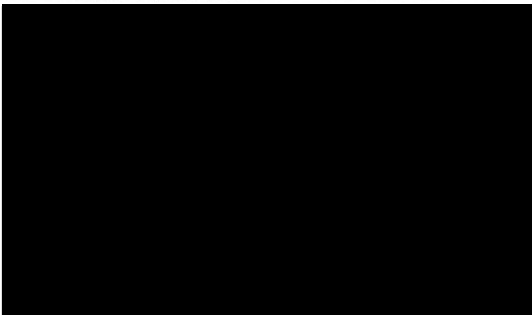
**ETHICS CLEARANCE CERTIFICATE**

Student Name	Mark Zuidewind	Student No	20609783
Ethics Reference Number	PH SEC 008/11	Date of FRC Approval	18/04/2011
Qualification	M.Tech: Chiropractic		
Research Title:	The effect of Kinesio Taping ® space-correction-technique on post-needling soreness in the Trapezius muscle trigger point two.		

In terms of the ethical considerations for the conduct of research in the Faculty of Health Sciences, Durban University of Technology, this proposal meets with Institutional requirements and confirms the following ethical obligations:

1. The researcher has read and understood the research ethics policy and procedures as endorsed by the Durban University of Technology, has sufficiently answered all questions pertaining to ethics in the DUT 186 and agrees to comply with them.
2. The researcher will report any serious adverse events pertaining to the research to the Faculty of Health Sciences Research Ethics Committee.
3. The researcher will submit any major additions or changes to the research proposal after approval has been granted to the Faculty of Health Sciences Research Committee for consideration.
4. The researcher, with the supervisor and co-researchers will take full responsibility in ensuring that the protocol is adhered to.
5. **The following section must be completed if the research involves human participants:**

	YES	NO	N/A
❖ Provision has been made to obtain informed consent of the participants	√		
❖ Potential psychological and physical risks have been considered and minimised	√		
❖ Provision has been made to avoid undue intrusion with regard to participants and community	√		
❖ Rights of participants will be safe-guarded in relation to:			
- Measures for the protection of anonymity and the maintenance of Confidentiality.	√		
- Access to research information and findings.	√		
- Termination of involvement without compromise	√		
- Misleading promises regarding benefits of the research	√		



SIGNATURE: CHAIRPERSON OF RESEARCH ETHICS COMMITTEE

09/05/11  
DATE

06/05/11  
DATE

09/05/2011  
DATE

13/05/2011  
DATE

Are you between the ages of **18** and **45** and  
suffering from:

# Neck and Shoulder pain

Research is currently being carried out at the  
Durban University of Technology Chiropractic Day  
Clinic

## **Free Treatment**

available to those who qualify to take part in this  
study.

Contact **Mark Zuidewind** on 0836042598 or  
031 373 2205 / 2512 for more information.

## Appendix C: Letter of Information and Informed Consent

Dear Participant

Thank you for joining my research. I am a chiropractic student completing my M.Tech Chiropractic degree. Outlined below is a brief description of the study and what will be needed from you. Your participation is greatly appreciated and your involvement is contributing to making a successful study.

**Title of the research study:** *The effect of Kinesio Taping® space-correction-technique on post-needling soreness in the Trapezius muscle trigger point two.*

**Principle researcher:**

Mark Zuidewind

Contact number 0313732205 / 0836042598

**Research supervisor:**

Dr. Grant Matkovich [M.Tech-Chiropractic]

Contact number 0312018204

**Brief Introduction and Purpose of the Study:**

You have been selected to be part of the research programme. This research programme will determine the effectiveness of Kinesio Taping® in reducing the post-needling soreness experienced by patients. All participants will be randomly split into three equal groups. Each participant will receive a clinical treatment depending on the group they are allocated to. As part of their treatment, each group will receive dry needling, which is an effective treatment for muscular neck and shoulder pain.

**Outline of the procedures:**

At the initial appointment you will be screened to determine whether you are suitable as a participant, using a case history, physical examination and neck (cervical spine) examination. All participants are requested to attend 2 consultations over a 24 hour period at the Durban University of Technology Chiropractic Day Clinic.

Please do not change your daily activities/lifestyle as this may interfere with the readings of the study.

Participants will not be allowed to participate in this study if they do not sign the informed consent form or have contra-indications to dry needling therapy, including being under the influence of alcohol, if they have taken blood thinning medication during the three days prior to the initial consultation, are currently on painkiller medication, have received dry needling to the affected muscle up to 72 hours prior to the initial consultation, are unable to commit to the 24 hour follow up appointment or are suffering from any of the following medical conditions (cancer / blood disorders / fever / frozen shoulder / chronic fatigue syndrome / nerve root entrapment / anxiety disorder / needle phobia)

**Benefits:**

This study will add to the information on how to effectively reduce the degree of post-needling soreness experienced by patients.

After the duration of the study, you may have also noticed a decrease in pain at the base of your neck/upper shoulders.

**Risks or discomforts to the subject:**

All groups in the study will receive treatment that is safe and efficient with all the treatments carried out under the supervision of a qualified chiropractor.

Dry needling as performed in this study is considered a safe treatment technique with no adverse long term side effects.

Dry needle insertion may be perceived as a minor "prick" sensation, while a dull ache may accompany the treatment duration. There may be minimal bleeding from the dry needling site when the needle is removed, however this is stopped with mild pressure from the researcher.

All taping products used in this study carry minimal risk of causing adverse side-effects. In the unlikely event of a side-effect (such as a rash) it can be easily treated, however there will be no compensation available.

Adverse skin reactions/rashes etc. due to the tape used in the study are extremely uncommon, these are easily treated and no compensation will be available.

**Reason/s why the subject may be withdrawn from the study:**

If you do not follow the research procedure during the course of the study.  
You have adverse reactions to the treatment and are unwilling to continue.

**Remuneration:**

Patients taking part in the study will not receive any form of remuneration for taking part in the study.

**Costs of the study:**

Participants will not be charged for the treatments involved in the study, however if the participant wants further treatment upon completion of the study, normal consultation rates will apply.

**Confidentiality:**

All patient information relevant to the study will be kept confidential and will be stored in the Chiropractic Day Clinic for 5 years, after which it will be disposed of. The results of the study will be made available at the Durban University of Technology Library for educational purposes, but no patient information will be revealed.

**Persons to contact in the event of any problems or queries:**

If you any questions or problems with respect to the study, please feel free to contact my research supervisor, Dr. Grant Matkovich on 0312018204.

**Statement of agreement to participate in the research study:**

I ..... (subject's full name), ID number....., have read this document in its entirety and understand its contents. Where I have had any questions or queries, these have been explained to me by Mark Zuidewind to my satisfaction. Furthermore, I fully understand that I may withdraw from this study at any stage without any adverse consequences and my future health care will not be compromised. I, therefore, voluntarily agree to participate in this study.

Subject's name (print) .....

Subject's signature: ..... Date: .....

Researcher's name (print): .....



Researcher's signature: ..... Date: .....

Witness name (print): .....

Witness signature: ..... Date: .....



## Appendix D: Case History

 <b>D U R B A N</b> <b>UNIVERSITY of</b> <b>TECHNOLOGY</b>	<b>DURBAN UNIVERSITY OF TECHNOLOGY</b> <b>CHIROPRACTIC DAY CLINIC</b> <b>CASE HISTORY</b>	 <b>D U R B A N</b> <b>UNIVERSITY of</b> <b>TECHNOLOGY</b>
Patient: _____		Date: _____
File # : _____		Age: _____
Sex : _____	Occupation: _____	
Intern : _____		Signature _____
<b><u>FOR CLINICIANS USE ONLY:</u></b>		
Initial visit Clinician: _____		Signature : _____
<b>Case History:</b>		
Examination: Previous: _____		Current: _____
X-Ray Studies: Previous: _____		Current: _____
Clinical Path. lab: Previous: _____		Current: _____
<b>CASE STATUS:</b>		
PTT: _____		Signature: _____ Date: _____
<b>CONDITIONAL:</b> Reason for Conditional: _____ _____ _____ _____		
Signature: _____		Date: _____
Conditions met in Visit No: _____		Signed into PTT: _____ Date: _____
Case Summary signed off: _____		Date: _____

**6. Current health status and life-style:**

- < Allergies
- < Immunizations
- < Screening Tests incl. x-rays
- < Environmental Hazards (Home, School, Work)
- < Exercise and Leisure
- < Sleep Patterns
- < Diet
- < Current Medication
- < Analgesics/week:
- < Tobacco
- < Alcohol
- < Social Drugs

**7. Immediate Family Medical History:**

- < Age
- < Health
- < Cause of Death
- < DM
- < Heart Disease
- < TB
- < Stroke
- < Kidney Disease
- < CA
- < Arthritis
- < Anaemia
- < Headaches
- < Thyroid Disease
- < Epilepsy
- < Mental Illness
- < Alcoholism
- < Drug Addiction
- < Other

**8. Psychosocial history:**

- < Home Situation and daily life
- < Important experiences
- < Religious Beliefs

**Intern's Case History:**

**1. Source of History:**

**2. Chief Complaint : (patient's own words):**

**3. Present Illness:**

	Complaint 1	Complaint 2
< Location		
< Onset : Initial:		
Recent:		
< Cause:		
< Duration		
< Frequency		
< Pain (Character)		
< Progression		
< Aggravating Factors		
< Relieving Factors		
< Associated S & S		
< Previous Occurrences		
< Past Treatment		
< Outcome:		

**4. Other Complaints:**

**5. Past Medical History:**

- < General Health Status
- < Childhood Illnesses
- < Adult Illnesses
- < Psychiatric Illnesses
- < Accidents/Injuries
- < Surgery
- < Hospitalizations

**9. Review of Systems:**

- < General
- < Skin
- < Head
- < Eyes
- < Ears
- < Nose/Sinuses
- < Mouth/Throat
- < Neck
- < Breasts
- < Respiratory
- < Cardiac
- < Gastro-intestinal
- < Urinary
- < Genital
- < Vascular
- < Musculoskeletal
- < Neurologic
- < Haematologic
- < Endocrine
- < Psychiatric

## Appendix E: Senior Physical

<b>Durban University of Technology</b> <b>PHYSICAL EXAMINATION: SENIOR</b>					
<b>Patient Name :</b> _____		<b>File no :</b> _____		<b>Date :</b> _____	
<b>Student :</b> _____			<b>Signature :</b> _____		
<b>VITALS:</b>					
Pulse rate:			Respiratory rate:		
Blood pressure:	R	L	Medication if hypertensive:		
Temperature:			Height:		
Weight:	Any recent change? Y / N		If Yes: How much gain/loss	Over what period	
<b>GENERAL EXAMINATION:</b>					
General Impression					
Skin					
Jaundice					
Pallor					
Clubbing					
Cyanosis (Central/Peripheral)					
Oedema					
Lymph nodes	Head and neck				
	Axillary				
	Epitrochlear				
	Inguinal				
Pulses					
Urinalysis					
<b>SYSTEM SPECIFIC EXAMINATION:</b>					
CARDIOVASCULAR EXAMINATION					
RESPIRATORY EXAMINATION					
ABDOMINAL EXAMINATION					
NEUROLOGICAL EXAMINATION					
COMMENTS					
<b>Clinician:</b> _____			<b>Signature :</b> _____		

## Appendix F: Cervical Spine Regional Examination

### DURBAN UNIVERSITY OF TECHNOLOGY REGIONAL EXAMINATION - CERVICAL SPINE

Patient: \_\_\_\_\_ File No: \_\_\_\_\_

Date: \_\_\_\_\_ Student: \_\_\_\_\_

Clinician: \_\_\_\_\_ Sign: \_\_\_\_\_

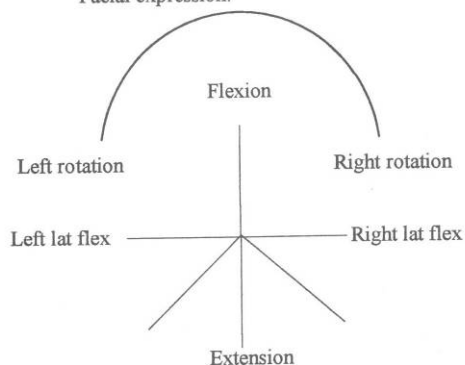
#### OBSERVATION:

Posture  
Swellings  
Scars, discolouration  
Hair line  
Body and soft tissue contours

Shoulder position  
Left :  
Right :  
Shoulder dominance ( hand ):  
Facial expression:

#### RANGE OF MOTION:

Extension ( 70°):  
L/R Rotation ( 70°):  
L/R Lat flex (45°):  
Flexion ( 45°):



#### PALPATION:

Lymph nodes  
Thyroid Gland  
Trachea

#### ORTHOPAEDIC EXAMINATION:

Tenderness		Right	Left
Trigger Points:	SCM		
	Scalenii		
	Post Cervicals		
	Trapezius		
	Lev scapular		

	Right	Left		Right	Left
Doorbell sign			Cervical compression		
Kemp's test			Lateral compression		
Cervical distraction			Adson's test		
Halstead's test			Costoclavicular test		
Hyper-abduction test			Eden's test		
Shoulder abduction test			Shoulder compression test		
Dizziness rotation test			Lhermitte's sign		
Brachial plexus test					

# **NEUROLOGICAL EXAMINATION:**

Dermatomes	Left	Right	Myotomes	Left	Right	Reflexes	Left	Right
C2			C1			C5		
C3			C2			C6		
C4			C3			C7		
C5			C4					
C6			C5					
C7			C6					
C8			C7					
T1			C8					
			T1					
Cerebellar tests:			Left		Right			
Disidiadochokinesis								

VASCULAR:	Left	Right	Left	Right
Blood pressure			Subclavian arts.	
Carotid arts.			Wallenberg's test	

# **MOTION PALPATION & JOINT PLAY:**

Left: Motion Palpation:  
Joint Play:  
Right: Motion Palpation:  
Joint Play:

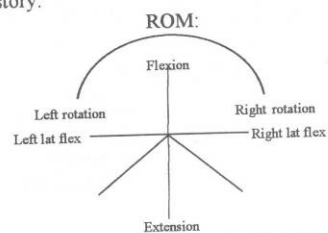
## **BASIC EXAM: SHOULDER:**

Case History:

ROM: Active:  
Passive:  
RIM:  
Orthopaedic:  
Neuro:  
Vascular:


## **BASIC EXAM: THORACIC SPINE:**

Case History:



Motion Palpation:	
Orthopaedic:	
Neuro:	
Vascular:	
Observ/Palpation:	
Joint Play:	

## Appendix G: SOAPE Note

DURBAN UNIVERSITY OF TECHNOLOGY				 DUT
<i>Patient Name:</i>		<i>File #:</i>		<i>Page:</i>
<i>Date:</i>	<i>Visit:</i>	<i>Intern:</i>	<i>Signature:</i>	
<i>Attending Clinician:</i>				
<i>S: Numerical Pain Rating Scale (Patient)</i> <i>Least 0 1 2 3 4 5 6 7 8 9 10 Worst</i>		<i>Intern Rating</i> <input type="text"/>	<i>A:</i>  	
<i>O:</i>		<i>P:</i>		
		<i>E:</i>		
<i>Special attention to:</i>		<i>Next appointment:</i>		
<i>Date:</i>		<i>Visit:</i>		<i>Page:</i>
<i>Date:</i>	<i>Visit:</i>	<i>Intern:</i>	<i>Signature:</i>	
<i>Attending Clinician:</i>				
<i>S: Numerical Pain Rating Scale (Patient)</i> <i>Least 0 1 2 3 4 5 6 7 8 9 10 Worst</i>		<i>Intern Rating</i> <input type="text"/>	<i>A:</i>  	
<i>O:</i>		<i>P:</i>		
		<i>E:</i>		
<i>Special attention to:</i>		<i>Next appointment:</i>		
<i>Date:</i>		<i>Visit:</i>		<i>Page:</i>
<i>Date:</i>	<i>Visit:</i>	<i>Intern:</i>	<i>Signature:</i>	
<i>Attending Clinician:</i>				
<i>S: Numerical Pain Rating Scale (Patient)</i> <i>Least 0 1 2 3 4 5 6 7 8 9 10 Worst</i>		<i>Intern Rating</i> <input type="text"/>	<i>A:</i>  	
<i>O:</i>		<i>P:</i>		
		<i>E:</i>		
<i>Special attention to:</i>		<i>Next appointment:</i>		



## Appendix H: Correspondence with Statistician

### **Research Statistics**

From: **Tonya Esterhuizen** (Esterhuizen@ukzn.ac.za)

Sent: 03 February 2011 06:02:13 AM

To: Mark Zuidewind (run-dmz@hotmail.com)

1 attachment

MZ PG4a TE.DOC (197.0 KB)

Hi

Please see attached where I have inserted the cost and stats methodology paragraph.

Regards

Tonya

From: **Mark Zuidewind** (run-dmz@hotmail.com)

Sent: 02 February 2011 09:02:48 PM

To: esterhuizen@ukzn.ac.za

1 attachment

MZ PG4a.doc (215.5 KB)

Hi Tonya,

Sorry I have taken so long to apply, been away on holiday and then trying to register while the DUT strikes were going on.

I have attached the protocol and have highlighted the statistical sections in bold red to make identification easier for you.

Many thanks

Mark Zuidewind

From: **Tonya Esterhuizen** (Esterhuizen@ukzn.ac.za)

Sent: 18 January 2011 07:08:30 AM

To: Run-dmz@hotmail.com Subject: RE: Research Statistics

Sure, please email me your protocol and I will insert the stats paragraph and cost.

Thanks

Tonya

From: **Run-dmz@hotmail.com**

Sent: 17 January 2011 10:37:16 PM

To: Run-dmz@hotmail.com

Hi Tonya,

Thanks, I'll check what sample sizes were used in similar previous studies and use a similar group size.

If you could write up that paragraph statistical methodology I would appreciate it.

Also, would you let me know how much your fee is for doing the statistical analysis. I will need it for my budget calculations.

Regards,

Mark

From: **Tonya Esterhuizen** (Esterhuizent@ukzn.ac.za)

Sent: 17 January 2011 06:11:44 AM

To: Run-dmz@hotmail.com Subject: RE: Research Statistics

Hi

Yes so its a normal parallel group trial with 3 treatment groups. I can write up a paragraph on statistical methodology for your protocol but when it comes to sample size there is no rule of thumb. Each study has different considerations. Basically the sample size must be large enough to provide at least 80% power to be able to detect a significant difference between the groups you want to compare, should a clinical difference exist. So the problem is to specify the quantity of clinically important difference you expect in each comparison and then to perform the sample size calculation around that. If you can choose the most important outcome measurement and tell me what you expect the post treatment Mean value and standard deviation will be in each group then i can perform some calculations for you.

If you are not able to estimate this then we usually use the maximum sample size you can, but there is no guarantee of achieving statistical significance. Other students usually use the numbers that have been used previously in similar studies.

Regards

Tonya

## Appendix I: Numerical Pain Rating Scale and Algometer log

Date: \_\_\_\_\_ File number: \_\_\_\_\_ Group: \_\_\_\_\_  
Patient name: \_\_\_\_\_

### Numerical Pain Rating Scale – 101

#### **Immediately prior to Dry Needling**

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its least severe**. A zero (0) would mean "no pain at all", and one hundred (100) would mean, "pain as bad as it could be" / "worst pain imaginable".  
Please write only one number.

0 \_\_\_\_\_ 100

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its most severe**. A zero (0) would mean "no pain at all", and one hundred (100) would mean "pain as bad as it could be" / "worst pain imaginable".  
Please write only one number.

0 \_\_\_\_\_ 100

#### **10 minutes after Dry Needling**

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its least severe**. A zero (0) would mean "no pain at all", and one hundred (100) would mean, "pain as bad as it could be" / "worst pain imaginable".  
Please write only one number.

0 \_\_\_\_\_ 100

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its most severe**. A zero (0) would mean "no pain at all", and one hundred (100) would mean "pain as bad as it could be" / "worst pain imaginable".  
Please write only one number.

0 \_\_\_\_\_ 100

**24 hours after Dry Needling**

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its least severe**. A zero (0) would mean "no pain at all", and one hundred (100) would mean, "pain as bad as it could be" / "worst pain imaginable".  
Please write only one number.

0 \_\_\_\_\_ 100

Please indicate on the line below, the number between 0 and 100 that best describes the pain you experience **when it is at its most severe**. A zero (0) would mean "no pain at all", and one hundred (100) would mean "pain as bad as it could be" / "worst pain imaginable".  
Please write only one number.

0 \_\_\_\_\_ 100

**Algometer Readings**

Immediately prior to Dry Needling: \_\_\_\_\_

10 minutes after Dry Needling: \_\_\_\_\_

24 hours after Dry Needling: \_\_\_\_\_

## Appendix J: Pain Diary

### PAIN DIARY

Dear patient.

Kindly complete this pain diary documenting any pain / soreness you may experience, in the area that was needled, during the 24 hours following your treatment.

Did you experience any pain / soreness in the area that was needled at the following times after receiving dry needling treatment (please tick Yes / No as appropriate).

	3 hours	6 hours	9 hours	12 hours	24 hours
Yes					
No					

I experienced the most severe amount of pain / soreness at approximately \_\_\_\_\_ hours after receiving dry needling therapy.

If you have any questions regarding the research, kindly contact Mark Zuidewind on 0313732205 / 0836042598 or you can contact my research supervisor Dr. Grant Matkovich on 0312018204.

Patient Name: \_\_\_\_\_ Signature: \_\_\_\_\_

Research Student Name: \_\_\_\_\_ Signature: \_\_\_\_\_

## Appendix K: Data Collection Sheet

### Data collection sheet

Date: \_\_\_\_\_ File number: \_\_\_\_\_ Group: \_\_\_\_\_  
 Patient name: \_\_\_\_\_

Consultation 1		
NRS	Pre DN	
	Post DN	
Algometer	Pre DN	
	Post DN	

Consultation 2			
NRS	24 hr		
Algometer	24 hr		
Pain Diary	3	Yes	No
	6	Yes	No
	9	Yes	No
	12	Yes	No
	24	Yes	No
	Worst		