The knowledge, attitudes, and practice of registered Masters Chiropractic students of dry needling during their clinical practicum

By

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I, Talia Seale, do declare that this dissertation is representative of my own work in both conception

and execution (except where acknowledgements indicate to the contrary)

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DECLARATION

I, Talia Cherise Seale, hereby declare that this dissertation is representative of my own efforts in both conception and execution, except where references indicate otherwise. All resources used have been acknowledged and referenced.

16/01/2022

Talia Cherise Seale Date

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DEDICATION

For my parents, Jennifer and Kevin.

Thank you for giving me the tools to succeed, the opportunities to make you proud, the freedom to make mistakes, and the courage to learn from them and persevere.

I love and appreciate you.

“Behind every young child who believes in themselves is a parent who believed first”

- Mathew L Jacobson

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ABSTRACT

Background

Dry needling (DN) is an effective treatment protocol commonly used by chiropractors and chiropractic students for patients presenting with myofascial trigger points (MFTPs). The efficacy of DN is majorly advantageous in its use in clinical practice, but it is not without risk. As an invasive procedure, requiring the penetration of skin, DN has the potential to cause infection, as well as other adverse events. These range from undesirable short-term side effects to more serious harm that can result in fatality. As such, a practitioner is expected to be well versed in the modality and confident in performing the procedure on patients. This requires a strong educational background in DN, both theoretically and practically, to ensure the safe and effective practice of DN. Despite the call for more research-based investigation into chiropractic education, the literature in this regard is still lacking. Various authors have demonstrated the beneficial nature of the student perspective and in this case, as the involved party, the student experience would best address the successes and shortcomings of the teaching and learning of DN at the Durban University of Technology (DUT).

Aim

To describe the knowledge, attitudes, and practice of registered Master of Technology in Chiropractic students on the usage of dry needling during their clinical practicum at the DUT Chiropractic Day Clinic (CDC).

Method

A qualitative approach was used with an exploratory and descriptive design, within an interpretive paradigm. The eight participants chosen were selected by means of purposeful sampling. Their experiences of DN were recorded electronically during semi-structured, individual interviews and were later transcribed verbatim. The researcher then used thematic analysis to interpret the data and discuss the findings.

Results

One main theme prevailed. *Dry needling is an important modality in the treatment of myofascial trigger points and is a clinical skill that is learnt through observation and practice to prevent patient harm*. A total of five sub-themes emerged from the data, which categorised the different components discussed in this study. These included: *trigger point treatment, pre-clinic teaching and preparedness for dry needling, appraisal of dry needling during the clinical practicum, choice of dry needling practice style,* and *dry needling high-risk muscles*.

The participants reported their dissatisfaction with the pre-clinic DN education and their dislike for the rule that prohibits the DN of high-risk muscles (HRM). They indicated that the pre-clinic DN education required more practical exposure and direct supervision. Participants commented on the need for examinations and testing to be more practical in nature. Despite the negative aspects shared by participants, the DN education at DUT left students feeling prepared and confident to DN in clinical practice. They attributed their development of knowledge, skills and confidence to a year of clinical experience and the clinicians' input during the clinical practicum. This study highlighted the DN knowledge and attitudes of master's chiropractic students and described their practice of the modality.

Key concepts

Chiropractic, Clinical practicum, Dry needling, High-risk muscles, Myofascial Trigger Points, Pre-clinic education.

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CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION

Dry needling (DN) is an auxiliary treatment protocol used by chiropractors and other manual therapists, such as physiotherapists, in the management of many conditions, a common one being myofascial trigger points (MFTPs). MFTPs are one of the most common musculoskeletal pain conditions (Hidalgo-Lozano *et al.* 2010) and they are often a primary cause of dysfunction (Mense 2010). The use of DN in the management of MFTPs is becoming common practice. This may be due to the recent surge in high-quality DN research (Tekin *et al.* 2013, Dommerholt and Fernandez de las Penas 2013, DiLorenzo *et al.* 2004), showing the modality to be effective and safe when administered by a trained practitioner, for the treatment of myofascial pain (Fogelman and Kent 2015).

DN is a treatment protocol that is often referred to as a procedure, technique, or modality. For the purposes of this study, the term modality will be the most used term as it is familiar to the chiropractic students at DUT.

This chapter serves as an introduction to the research, giving a brief overview of the study and outlining the chapters to follow. The chapter also addresses the background of the study, the research problem and question, as well as the aims and objectives of the research. A brief discussion of the research methodology has been included.

1.2 BACKGROUND TO THE STUDY

Musculoskeletal conditions are one of the most prevalent complaints among patients (Daniels, Ishmael and Wesley 2003), and are therefore an important aspect to consider in health care (Vernon and Schneider, 2009). Among these complaints, myofascial pain syndrome (MPS) is a noteworthy condition encountered in chiropractic practices (Lavelle, Lavelle and Smith 2007). It is seen in acute and chronic phases (Kalichman and Vulfson 2010), but with its potential for chronicity, the condition poses a marked economic burden, resulting in substantial disability and absenteeism from work (Nyman *et al.* 2007). Srbely (2010) described MPS as a costly medical challenge that poses not only a financial burden, but a physical burden too. Chronic pain

conditions can also be responsible for depression, sleep disturbances and psychological and behavioural disturbances (Rachlin, 1994). The leading diagnosis among pain management specialists is thought to be MPS, as well as amongst pain patients presenting to general practitioners (Vernon and Schneider, 2009). MPS, as defined by Lavelle, Lavelle and Smith (2007), consists of sensory, motor and autonomic symptoms which are caused by MFTPs, a hyperirritable, hypersensitive palpable nodule in a tight band of skeletal muscle.

Various methods and modalities are used in the treatment and management of MFTPs, including laser therapy, heat, acupressure, biofeedback, pharmaceutical treatment (Kalichman and Vulfsons 2010), ischaemic compression, spray and stretch, DN, transcutaneous electrical nerve stimulation, ultrasound, physical therapy and massage (Lavelle, Lavelle and Smith 2007).

DN is often the practitioner's modality of choice due to its efficacy and ease of use. It is a low-risk, effective modality when performed by a well-trained and skilled practitioner (Fogelman and Kent 2015). The practitioner can perform the treatment using a variety of techniques, based on several models (Dommerholt, del Moral and Grobli 2006). One of these techniques include the insertion of a needle into the most tender points in the muscle to elicit a local twitch response, which means the muscle sharply contracts with associated pain (Baldry 2002). This is known as deep DN, western acupuncture, medical acupuncture or intramuscular stimulation (Kalichman and Vulfsons 2010). Deep DN has been shown to decrease pain intensity and improve quality of life to a greater degree than acupuncture and superficial DN in a randomised clinical trial (Itoh, Katsumi and Kitakoji 2004).

However, according to Brady *et al.* (2014), DN is an invasive and sometimes dangerous management protocol. Superficial DN is an alternative to deep needling, whereby the needle is inserted superficially in the tissue directly over the MFTP (Baldry 1989). Baldry (1989) recommended a depth of 5 to 10 mm for a duration of 30 seconds, with reinsertion for an additional 2 to 3 minutes if the pain persists. Baldry (1995) preferred and recommended this method as the procedure carries less risk for damage to structures and is less painful during and after treatment. Techniques vary between practitioners, with some preferring deep DN and others superficial DN or single insertion of the needle, as opposed to fanning the needle in and out of the trigger point to elicit multiple twitch responses.

In a systematic review, Cummings and White (2001) concluded that patients treated with DN for myofascial trigger points experienced marked improvements. A study by Couto *et al.* (2014) showed paraspinal DN of the multifidi muscle to be more effective than sham needling or lidocaine injection in pain relief and return of muscle function. The effectiveness of DN in the management of musculoskeletal pain has been confirmed in numerous studies (Kalichman and Vulfsons 2010) and systematic reviews (Cummings and White 2001; Furlan *et al.* 2005; Tough *et al.* 2009).

There are, however, risks and adverse effects associated with DN (Kalichman and Vulfsons 2010), namely post needling soreness, local haemorrhage and syncope. Baldry (2002) included nerve and blood vessel damage as some of the risks associated with DN. Vulfson, Ratmansky and Kalichman (2012) added several adverse effects, including post needling soreness, local haemorrhages, syncopal responses and acute cervical epidural hematoma. McCutcheon and Yelland (2011) showed over 100 cases of acupuncture or DN induced pneumothorax, including four deaths in an Australian study. Pneumothorax, although rare, is a serious complication that can be life threatening (McCutcheon and Yelland, 2011). Guidelines are available to reduce the risk of complications in these regions of concern (McCutcheon and Yelland 2011). Kalichman and Vulfsons (2010) recommend superficial DN for muscles that overlay areas of potential risk for significant adverse effects.

A clinical commentary study reviewed the literature to justify the use of DN by sport and orthopaedic physical therapists with the focus on DN safety. The literature showed that DN had not been included in entry level curriculum and concluded that it was therefore not an entry level skill and was not to be performed without the appropriate postgraduate training (Unverzagt, Berglund and Thomas 2015). A majority of chiropractic qualifications around the world do not include, or do not have as comprehensive a DN component as the Durban University of Technology (DUT).

In the 4th year (Bachelor of Technology) of the chiropractic programme at DUT, students are taught deep DN only and as such may not be aware of alternative DN techniques without doing any of their own research or reading. Generalized DN precautions are taught, as well as caution with respect to areas of potential risk. Alternative modalities to DN are usually recommended for treatment of these muscles. Students then acquire further knowledge and skill from more experienced students,

treating at sports events, interacting with clinicians and treating patients during their clinical practicum in their 5th and consecutive master's years of study.

This clinical education facilitates the acquiring of new knowledge and skills that are aimed at the needs of different individual patients (Westerman *et al.* 2013). In an email communication on 18 April 2018, the DUT Chiropractic Day Clinic (CDC) indicated that they considered posterior cervical, sub-occipitals, cubital fossa, scalene, popliteal fossa, piriformis, inguinal area, upper and lower inner quadrants and lower outer quadrant of the gluteal muscles to be high risk for DN. Subsequently, the list was placed in the clinicians' office after being altered slightly to include the sternocleidomastoid muscle and change popliteal fossa to popliteal area.

In a study conducted using clinical and EMG data to identify muscles that were high risk for pneumothorax, the most commonly associated were serratus anterior, trapezius and rhomboid major (Kassardjian, O'gorman and Sorenson 2016). Master's chiropractic students treating in the DUT CDC are discouraged from DN these high-risk muscles (HRM) and are only permitted to do so under direct clinician supervision, when and if a clinician is available. Resultantly, students may be inadequately prepared or even incompetent prior to qualifying, as DN is a learned skill that requires accuracy (Dommerholt, del Moral and Grobli 2006). Alternatively, some students may be reluctant to needle these regions once qualified due to fear of causing injury to their patient. Chiropractors in private practice often needle HRM, but while there are risks to any intervention, the risk associated with DN is minimal in the hands of a skilled practitioner (Dommerholt and Simons 2008).

This study is aimed at understanding the knowledge, attitudes and practices of registered Master of Technology in Chiropractic students on the usage of DN during their clinical practicum. Veerapen and McAleer (2010) described student feedback as an asset in providing necessary information for curriculum revision, as well as for the improvement of learning environments and evaluating their efficacy and short comings.

1.3 PROBLEM STATEMENT

DN can be dangerous in some regions and muscles of the body which have resultantly been classified as high risk. Chiropractic master's students may be reluctant to DN

these HRM due to fear of causing harm or injury to a patient. This could lead to students being ill-prepared or incompetent prior to clinical practice, as DN is a learned skill that requires accuracy (Dommerholt, del Moral and Grobli 2006). As such, understanding the knowledge, attitudes and practices of registered chiropractic master's students on the usage of DN is necessary. Previous studies have shown both the effectiveness and the risks of DN; however, none have explored the clinical experiences of DN amongst chiropractic students.

1.4 AIMS OF THE STUDY

This study aims to describe the knowledge, attitudes and practices of registered, Master of Technology in Chiropractic students on the usage of dry needling during their clinical practicum.

1.5 OBJECTIVES

Objective one: To describe the knowledge of chiropractic master's students on the usage of dry needling.

Objective two: To describe the attitudes of chiropractic master's students towards the usage of dry needling.

Objective three: To describe the practices of chiropractic master's students in the technique of dry needling.

1.6 RESEARCH QUESTION

What knowledge and attitudes do chiropractic master's students at the Durban University of Technology (DUT) Chiropractic Day Clinic (CDC), have of dry needling (DN) and how do they practice the modality?

1.7 BRIEF OVERVIEW OF THE RESEARCH METHODOLOGY

1.7.1 Design

A qualitative approach was used with an exploratory and descriptive design within interpretive paradigm.

1.7.2 Research Procedure

After all ethical and gate keeper permissions were attained, a list of students who met the inclusion criteria for the study was obtained from the DUT CDC administrative staff. The students who fitted the study criteria were informed of the research via WhatsApp messenger. Of the final participants selected, five volunteered for the study. The remaining participants chosen were selected by means of purposeful sampling. This is a form of non-probability sampling that involves the deliberate selection of a sample population, by the researcher, to fulfil a specific purpose (Teddlie and Tashakkori 2003), making it ideal for qualitative research. The students were asked to be part of the study with no coercion and had the choice to decline or leave the study at any time. They were given the opportunity to review the letter of information and consent, which they were required to sign if they wished to join the study. Semi-structured interviews were held using a ‘grand tour’ question, which is an open ended question method with probes and subsequent questioning. The interviews were conducted by means of electronic voice or video call, at a time of the participants’ choosing to ensure their health and safety, comfort and willingness to participate and share openly in a private environment in which they felt safe. The participants were informed that interviews would be recorded but remain confidential. Participants were interviewed until data saturation was met. Later, the interviews were transcribed manually, verbatim and coded and analysed by the researcher.

Qualitative research is a method of scientific enquiry which is mainly concerned with explaining social phenomena (Hancock, Ockleford and Windridge 2007). The main aim of qualitative research is to understand social constructs and explore subjective matter such as views, perceptions, opinions, attitudes and experiences. Saturation is used for ensuring that adequate and quality data are collected to support the study. This may be attributed to the fact that qualitative data is based on the principle of diminishing return, i.e. more data does not necessarily equate to more information

(Ritchie, Lewis and Elam 2003). Therefore, data are collected until saturation is reached.

A focus group was considered as a method of data collection or as a pilot study. Students may, however, have been reluctant to share in a group for fear of being judged on their differing opinions and depth of knowledge, and therefore individual interviews were chosen as the most appropriate means.

1.8 STRUCTURE OF THE RESEARCH CHAPTERS

Chapter one: This chapter served as an introduction of the research to the reader, outlining the rationale, aims, objectives and research question along with an overview of the procedures used.

Chapter two: In this chapter, an extensive review of the relevant literature is presented and discussed with emphasis on the lack of information in this area of study. This helps the reader to understand why this research was conducted. Each component of the research is explained in detail in this chapter to maximize the readers understanding by providing context.

Chapter three: The research procedures and methods are detailed extensively in this chapter, along with justification for the chosen methodology, model and design. This chapter also addresses all the ethical considerations of the study.

Chapter four: This chapter presents the results from the collected data in the research. The results are then interpreted and discussed with quotes from the research participants to support and substantiate the selected themes.

Chapter five: In this chapter, the relevance of the results is highlighted and related to the aims, objectives and literature relevant to the study. The study is summarised, and recommendations are made for further research in this field, the curriculum for DN at DUT and the chiropractic profession. Included are the strengths and limitations of the study as the researcher reflects.

1.9 CONCLUSION

Previous studies have shown both the effectiveness and the risks of DN; however, none have explored the clinical experiences of DN amongst chiropractic students. Veerapen and McAleer (2010) described student feedback as an asset in providing the necessary information for curriculum revision, as well as for the improvement of learning environments and evaluating their efficacy and short comings.

This chapter has introduced the research and provided the reader with an insight into the background and rationale for the research, to explain why this study has relevance. It included an overview of how the study was conducted to ensure an understanding of the model used in the study. The next chapter summarises the literature that exists on the topic, to inform the reader and provide context to ensure an understanding of the study outcomes.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

The literature review serves to inform the researcher initially, and give context to the reader thereafter, of the knowledge that exists pertaining to the study. The literature includes the background topics that encourage an understanding of the concepts discussed. It also considers the findings of other relevant studies that may bear resemblance or give insight into the phenomenon being studied. The literature review gives the researcher valuable insight into what still needs to be known or what has not yet been addressed in the field they have chosen to study.

In this chapter, the researcher discusses all the relevant topics surrounding the study, including MPS, MFTPs, modalities used in the treatment of MFTPs, DN, the teaching and learning of DN, clinical education, contra-indications and risks involved with DN, as well as the concepts of knowledge, attitudes and practices, and how they relate to the study phenomenon.

This extensive information was sourced and retrieved from many databases including, but not limited to, Google Scholar, DUT Summon and Open Scholar, Science Direct and Medline. Keywords were used to search for relevant literature, such as ‘muscle anatomy’, ‘muscle physiology’, ‘myofascial’, ‘myofascial pain syndrome’, ‘myofascial trigger points’, ‘myofascial trigger point treatment modalities’, ‘dry needling’, ‘dry needling myofascial trigger points’, among others.

DN is an auxiliary treatment protocol used by chiropractors and other manual therapists, such as physiotherapists, in the management of many conditions, a common one being myofascial pain syndrome (Kalichman and Vulfson 2010). The introductory chapter reflected on the need for interventions in patients presenting with MPS and the importance of the practitioner having a relevant skill set to treat these MFTPs.

2.2 MUSCLES AND FASCIA

It is important to introduce the anatomy and physiology of the muscles, fascia and myofascial trigger points to understand how they work, become dysfunctional, and the mechanisms behind the modalities with which they are managed and treated.

The term ‘myo-fascial’ was coined by Travell and Rinzler in their work on trigger points (TPs) (Travell and Rinzler 1952), yet the role of the fascia component is usually neglected when considering the topic, with literature often referring to muscles as discrete structures (Dommerholt and Fernandez de las Penas 2013). However, the muscles and fascia work together. Advancements in this field of research have shown the undeniable importance of the role of the fascia, but when describing the anatomy, for the purposes of understanding MPS or TPs, it is acceptable to discuss muscles in isolation (Dommerholt and Fernandez de las Penas 2013).

2.2.1 Fascia Anatomy

Fascia is separated into two layers, namely superficial and deep, based on their location in relation to the skin (Findley *et al*. 2012). Superficial fascia is made up of loose connective tissue and lies subcutaneously, containing fat tissue, unlike deep connective tissue which has no fat tissue and interacts with the muscles they encapsulate (Dommerholt and Fernandez de las Penas 2013). Deep fascia surrounds muscles individually or in groups, along with nerves and blood vessels, with a layer of loose connective tissue between the muscle and fascia to allow for movement between the layers (Stecco *et al*. 2011).

The muscle related fascia consists of three connected layers, namely epimysium surrounding individual muscles, perimysium surrounding bundles of muscle fibres and endomysium surrounding deeper muscle fibres (Findley *et al*. 2012). The fascia encases the muscle, as well as its associated nerve and blood supply (Totora and Derrickson 2009). This can be seen in **Figure 2.2**.

2.2.2 Muscle Macro-Anatomy

Skeletal muscle is the voluntary or consciously controlled muscle (Totora and Derrickson 2009) that is referred to when discussing muscles in the context of MFTPs. Muscles can be described in terms of their location in the body, origin and insertion

points on bone, nerve innervation, and the movements they bring about or in groups of muscles that work synergistically or antagonistically.

The structure of a tissue is indicative of its intended function. In muscle tissue, the function is force generation to bring about movement (MacIntosh, Gardiner and McComas 2006).

Figure 2.1 shows how the bicep's brachii muscle originates in the shoulder and inserts into the forearm to draw the forearm to the shoulder when the muscle is contracted (shortened), bringing about flexion at the elbow.

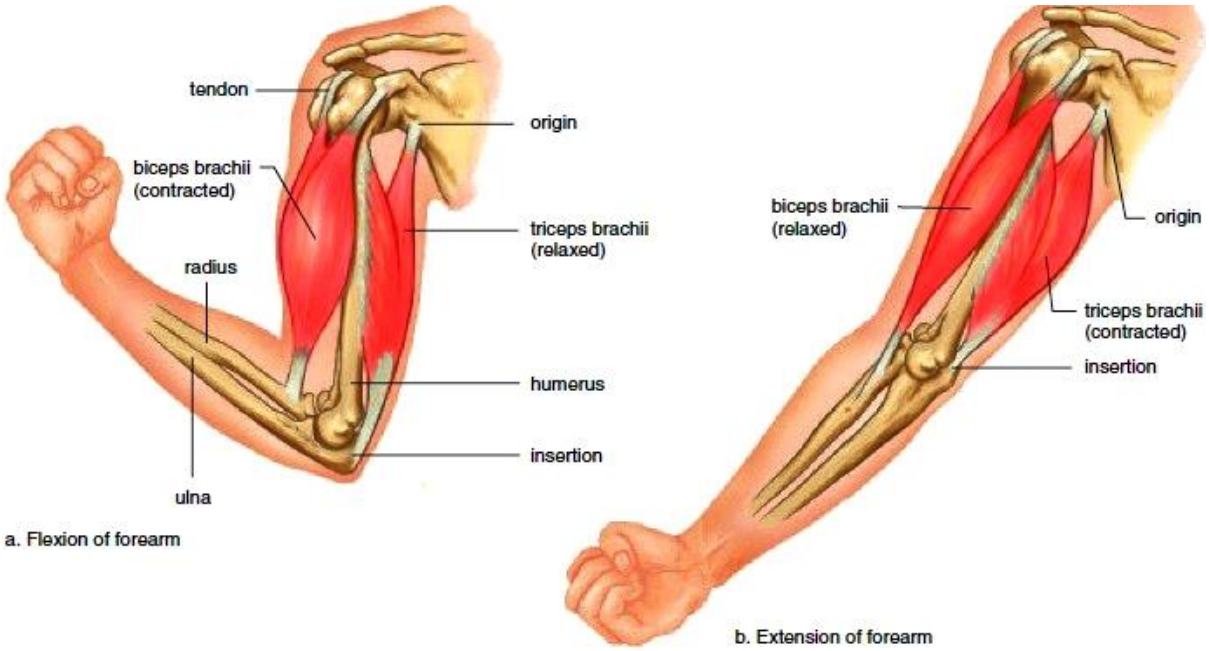

Figure 2.1: Movements generated based on the location of muscle attachments (Encyclopedia n.d.)

2.2.3 Muscle Micro-Anatomy

Each muscle comprises of multiple motor units. A motor unit is made up of a myofibril and its nerve supply (Totora and Derrickson 2009). These myofibrils clump together into bundles called muscle fibres. A group of muscle fibres make a bundle known as a fasciculus, and fasciculi are banded together by fascia to make a muscle.

Motor units are responsible for muscle tone, contraction and relaxation (Young *et al.* 2000; Tortora and Derrickson, 2009). Myofibrils are the contractile units of a muscle and span the length of a muscle fibre. The myofibril is composed of sarcomeres, the smallest functional unit in a muscle, connected end to end, giving skeletal muscle a

striated appearance. Sarcomeres comprise of actin and myosin filaments which interdigitate (Hopkins 2006).

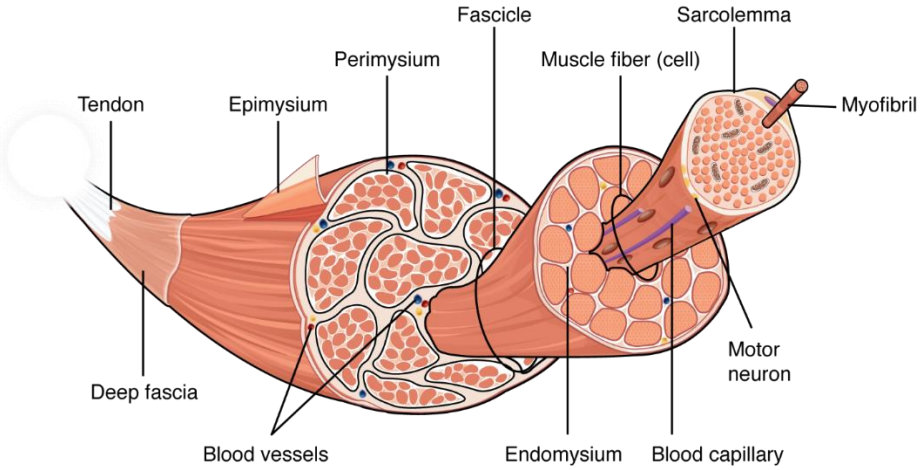

Figure 2.2: The anatomy of muscle and fascia (Biga *et al.* 2019)

2.2.4 Physiology of Muscle Action

The interaction between the protein filament components of a sarcomere, actin and myosin allows a muscle to contract (Young *et al.* 2000). Myosin filaments are thick filaments that have tiny projections that attach to the thin actin filaments by bonds known as cross-bridges. The more cross-bridges present, the stronger the contraction. The sarcomeres shorten in concentric contraction and lengthen in eccentric contraction (Vizniak 2011).

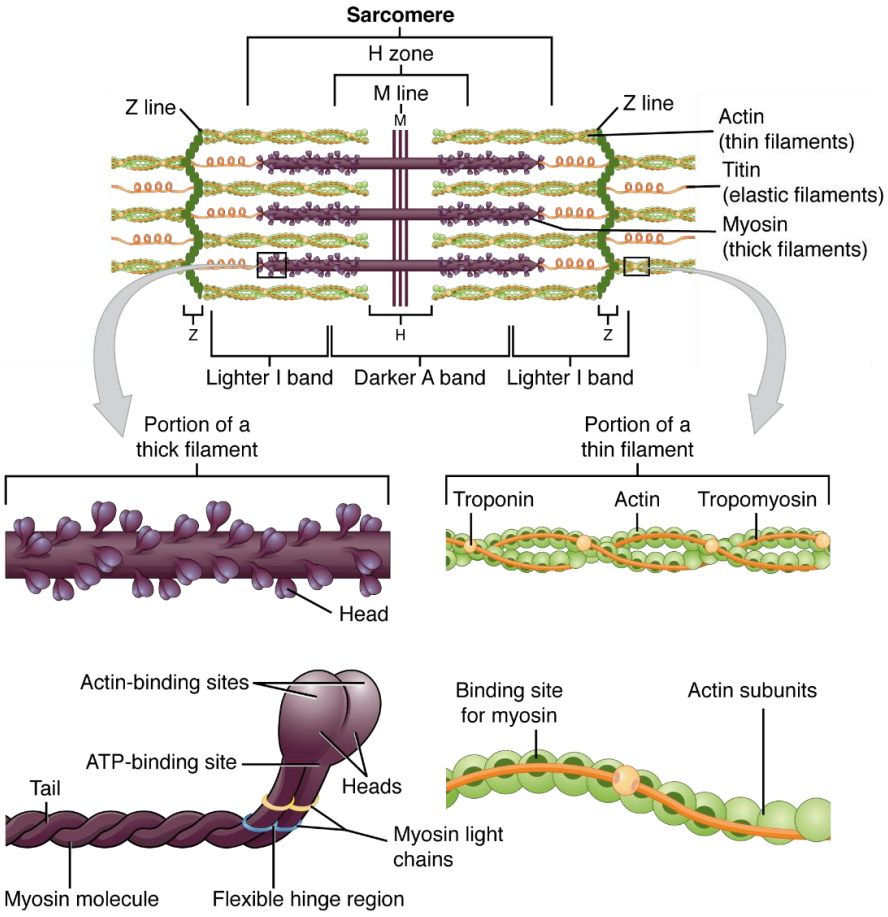

Figure 2.3: Filament components within the sarcomere (Biga *et al.* 2019).

The filament interaction is triggered by a chemical signal in the myofibril cell. The motor neuron releases a neuroreceptor at the neuromuscular junction, causing ion channels in the cell membrane (sarcolemma) to open and allow positively charged ions into the cell (depolarization). Voltage gated sodium channels are then triggered to open, allowing sodium ions into the muscle cell (Biga *et al.* 2019). An action potential is generated and spread across the sarcolemma and into the cell, signalling calcium release via transverse tubules. Calcium is released into the cell's cytoplasm, which help to expose the myosin-binding sites on the actin filaments, thereby triggering contraction (Hopkins 2006).

The sarcolemma contains ion channels and pumps, allowing it to maintain a negative resting membrane potential and voltage gated ion channels for the generation of action potentials (Hopkins 2006).

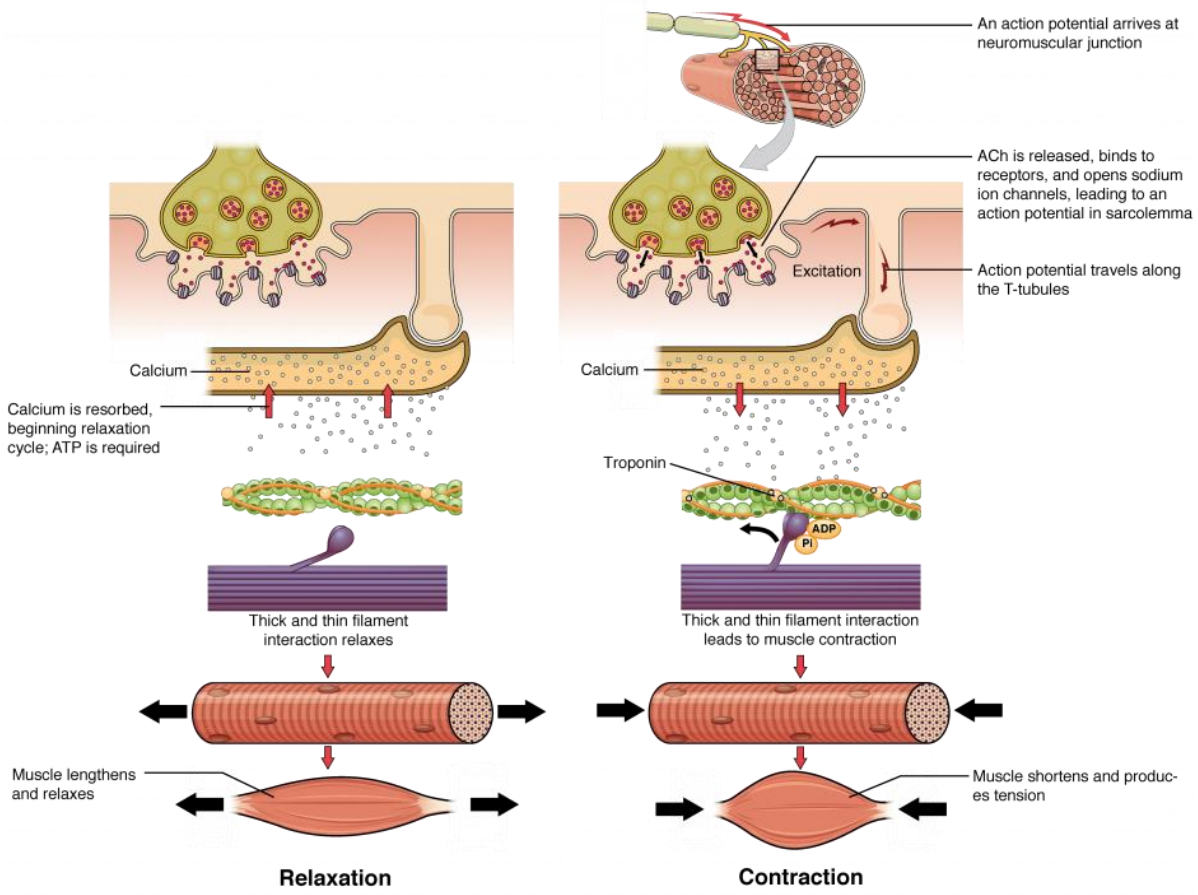

Figure 2.4: Physiology of muscle contraction (Biga *et al.* 2019)

2.3 MYOFASCIAL PAIN SYNDROME

MPS is a noteworthy condition encountered in chiropractic practice (Lavelle, Lavelle and Smith 2007). It is seen in acute and chronic phases (Kalichman and Vulfson 2010), but with its potential for chronicity, the condition poses a marked economic burden, resulting in substantial disability and absenteeism from work (Nyman *et al.* 2007). Srbely (2010) described MPS as a costly medical challenge that poses not only a financial burden, but a physical burden too. Chronic pain conditions can also be responsible for depression, sleep disturbances and psychological and behavioural disturbances (Rachlin 1994). The leading diagnosis among pain management specialists is thought to be MPS, as well as amongst pain patients presenting to general practitioners (Vernon and Schneider 2009). MPS, as defined by Lavelle, Lavelle and Smith (2007), consists of sensory, motor and autonomic symptoms, which are caused by MFTPs, a hyperirritable, hypersensitive palpable nodule in a tight band of skeletal muscle.

2.3.1 Myofascial Trigger Points

MFTPs are one of the most common musculoskeletal pain conditions (Hidalgo-Lozano *et al.* 2010) and are often a primary cause of dysfunction (Mense 2010). TPs may also be secondary or comorbid to other conditions, such as metabolic or systemic disease, osteoarthritis, and whiplash (Dommerholt and Fernandez de las Penas 2013: Bajaj *et al.* 2001: Freeman, Nystrom and Centeno 2009). In female patients, abdominal TPs were 90% predictive of endometriosis (Jarell 2004).

The term “trigger points” was first used by Steindler in 1940, when reporting his findings on some cases of sciatica not being of neurological origin, but rather from musculo/tendinous/ligamentous structures (Legge 2014). However, the term was not used to solely identify a MFTP (Legge 2014).

Travell, Rinzler and Herman (1942) used the term “trigger points”, limiting their definition to the identification of tender points in muscles only. Travell later mapped most of the trigger points and their referred pain, for the human body, with the help of Simons (Legge 2014). MFTPs can now be differentiated from tender points in a muscle (Unverzagt, Berglund and Thomas 2015).

There is a distinct difference between an active and latent trigger point. Travell, Simons and Simons described an active (1983: 1) and a latent (1999: 4) MFTP:

> *A focus of hyperirritability in a muscle or its fascia that is symptomatic with respect to pain; it causes a pattern of referred pain at rest and/or on motion that is specific for that muscle. An active trigger point is tender, prevents full lengthening of the muscle, weakens the muscle, usually refers pain on direct compression, mediates a local twitch response of its taut muscle fibres when adequately stimulated, causes tenderness in the pain reference zone, and often produces specific referred autonomic phenomenon, generally in its pain reference zone.* (Travell, Simons and Simons 1983: 1)
>
> *A myofascial trigger point that is clinically quiescent with respect to spontaneous pain; it is painful only when palpated. A latent trigger point may have all the other characteristics of an active trigger point and always has a taut band that increases muscle tension and restricts range of motion.* (Simons, Travell and Simons 1999: 4)

Active and latent TPs can both cause motor dysfunction in the muscle with the TP or in its functionally related muscles, including muscle weakness or inhibition, an increase in motor irritability, muscle spasm or imbalance, and altered motor recruitment and movement patterns (Lucas, Polus and Rich 2004). Grieve *et al.* (2011) demonstrated this in a study by manually releasing TPs in the soleus muscle, which resulted in the correction of restrictions in the ankle's range of motion (ROM). In summary, the most prominent physical impairments related to MFTPs are a decrease in the ROM, strength in the affected muscle, and often associated muscles, and painful contracture.

Latent TPs are more common than active TPs (Simons, Travell and Simons 1999) and should be considered when treating, due to the possibility of the TP causing muscle activation dysfunction, or even making the muscle prone to future injury (Simons, Travell and Simons 1999). However, active trigger points produce more intense local pain and referred symptoms (Hong *et al.* 1997), as well as sensitivity of the TP and its overlying tissues, when compared to latent TPs (Vecchiet *et al.* 1990).

TPs are often described as primary, secondary or satellite depending on the nature of their origin. Students often use the terms secondary TP and satellite TP interchangeably but, although they are both activated by the primary TP, a secondary TP is activated due to its location in a muscle that acts as a synergist or antagonist to the muscle, which has the primary TP. In contrast, a satellite TP is activated due to its location in a muscle in the zone of reference of the primary TP (Travell, Simons and Simons 1983). A primary TP is:

> *A hyperirritable focus within a taut band of skeletal muscle. The hyperirritability was activated by acute or chronic overload (mechanical strain) of the muscle in which it occurs and was not activated as the result of trigger point activity in another muscle of the body.* (Travell, Simons and Simons 1983: 5)

2.3.2 Proposed Trigger Point Physiology

Muscle pain itself is caused by the activation of nociceptors in the muscle by means of neuropeptides, inflammatory mediators and other substances (Dommerholt and Fernandez de las Penas 2013). The work of Hong *et al.* (1996), Shah *et al.* (2005, 2008) and Gerwin (2008) have all contributed to the understanding that TPs are a focus of peripheral sensitization, whereby substances associated with muscular pain

and fatigue are not anatomically limited to a locus or TP (Dommerholt and Fernandez de las Penas 2013). Patients with TPs also present with allodynia and hyperalgesia which are characteristic of central sensitization (Dommerholt and Fernandez de las Penas 2013).

Trigger points are found in taut bands of muscle, which are bands of contractured muscle fibres (Dommerholt and Fernandez de las Penas 2013). A contracture is the independent activation of a number of muscle fibres within the muscle but does not involve the entire muscle and is does not involve electromyogenic activity (Simons and Mense 1998). It is still not clear how the taut band forms, but the current view is that the taut bands form after unusual or excessive concentric or eccentric overuse or over-load of the muscle (Gerwin 2008; Mense and Gerwin 2010). TP formation can commonly be seen in cases of prolonged sub-maximal muscle contraction, such as in the trapezius muscles of computer operators (Hoyle *et al.* 2011). In such cases, the smaller motor units that are activated first and deactivated last, during the sub-maximal contracture, are most vulnerable due to these fibres being the most overworked (Gerwin 2008).

Furthermore, MFTPs can be seen to have a higher concentration of inflammatory and nociceptive agents, as well as a lower pH, when compared to muscle fibres that are not affected (Shah *et al.* 2005; Shah *et al.* 2008; Perez-Palomares *et al.* 2010).

When a taut band is manually “strummed” or needled, it may elicit what is known as a local twitch response (LTR), which is a sudden contraction of the muscle fibres in the taut band (Hong and Simons 1998). This sudden contraction that is elicited when stimulating the TP is a spinal cord reflex (Hong, Torigoe and Yu 1995). The LTR can often be seen and felt and may even be demonstrated electromyographically or on ultrasound (Rha *et al.* 2011).

Referred pain is pain felt away from the primary source of pain, in another location of the body (Jensen *et al.* 2010). Referred pain is often inclusive of other symptoms, such as numbness, weakness, coldness, stiffness, fatigue, or motor dysfunction, and as such can preferably be termed “referred sensation” (Dommerholt and Fernandez de las Penas 2013). Calandre *et al.* (2006) demonstrated that needling a patient’s sternocleidomastoid or upper trapezius muscle could reproduce a familiar migraine or tension-type headache.

Pain is created in the brain as a response to what is perceived as dangerous stimuli or input received from peripheral tissues (Moseley 2003). Due to perception playing a large role in the generation of pain and pain conditions, it is important to consider the patient and their circumstances (Butler 1991; Moseley 2012), which requires a biopsychosocial approach to managing TPs (Gerwin and Dommerholt 2006). The anterior cingulate cortex (ACC) of the brain increases in activity in chronic pain conditions and when pain is sensed (Hsieh *et al.* 1995; Peyron *et al*. 2000; Sawamoto *et al.* 2000; Longo *et al.* 2012) and are also activated in the presence of TPs (Svensson *et al.* 1997; Niddam *et al.* 2007, 2008). In chronic pain conditions, TPs are often a continuous source of nociceptive input (Giamberardino *et al.* 2007; Melzack 2001; Ge *et al.* 2011). It is important to remove such peripheral input in the steps to treating pain conditions (Melzack 2001), as persistent peripheral nociceptive input will increase sensitivity of the central nervous system (Dommerholt and Fernandez de las Penas 2013).

2.3.3 Treatment of MFTPs

Many clinicians have adopted a multifaceted, holistic approach to the management of pain conditions, incorporating phased exercise, posture and movement facilitation and restoration (Gifford and Butler 1997; George *et al.* 2010; Nijs *et al.* 2010; Hodges and Tucker 2011), which include in-facility treatments, potential co-management with other clinicians in other professions, as well as at-home rehabilitation programmes.

Treatment objectives usually include, but are not limited to, the deactivation of active TPs, the resolution of the palpable nodule, pain, autonomic symptoms and referred sensation, as well as restoration of ROM and muscle function.

There are two main categories of interventions used for the treatment and management of MFTPs: manual therapy and non-manual therapy (Lari *et al.* 2016). Manual therapies often include ischaemic compression, myofascial release, or muscle-energy technique. Non-manual therapies can include DN, acupuncture or spray and stretch technique (Alvarez and Rockwell 2002).

Interventions vary in effectiveness, efficacy, portability, reliability, skill, and knowledge needed by the practitioner, discomfort or pain to the patient, and invasiveness among other factors. Other interventions include, but are not limited to, laser therapy, heat, acupressure, biofeedback, pharmaceutical treatment (Kalichman and Vulfsons, 2010),

transcutaneous electrical nerve stimulation, ultrasound, physical therapy, and massage (Lavelle, Lavelle and Smith, 2007). However, DN is one of the fastest and most effective ways to treat MFTPs (Desai, Saini and Saini 2013), with an immense body of literature validating its use and effectiveness (Unverzagt, Berglund and Thomas 2015).

2.4 DRY NEEDLING FOR MFTPS

DN is often the practitioner's modality of choice in the treatment and management of neuromusculoskeletal pain and dysfunction due to its efficacy and ease of use. The indications for DN use include the treatment of muscles and MFTPs, tendons, ligaments, scar tissue (Kellgren 1938; Steindler 1940; Brav and Sigmond 1941, Lewit 1979; Rha *et al.* 2013; Rozenfeld *et al.* 2020), subcutaneous fascia, peripheral nerves, and neurovascular bundlers, when managing neuromusculoskeletal pain conditions (Lewit 1979; Neal and Longbottom 2012; Casaneuva *et al.* 2013). It is a low-risk, effective modality when performed by a well-trained and skilled practitioner (Fogelman and Kent 2015). DN is most often used to treat musculoskeletal pain conditions, usually MPS (Dunning *et al.* 2014). For the purposes of this study, the term DN will be used in the context as it pertains to MFTPs, also known as intramuscular manual therapy (IMT) or trigger point dry needling (TDN), which is merely one component of DN (Dunning *et al.* 2014), and differs from acupuncture (Unverzagt, Berglund and Thomas 2015).

The practitioner can perform DN using a variety of techniques, based on several models (Dommerholt, del Moral and Grobli, 2006). While risk is minimal, and severe harm rare, this invasive treatment modality can have serious outcomes with its potential for pneumothorax and other complications.

2.4.1 History of Dry Needling

DN developed in a seemingly incidental manner, from the common practice of injecting anaesthetics to treat painful musculoskeletal conditions (Legge 2014). Kellgren (1938) made note of some of the critical findings that shaped modern DN, when studying the injection of anaesthetic into muscle tissue. The most notable finding was that the relief from the injection of anaesthetic into a muscle far outlasted the known effect of time

of the anaesthetic and was even found to be permanent relief in many cases (Kellgren 1938).

Brav and Sigmond (1941), however, were the first to make the claim that an injection without any substance could relieve pain, which is the basis of modern DN. They based this on the findings of their 62-person clinical trial, where they were surprised by the outcome of the third group, which received only hypodermic needle insertion with no substance injected (Brav and Sigmond 1941). They also referenced an acupuncture study published by Churchill in 1821 to support this claim (Legge 2014).

Paulett (1947) published a paper on the findings from 25 cases, where the term “dry needling” was first mentioned. The paper described the technique in detail and concluded that relief could be obtained from DN: that deep DN into a tender point produced sudden pain and a reflex muscle spasm and that superficial needling or needling that did not produce pain was not effective in relieving pain (Paulett 1947).

Travell and Rinzler (1952) explained that TPs could produce autonomic symptoms and referred pain which mimicked visceral pathology. They made the claim that DN could be effective in the treatment of MFTPs (Travell and Rinzler 1952).

A review of the literature by Legge (2014) showed that by the 1960s, DN had been suggested as a treatment option for TP treatment, but anaesthetic injection was still the common practice. Furthermore, there were barely any new insights into trigger points or DN and no clinical trials done. Legge did, however, note three papers published reporting iatrogenic pneumothorax from injecting trigger points.

In the 1970s, China shared acupuncture with the West and interest grew in its uses for treating pain conditions and as a form of anaesthetic (Legge 2014). Literature comparing acupuncture points to trigger points began to emerge at this time (Ghia *et al.* 1976; Melzack 1981). Many authors were influenced by acupuncture in their work on DN, such as Gunn (1997), who published a manual describing and illustrating his radiculopathy-based model of DN, called IMS, using acupuncture needles.

Lewit (1979) published his findings and observations which have significantly shaped modern DN. He noted that the effect of the needling was dependent on the accuracy of the needling technique and acupuncture needles were safer and caused less bleeding and bruising than hypodermic needles (Lewit 1979). In his paper, Lewit

(1979) did not restrict himself to myofascial trigger points, but rather based his work on tender points, including scars, ligaments, and periosteal insertions.

Travell and Simons (1983, 1993) later created extensive manuals that had a major influence on the clinical rigidity and reliability in the identification of myofascial trigger points. However, this manual did not provide detailed DN instructions. Baldry (1989) also developed manuals on the treatment of musculoskeletal pain with a large focus on DN.

By the turn of the century there was a worldwide interest in DN and substantial literature and manuals to utilize. Using acupuncture needles had become the norm for DN, but the technique and suggested physiology underpinning DN was clearly differentiated from that of acupuncture and DN had become associated with trigger point theory and manual therapists rather than with acupuncturists (Dommerholt 2011). DN seemed to be quite readily accepted due to the prevalent use and awareness of wet needling/pharmaceutical injection into muscles and acupuncture (Legge 2014).

Today, DN has been adopted by medical, physiotherapy, chiropractic, and osteopathic professions around the world (Kalichman and Wulfson 2010).

2.4.2 Proposed Mechanism of Dry Needling

There are currently no studies demonstrating the effect of DN on the ACC, but many studies indicate the involvement of the limbic system in DN (Takeshige *et al.* 1992; Wu *et al.* 1999; Biella *et al.* 2001; Hsieh *et al.* 2001; Hui *et al.* 2000; Wu *et al.* 2002).

Patients with fibromyalgia, which is a central sensitization condition (Harte, Harris and Clauw 2018; Dommerholt and Stanborough 2012), had reduction in local and overall sensitivity and pain after having only a few TPs DN (Ge *et al.* 2009, 2010, 2011; Affaitati *et al.* 2011). The assumption is that DN affects central sensitization by altering nociceptive processing (Kuan *et al.* 2007; Mense 2010; Mense and Masi 2011). Srbely *et al.* (2010) indicated DN for therapeutic use due to its ability to decrease segmental nociceptive input.

Gaspersic *et al.* (2001) suggested that the mechanism of action may be mechanical whereby the needle stretches out contractured sarcomeres, removed the overlap of the actin and myosin filaments or even destroyed the motor endplates causing denervation. Many studies have confirmed that DN inactivates TPs, when a LTR is

achieved, by decreasing the endplate noise associated with TPs (Hong and Torigoe 1994; Hong 1994; Chen *et al.* 2001). Kuan *et al.* (2007) demonstrated the positive correlation between endplate noise in the region of a TP and the intensity of pain in that TP. Shah *et al.* (2003, 2005, 2008) and Shah and Gilliams (2008) found that elicitation of an LRT also decreases the amounts of substance P, serotonin, calcitonin gene related peptides, epinephrine, interleukins and other local nociceptive chemicals related to TPs, corresponding with a decrease in pain (Shah *et al.* 2008).

Other mechanical models suggest that the pressure exerted by the needle electrically polarizes the muscle and connective tissue, thereby converting mechanical stress into electrical activity as required for tissue remodelling (Liboff 1997). Olausson *et al.* (2002), Mohr *et al.* (2005) and Lund and Lundeberg (2006) proposed that the mechanism of superficial DN was based in the activation of mechanoreceptors linked to unmyelinated afferent C fibres, thereby triggering a reduction in pain through the activation of the insular region and ACC of the brain.

The efficacy of DN has been proven time and time again, however, the way in which DN works is still unclear (Fernandez-Carneno *et al*. 2010; Lucas, Rich and Polus 2010; Osborne and Gatt 2010; Tsai *et al.* 2010; Srbely *et al.* 2010; Affaitati *et al.* 2011). However, it has been theorised broadly that a change occurs in the activity at the motor end plate when a needle is inserted into the MFTP which elicits an analgesic effect (Kietrys *et al.* 2013) which appears to be centrally mediated (Audette, Wang and Smith 2004).

2.4.3 Dry Needling Safety and Precautions

The Allied Health Professions Council of South Africa (AHPCSA) (2020) has provided guidelines which a practitioner must follow for safe DN practice. This entails conducting a full examination of the patient and determining if DN is indicated and if the benefits of DN the area in question outweighs the risk involved. The procedure must be explained to the patient, along with the risks, adverse events/ post-needling considerations, benefits and alternative treatment options available, in order to obtain informed consent. The procedure should only commence after the patient has been assessed for contra-indications to DN (Unverzagt, Berglund and Thomas 2015; Australian Society of Acupuncture Physiotherapists Inc. 2007; Irish Society of Chartered Physiotherapists 2012).

The absolute contra-indications for DN are:

- Needle phobia, patient unwilling to have DN or unwilling to consent to the procedure.
- A history of atypical response to DN or injection.
- In the case of a medical emergency.
- In a region of lymphoedema or lymph adenopathy.
- Patients using anti-coagulant medication or with a clotting disorder.

There is also an extensive list of relative contra-indications which include, but are not limited to:

- History of abnormal bleeding.
- Impaired immunity.
- In an area where lymph nodes were removed.
- Patients with diabetes mellitus.
- Pregnant patients.
- Patients with a history of epilepsy.
- Allergy to metals.
- Areas of paraesthesia.
- Tumours.

The practitioner then needs to ensure an aseptic procedure, utilising techniques to reduce the chance of infection. As such, the practitioner must wash their hands, expose the area that needs to be treated and disinfect the patient's skin. It is recommended that the practitioner wear gloves during the procedure, which should be latex free if the patient has a latex allergy. When conducting the procedure, the needle should not be touched along the length that may be inserted to maintain sterility of the needle (Bachmann *et al.* 2014). Should the practitioner need to cough or sneeze during the procedure, they are expected to use their inner elbow to cover their mouth and nose and not their hands (Bachmann *et al.* 2014).

The patient should not move, cough or sneeze either during the procedure but must inform the practitioner, so the needles may be removed, should they need to so as to prevent injury (Halle and Halle 2016). The practitioner is also advised against inserting the needle all the way to the base of the hub as this is known to be a point of weakness in the needle and may break at this point (Simons, Travell and Simons 1999). When

possible, the patient should be placed in the recumbent position to prevent psychogenic syncope (Simons, Travell and Simons 1999). The practitioner washes their hands again after the procedure and documents the exact locations of DN in the patient file and any adverse events that took place as a result (Simons, Travell and Simons 1999).

2.4.4 Dry Needling Techniques

DN evolved from a technique known as wet needling, whereby anaesthetics, corticosteroids, botulinum toxin, and other substances were injected into muscles with a hollow-bore, hypodermic needle to relieve pain (Speed 2003, 2007). In contrast, DN uses acupuncture needles and is not associated with the injection of any substance (Casanueva *et al.* 2013; Lewit 1979). These acupuncture needles are sterile, single use, solid filament, disposable needles that vary in thickness and length. These variables are selected at the practitioner's discretion, usually basing the needle length on the thickness of the muscle being treated and its proximity to other anatomical structures.

DN techniques are generally classified based on the depth of insertion of the needle. The insertion of the needle into the MFTP in the muscle to elicit a local twitch response, whereby the muscle sharply contracts with associated pain (Baldry 2002), is known as deep DN (Kalichman and Vulfsons 2010). Superficial DN is an alternative to deep needling, whereby the needle is inserted superficially in the tissue directly over the MFTP (Baldry 1989). Baldry (1989) recommended a depth of 5 to 10 mm for a duration of 30 seconds, with reinsertion for an additional two to three minutes if the pain persists. Baldry (1995) preferred and recommended this method as the procedure carries less risk for damage to blood vessels, nerves and other structures and is less painful during and after treatment. Hong (1994) advocated for the elicitation of LTRs for effective DN. Eliciting a LTR suggests that the needle was accurately placed, as a LTR is important when attempting to inactivate a TP (Dommerholt and Fernandez de las Penas 2013). For the purposes of this study, when DN is mentioned, the researcher is referring to deep DN, unless otherwise stated.

Practitioners perform DN utilising various techniques, with two common branches of practice: dynamic and static DN. Static DN is also known as needle in situ and it usually involves placing the needle and leaving it in place until the practitioner is ready

to withdraw it or rotate it to engage the soft tissue (Audette, Wang and Smith 2004), which involves insertion, rotation and then leaving the needle in place until the muscle relaxes (Dommerholt, del Moral and Grobli 2006). The duration of the needle left in situ also varies between practitioners but most clinical trials retain the needles for five to forty minutes with positive outcomes and a recent study on low back pain demonstrated that the effects of ten minutes of needle retention outweighed that of immediate removal of the needle (Furlan *et al.* 2005).

Dynamic DN is often referred to as 'sparrow pecking', 'pistoning', 'fanning' or a 'fast-in-and-out manoeuvre', whereby the practitioner attempts to elicit multiple LTRs, by stimulating the TP repeatedly in a short space of time (Dunning *et al.* 2014). Some practitioners choose to combine both techniques and retain the needle, after 'fanning', for ten minutes or more (Itoh, Katsumi and Kitakoji 2004; Itoh *et al.* 2007).

The positioning of needles may vary and can be based on the practitioner's school of thought underpinning the cause of MFTPs. This is evident in models based on radiculopathy being the cause of MFTPs (Gunn 1997). The general practice in terms of needle placement for MFTPs is the penetration of the skin with a needle in order to stimulate the underlying MFTP, muscle and connective tissue, either within or overlying these structures.

DN can also be combined well with other treatment techniques and modalities, as part of a multimodal approach to the treatment of MFTPs (Legge 2014). Clinicians often combine deep and superficial DN with electrical stimulation using the needles as the vector (Mayoral and Torres 2003; Mayoral-del-Moral 2005; Dommerholt, del Moral and Gobli 2006). There are no evidence-based guidelines for the optimal needle placement or treatment parameters for electrical stimulation, but White *et al.* (2000) suggested placement in the same dermatomal pattern as the lesion and the parameters are often selected based on 2-4Hz (frequency) triggering the release of endorphins and encephalin, and 80-100 Hz triggering the release of gamma-aminobutyric acid, galanin and dynorphin (Lundeberg and Stener-Victorin 2002).

2.4.5 Benefits

DN serves to address the physical impairments or signs and symptoms that develop in patients with MFTPs, reducing painful contractures and increasing ROM and strength in affected muscles (Simons, Travell and Simons 1999; Gerwin, Dommerholt

and Shah 2004; Dommerholt, del Moral and Gobli 2006). Fogelman and Kent (2015) concluded that some of the benefits of DN were that it was not a difficult technique to learn and integrate into clinical practice, and there is no need for further investigation or imaging before the implementation of DN, making it an inexpensive and minimally invasive, low risk treatment option. DN also allows the practitioner to gain access to muscles that may be difficult to treat due to their depth or location and pairs well with other modalities in the management of chronic pain conditions (Fogelman and Kent 2015).

Deep DN was shown to decrease pain intensity and improve quality of life to a greater degree than acupuncture and superficial DN in a randomised clinical trial (Itoh, Katsumi and Kitakoji 2004). In a systematic review, Cummings and White (2001) concluded that patients treated with DN for myofascial trigger points experienced marked improvements. A study by Couto *et al.* (2014) showed paraspinal DN of the multifidi muscle to be more effective than sham needling or lidocaine injection in pain relief and return of muscle function. The effectiveness of DN in the management of musculoskeletal pain has been confirmed in numerous studies and systematic reviews (Kalichman and Vulfsons 2010; Cummings and White 2001; Furlan *et al.* 2005; Tough *et al.* 2009).

2.4.6 Risks for Patients and Adverse Events

There are, however, risks and adverse effects associated with DN (Kalichman and Vulfsons 2010) which have been said to be under documented and under reported (Halle and Halle 2016). Baldry (2002) included nerve and blood vessel damage as some of the risks associated with DN. Vulfson, Ratmansky and Kalichman (2012) defined several adverse effects, including post needling soreness, local haemorrhages, syncopal responses, and acute cervical epidural hematoma. Pneumothorax is a rare adverse event associated with deep DN over the thorax (White 2004; Witt, Pach and Brinkhaus 2009), but may be more prevalent and merely under reported (Halle and Halle 2016). It can become a medical emergency requiring medical intervention (Halle and Halle 2016). Other adverse effects include stuck, bent or broken needles, infection, local pain, trauma to internal organs in the peritoneal cavity, excessive drowsiness, needle stick injury, penetration of the spinal meninges and brain stem penetration (Bachmann *et al.* 2014; Irish Society of Chartered Physiotherapists 2012).

An adverse event (AE) is any negative outcome, regardless of its size or intensity, that was not intended and did not serve a therapeutic purpose (White, Hayhoe and Ernst 1997). A DN study performed by Brady *et al.* (2014), with physiotherapists, noted bruising, bleeding or haematoma, and pain during and after treatment as common adverse events, aggravation of symptoms, drowsiness, feeling faint, nausea and headaches as uncommon adverse events, and fatigue, altered emotions, shaking, itching, claustrophobia and numbness as rare adverse events.

Brady *et al.* (2014) adapted their definition for a significant event from Carnes *et al.* (2010) and included pneumothorax, seizure, anxiety lasting 60 hours, cellulitis and headache lasting three days in their findings of significant adverse events. Chan *et al.* (2017) conducted a systematic review which added to this list of adverse effects.

Although rare, in some patients the anticipation of pain from DN can result in counterproductive results (Dommerholt and Fernandez de las Penas 2013). However, for most patients, DN is a viable treatment option (Dilorenzo *et al.* 2004; Affaitati *et al*. 2011).

Guidelines are available from the AHPCSA (2020) to reduce the risk of complications, especially when DN is used in the treatment of muscles that require caution (McCutcheon and Yelland 2011; Halle and Halle 2016; Dommerholt and Fernandez de las Penas 2013; South African Society of Physiotherapists 2017).

Some of these recommendations include:

- Needle length selection based on patient body type (Halle and Halle 2016).
- Angle the needle in a direction away from underlying lung tissue (Australian Society of Acupuncture Physiotherapists 2013).
- Utilise pincer palpation, preferably maintaining the pincer grip for the duration of the procedure, and tangential needling to avoid thoracic cage penetration (Bachmann *et al.* 2014).
- Avoid bilateral thoracic DN to prevent bilateral pneumothorax (Bachman *et al.* 2014).
- Use the bracketing technique by trapping the muscle over bone to prevent pneumothorax but the needle is capable of penetrating bone (McCutcheon and Yelland 2011; Witt, Pach and Brinkhaus 2009).

- Consider the borders of the lungs when DN (McCutcheon and Yelland 2011; Honet, Honet and Cascade 1986).

Kalichman and Vulfsons (2010) recommend superficial DN for muscles that overlay areas of potential risk which could result in significant adverse effects. The AHPCSA have provided a list of muscles that require caution when being DN:

- Upper, middle and lower fibres of the trapezius.
- Levator scapulae.
- Lower cervical paraspinal muscles.
- Pectoralis major and minor.
- Supraspinatus.
- Infraspinatus.
- Rhomboid major and minor.
- Serratus anterior.
- Iliocostalis.
- Serratus posterior superior.
- Longissimus thoracis and Iliocostalis thoracis.
- Multifidus and other paraspinal muscles.

They advise against DN for abdominal muscles if the practitioner cannot bracket the muscle or maintain a pincer grip. Furthermore, they specify that the intercostal muscles should never be needled. Other muscles may only be DN with specialist knowledge and training in this regard (South African Society of Physiotherapists 2017; Halle and Halle 2016b), namely:

- Muscles around the temporomandibular joint.
- Sub-occipital muscles.
- Subclavius.
- Scalenes.

The AHPCSA (2020) relies on the clinical judgement of the practitioner to determine their own level of skill and training in this regard to determine their ability to DN these muscles.

2.5 DRY NEEDLING RISKS FOR PRACTITIONERS

An often-neglected topic in DN practice is needle stick injury. Practitioners take precautions against this but accidents happen and, although unlikely, if a practitioner's skin is accidently pierced with a used needle, blood borne diseases can be transmitted. The greatest fear in the South African context is HIV/AIDS. The practitioner may immediately be administered Antiretroviral (ARV) drugs, which can result in uncomfortable side effects, as a precautionary measure. The AHPCSA (2020) protocol, however, is to immediately wash the area with warm water and soap, and then disinfect the area with 70% alcohol. The patient and practitioner should be tested for HIV/AIDS and Hepatitis B and C if their status is not already known.

DN can also result in undesirable or adverse events for patients, as previously discussed in this chapter. This may lead to legal action being taken against the practitioner if a patient has sustained bodily harm due to the negligence or wrongdoing on the practitioner's part. A case of malpractice can result in a practitioner having to pay hefty settlements, as well as a ruined reputation, even if the practitioner is not found to be guilty of malpractice.

2.6 PROBLEMS WITH TEACHING AND LEARNING OF DRY NEEDLING

In Legge's (2014) review of the early literature, he noted three papers between 1960 and 1975 that reported cases of iatrogenic pneumothorax during trigger point needling. Here, the problem seems to have been the inconsistency in the identification of trigger points and their location, and insufficient experience or guidance in the learning of the technique as it was fairly new. Kelly (1941) and Copeman and Burt (1940) admitted to finding difficulty in identifying the most relevant trigger points, and thereby creating varied results.

It is crucial for the DN practitioner to have a theoretical knowledge of anatomy, the musculoskeletal system, and MFTPs. Practical training should be extensive and involve demonstration, participation, and testing. The danger often lies in short courses, which may include a short online theory component with a one to two day practical component (Kalichman and Wulfson 2010; Legge 2014). These courses

often have little to no criteria or standard that is upheld but certify a practitioner to DN (American Physical Therapy Association 2012).

The terms western acupuncture, medical acupuncture and DN are often used interchangeably (Kalichman and Vulfson 2010). However, there is ongoing debate on whether DN should be considered a form of acupuncture and if physiotherapists and chiropractors, who are not trained in the technique of acupuncture, should be allowed to practice it (Zhou, Ma and Brogan 2015).

The risk of pneumothorax associated with DN is also seen in acupuncture (Cummings, Ross-Marrs and Gerwin 2014; Tagami *et al.* 2013; Da Encarnação *et al.* 2014). McCutcheon and Yelland (2011) showed over 100 cases of acupuncture or DN induced pneumothorax, including four deaths in an Australian study. Pneumothorax, although rare, is a serious complication that can be life threatening (McCutcheon and Yelland 2011).

In the South African context, the scope of practice for a chiropractor includes DN, and thereby requires an extensive DN programme to be part of a university study. In almost all other countries around the world, this is not the case. DN does not fall within the scope of practice, it is not taught in a chiropractic university qualification, and it is a separate certification entirely. The certification course can either be a DN course or an acupuncture course depending on the legal requirements in the country of practice. Most of these certifications, however, do not meet the 200-hour minimum guideline set out by the WHO for the practice of acupuncture (Ijaz and Boon 2019).

A clinical commentary study reviewed the literature to justify the use of DN, by sport and orthopaedic physical therapists, with a focus on DN safety. The literature showed that DN was not included in entry level curriculum and concluded that it was therefore not an entry level skill and was not to be performed without the appropriate postgraduate training (Unverzagt, Berglund and Thomas 2015).

2.7 THE MASTER OF TECHNOLOGY (MTECH): CHIROPRACTIC PROGRAMME

Table 2.1 below aids in understanding how the chiropractic programme is structured and how the clinical years fit into the MTech component. The "6th and consecutive

years" of the chiropractic programme are not mandatory, provided the student completes all clinical, academic and research requirements in their 5th year of study. The master's programme can be completed within three years (after the 7th year of study) without applying for an extension, which some students require for research purposes.

Table 2.1: Structure of the chiropractic programme at DUT showing the clinical exposure at each level

QUALIFICATION	YEAR OF STUDY	CLINICAL EXPOSURE
NDip: Chiropractic	1st 2nd 3rd	- - Hospital visits (no treatment- diagnostic only)
BTech: Chiropractic	4th	Sports events Clinic observation programme Mock patient assessments
MTech: Chiropractic (Master's in Technology)	5th 6th (and consecutive years of study)	1st clinical year Sports events Community service (satellite clinics) 2nd clinical year (and consecutive clinical years) Sports events Community service

The pre-requisite qualification to this programme, the Bachelor in Technology (BTech), is not an exit level qualification, but merely a level towards the MTech qualification, which is required to practice as a chiropractor in South Africa. The MTech programme has an academic, clinical and research component. The first clinical year encompasses lectures, along with any testing or assessments, a clinical practicum at the DUT CDC and community clinics and events, as well as a dissertation. Any consecutive years of study are a continuation of any incomplete components from the first clinical year. The first clinical year can be a mixture of excitement and anxiety (Skovolt and Ronnestad 2003) and it is an important year for novice clinicians to gain confidence as they are exposed to the realities of the clinical environment.

The chiropractic programme at DUT has pre-clinical practical initiatives to help to acclimate students prior to the clinical practicum. These initiatives include hospital visits, the observation programme and mock patient assessments. A study by Ganesh (2017), however, found this to be inadequate in building student confidence for the clinical practicum.

2.8 DRY NEEDLING AT DUT

In the 4th year (BTech) of the chiropractic programme at the Durban University of Technology (DUT), students are trained in deep DN of the neck and torso. As such, students may not be aware of alternative DN techniques without doing any of their own research or reading. Generalized DN precautions are taught, as well as caution with respect to areas of potential risk and, usually, alternative modalities to DN are recommended for the treatment of these muscles.

In the 5th year of study (MTech), students are taught DN specific to the extremities. Further knowledge and skills are acquired from treating at sports events, interacting with clinicians, and treating patients during their clinical practicum in their 5th and consecutive years of study towards the master's degree. This clinical education facilitates the acquiring of new knowledge and skills that are aimed at the needs of individual patients (Westerman *et al.* 2013).

2.8.1 Technique and Training

In the BTech year, students are taught the theory component prior to any practical learning which follows soon after. The anatomy is studied in the National Diploma (NDip) years prior to the BTech. Students are taught aseptic techniques, precautions and risks, the location and referral patterns of MFTPs in the neck and torso and retaught the relevant anatomy. The general precaution taught includes tangential needling that involves directing the needle away from important anatomical structures, utilising a pincer grip on the muscle, bone bracketing, selection of the correct needle size, and always considering the underlying anatomy.

The technique taught at DUT for DN is loosely prescribed, with the lecturer informing students of some options to choose from when practicing the technique. Deep TP DN is the only technique taught and students are not practically made aware of the other techniques that exist or the knowledge that exists to support these alternatives. However, students are made aware of the option to leave the needle in situ (static DN) or to "fan" the needle (dynamic DN). There is no prescribed time that the lecturer requires students to leave the needle in for either. Students are encouraged to elicit a LTR to ensure they have needled correctly into the TP and the lecturer does encourage dynamic DN to elicit multiple LTRs. The lecturer demonstrates and students are required to practice the technique on each other in the classroom, under

supervision, to develop and refine their skills. With limited time and multiple groups performing the procedure, the lecturer does not get the opportunity to watch all students complete the entire DN procedure, and students often leave once satisfied with their own technique. Unfortunately, many students do not trust other students to DN certain muscles or regions, such as their necks, and therefore students may never DN certain muscles prior to their clinical practicum.

This is compounded by the testing protocol used at DUT for DN. The technique applied by the student during DN has no bearing on the student's ability to pass the subject. The testing is based on mapping the muscles, locating the TPs and identifying their referred pain patterns.

Similarly, in the MTech year of study, the assumption is that students are competent in DN and the focus for teaching and testing is placed on locating TPs in the extremity regions and learning their referred pain patterns. Technique is only the focus when DN specific muscles that require caution due to underlying structures such as nerves and blood vessels.

At the DUT CDC, students are required to obtain permission from the clinician on duty, to treat a patient after detailing the case. There is either one or two clinicians present at any time during clinic hours. The number of students in the clinic per day depends on the number of students completing their clinical practicum and usually includes any students who have research patients or are continuing with their clinical activity requirements. As such, the clinicians' office can get extremely busy, especially on an afternoon shift where 5th year students are seeing patients. A 5th year student takes longer than consecutive year students to present a case to a clinician and, in turn, the clinician usually spends more time asking a 5th year student questions and ensuring they understand and are making good clinical decisions. This can leave little room for individual demonstration and supervision in DN techniques for HRM. These regions are not to be DN without direct clinician supervision at the DUT CDC, according to an email communication sent out to students on 18 April 2018, from the Clinic Administrator.

2.8.2 DUT CDC Rules Regarding High-Risk Muscles

In an email communication on 18 April 2018, the clinic administrator of the DUT Chiropractic Day Clinic (CDC) indicated that they considered posterior cervical, sub-

occipitals, cubital fossa, scalene, popliteal fossa, piriformis, inguinal area, upper and lower inner quadrants and lower outer quadrant of the gluteal muscles to be high-risk for DN. Subsequently, the list was placed in the clinicians' office after being altered slightly to include the sternocleidomastoid muscle and change popliteal fossa to popliteal area. In a study conducted using clinical and EMG data to identify muscles that were high-risk for pneumothorax, the most commonly associated were serratus anterior, trapezius and rhomboid major (Kassardjian, O'gorman and Sorenson 2016). Master's chiropractic students treating in the clinic are discouraged from DN these muscles and are only permitted to do so under direct clinician supervision when a clinician is available. As a result, students may be inadequately prepared or competent prior to qualifying, as DN is a learned skill that requires accuracy (Dommerholt, del Moral and Grobli 2006). Some students may also be reluctant to needle these regions due to fear of causing injury to their patient. This attitude of fear towards DN can affect their clinical judgement and therefore their practice of DN. Chiropractors in private practice often needle HRM, but while there are risks to any intervention, the risk associated with DN is minimal in the hands of a skilled practitioner (Dommerholt and Simons 2008).

2.8.3 The Importance of Clinical Education and Student Experiences

Clinical education is fundamental in health science education (Conn *et al.* 2012) and therefore the role of educational settings for health care professionals has become a topic of interest due to its importance regarding student learning outcomes (Bassaw *et al*. 2003; Palmgren, Sundberg and Laksov 2015). It is therefore important to identify its downfalls to determine how to modify and improve learning experiences (Ralph *et al*. 2009; Palmgren, Sundberg and Laksov 2015). With the growing interest in this field, international qualitative studies have been done to explore and evaluate the clinical learning environment of chiropractic students (Palmgren and Chandratilake 2011; Palmgren and Bolander-Laksov 2015). A recent study was also conducted at the DUT CDC by Ganesh (2017) to evaluate the clinical experiences of first-time registered chiropractic master's students during their clinical practicum, which revealed various areas for curriculum revision and improvement. However, despite the important role of chiropractors in the health care system, there is still a paucity of information and data relating to the experiences of chiropractic students during the clinical education phase of learning (Palmgren and Chandratilake 2011) and more so in the DN context.

Palmgren and Chandratilake (2011) described student evaluation of their clinical environment as an asset and an untapped resource, with many authors also advocating for students views to be obtained (Gall, Gall and Borg 2003; Habbal, El Mardi and Inuwa 2007; Wenrich *et al.* 2010; Bakhshialiabad, Bhakhshi and Hassanshahi 2015). Ralph *et al.* (2008) recommended educational practitioners, policymakers, curriculum developers and researchers work together to seek and incorporate students' views and experiences to improve the delivery of quality programmes.

This is the first South African study to address chiropractic students' experiences of DN during their clinical practicum. Medical literature shows the benefits of early clinical experience and its creation of opportunities for practical skill development (Dornan *et al.* 2006). Dornan *et al.* (2007) developed an "experience-based learning" model which recognizes two broad categories of learning, the practical domain and the emotional domain. For the purposes of this study, we focus on learning the practical skill of DN.

Sand *et al*. (2014) described experiential learning as a way for students to clarify, consolidate and synthesise knowledge and skills when actively engaged. Evans (1994) referred to practical knowledge as an educational tool which empowers students. The clinical practicum is one of the most common forms of experiential learning (Eyler 2009) and is a supervised way for students to practically apply their previously obtained theoretical knowledge. Presumably, the best place to learn and perfect the skill and knowledge of DN, and develop the necessary confidence in DN HRM, would be in a clinical learning environment, such as the DUT CDC. Aspects of teaching and learning that are excluded from the clinical practicum, or that are difficult to attain guidance on, may become an area in which students lack competence on graduating. Benson (2013) suggested that the clinical practicum could be an effective way to successfully transition students into clinical practice. Presumably, this may be more so when considering that the clinical learning environment can often address theory-practice gaps that may exist (Peterson and Betchel 2000). These are some of the aspects that pertain to the teaching and learning of DN, which has led the researcher to enquire about student experiences during the clinical practicum.

Hart and Rothem (1995) described the characteristics of an ideal and effective clinical learning environment, which are important to consider when identifying and addressing shortfalls and their implications. **Table 2.2** is a summarized adaptation of

the characteristics relevant to this study, as defined by Hart and Rothem (1995). These characteristics are often used in studies when evaluating students' experiences within a clinical learning environment, as student feedback provides a valuable narrative on the quality of teaching and learning.

Table 2.2: Characteristics of an ideal and effective clinical learning environment

CHARACTERISTIC	DESCRIPTION
ORGANISATIONAL SUPPORT	The degree to which formal and informal policies, procedures and protocols facilitate learning.
SUPERVISORY SUPPORT	The support and guidance given to students in the performance of their clinical duties.
SOCIAL SUPPORT	The co-operation of the clinic staff and students in working as a team.
AUTONOMY	The authority and responsibility the student is allowed to assume in the making of clinical decisions and performing clinical duties.
VARIETY	To have diverse clinical experiences and opportunities for students.
CHANGE	The willingness and ability of staff to implement improvements in the curriculum and practise.

At the DUT, annual staff evaluation and subject evaluation questionnaires are distributed to all students for their formal feedback on clinician and lecturer performances and evaluation of the curriculum per module. However, as noted by Pearcey and Elliot (2004), organisations are efficient in collecting data from student feedback, but not necessarily as effective in using the data to implement change and improving the quality of education.

2.9 THE CONCEPTS OF KNOWLEDGE, ATTITUDES, AND PRACTICES

The objectives of the study are based on concepts which are not tangible but can be assessed and evaluated through observed behaviours (Hunt and Hassmén 1994) and qualitative research focuses on observed phenomenon as a source of data.

Badenhorst *et al.* (2006) described knowledge as a body of information that forms the basis of insight and judgement. Knowledge can be gained through experience and education by observation and attaining facts, information and skills.

Milton (1981) defined an attitude as a combination of thoughts and feelings that influence a person's behaviours and reaction to a particular aspect of their

environment and stressed the importance for a researcher to understand the complex psychology involved in how attitude influences behaviour. Coon and Mitterer (2007) suggested that an attitude is formed based on the belief and emotion created by preceding events and experiences, which inclines a person to respond positively or negatively to a person, object, or institution. Proctor (2001) also included that an attitude predisposed the person to a particular behaviour. As such, behaviour and attitudes are likely to have a strong relationship (Bennett and Murphy 1997).

A student's knowledge of, and attitude towards, DN may shape their behaviour, goals, desires, perceptions, and the way in which they practice in the clinical context. Although there are many aspects that may influence a student's practice style or choices, their knowledge influences their clinical judgement and decision making and their attitudes towards DN impact their behaviours and actions.

2.9.1 Relevance to the Study

Qualitative research is a method of scientific enquiry which is mainly concerned with explaining social phenomena (Hancock, Ockleford and Windridge 2007). The main aim of qualitative research is to understand social constructs and explore subjective matter, such as views, perceptions, opinions, attitudes, and experiences (Adams, Broom and Jennaway 2008). Jackson (2005) encouraged the use of the knowledge, attitudes, and practices approach in research, as it provided insights into what people know, what they still need to know, awareness and how it pertains to attitudes and behaviours, actual behaviour versus ideal behaviour, and how to formulate strategies for improving behaviours.

These three areas of study were particularly interesting to the researcher in an effort to uncover the students' perspective on DN at the DUT CDC and understand their thoughts and opinions, as well as gauge their depth of knowledge and how they perceive it to translate to their style and choice of practise.

2.10 CONCLUSION

The literature reveals that there is much to discover and study in the field of DN. As chiropractors become more familiar with the physiology of muscles and trigger points as well as student experiences, the techniques and quality of treatment for patients

may be improved, as well as the way techniques like DN are taught and learned. A qualitative approach to this study allows for an in depth and holistic perspective and allows for an explorative enquiry and descriptive results that cannot be attained from quantitative data (Matveev 2002).

Chiropractic students need to be adequately equipped to DN in practise and the theoretical and practical components of DN should therefore be considered to ensure the best knowledge, attitudes and practices for DN.

This chapter has introduced the existing literature available on the anatomy and physiology underpinning DN, enlightened the reader on DN benefits and risks, for patients and practitioners, as well as described the topics of debate in the field and the reasons for them. A large focus has been placed on how DN has developed over the years, the many techniques that exist today and how DN is taught, assessed, and practiced at the DUT and at the DUT CDC.

There is a lack of information regarding the educational environment for chiropractic students in general and specific to DN. The literature does not provide the necessary qualitative insights from students who are the key players in their education. This study attempts to add to the limited body of information that exists in this area of study.

The next chapter provides the detailed methodology employed in this study to attain the desired insights.

CHAPTER THREE: METHODOLOGY

3.1 INTRODUCTION

The methodology of a research study underpins the way the researcher conducts the study and should be chosen with an understanding of various methodologies to ensure cohesion between the researcher's position, the research question and the study objectives (Austin and Sutton 2014).

This chapter outlines the various aspects of the methodology utilised in this study. It describes the study design and the sampling procedures, the sample population and sample size. The methods employed for the collection and analysis of data is also explored in this chapter. Ethical considerations and the trustworthiness of the study are addressed in the latter part of this chapter.

3.2 STUDY DESIGN

The study design is a strategy or plan used to allow for the extraction of information in the research. The strategy of the study guides the achievement of the objectives. A qualitative approach was used with an exploratory and descriptive design in an interpretive paradigm.

Qualitative research is detailed and open in nature, maximising the trustworthiness of research outcomes (Terre Blanche, Durrheim and Painter 2006). Qualitative methodology is utilised to make new observations to describe phenomenon, where no prior information exists. Adams, Broom and Jennaway (2008) described this methodology as inductive and driven by the participants' experiences. Creswell (2013) made clear the need for a subjective and biased inquiry in his definition of qualitative methodologies. The main objective is to understand how people comprehend and perceive their reality and the world through their experiences and expectations of it (Merriam and Tisdell 2016). This makes the chosen design ideal for this study, which required an in depth look at the experiences of chiropractic students in the DN technique. Qualitative research within the chiropractic education setting seeks to address the multi-faceted nature of human behaviours within complicated environments (Mrozek *et al.* 2006).

An interpretive paradigm works to find meaning through reading and re-reading of data throughout the analysis process. The interpretive paradigm emphasizes the ability of the individual to construct meaning and understand social phenomena by observing from within, through people's experiences (Lindsay 2010).

Exploratory research is used to develop understanding in areas where there is a lack of pre-existing knowledge or literature. In this type of study, themes do not already exist and are only developed through the analysis process (Guest, Namey and Mitchell 2013). This design was not only chosen because of its relevance to the study and the lack of literature, but also due to the researcher's keen interest in the experiences of chiropractic students in the DN procedure. This type of design is often utilized when a researcher hopes to further understand an observed behaviour or an identified concept. A descriptive design is usually part of any exploratory study as it builds on the concepts from observable behaviours and outcomes, thereby creating meaning and significance from the collected data (Maxwell, 2012). Therefore, a descriptive design was used to allow for the explored phenomenon to be described and for relevance and meaning to be drawn from it.

Adams, Broom and Jennaway (2008) recognized qualitative research as having the ability to play a vital role in the examination of many areas of chiropractic education. For this reason, an exploratory, descriptive design within an interpretive paradigm was chosen to understand the clinical experiences of chiropractic students in their DN techniques. This allowed the researcher to understand these experiences and phenomenon that were not concrete or defined and therefore cannot be quantified.

This study design was approved by The Durban University of Technology Institutional Research and Ethics Committee (IREC), Ethical Clearance Number IREC 177/19.

3.3 RESEARCH SETTING

The research setting is usually the location for the data collection of the study or the environment that is relevant to the participants in the context of the study. In qualitative research, there is focus on the interview environment being a comfortable and natural environment for the participant. In this study, the location of data collection varied due to the health and safety precautions taken during the Covid-19 outbreak. Ethical clearance was obtained to allow for the interviews to be held via electronic voice or

video call to ensure the researcher and participants' safety, as well as the participants' comfort and willingness to participate.

All interviews remained private and confidential, with only the researcher and participant present on the call. The call took place at a time and location of the participants choosing to enable them to share openly in an environment they felt safe in. All participants in this study chose to be interviewed in their homes. The participants also had the option to voice or video call to ensure that they were comfortable and did not feel like the researcher was intruding on their home situations or circumstances. Video call was chosen by all participants, which was preferred for a more personal connection to be maintained during the interview. The virtual conference calling was mainly held over Zoom for clear audio during the interview. Zoom is a modern, American, cloud-based application that can be downloaded for free use, on their limited plan of 40 minutes per call. This application allowed participants to join a call scheduled by the researcher without signing in. The only cost to participants were internet data costs during the video call. The application can record audio but this function was not used to record the interviews to prevent any confidentiality breach. The remaining interviews were held using WhatsApp video call which is also an American application that is free to download. All participants already had access to this platform and used it regularly.

The DUT CDC environment, which has unique instructional offerings and operational guidelines, lends itself to the unique experiences of the students who learn within its walls. The DUT CDC has a reception and waiting area that is separated from the consulting space by a glass door. The consultation space is separated into an individual clinic room for each student to ensure privacy and confidentiality. Upon entering through the glass door, with a long passage ahead, the duty clinicians' office is to the left. Off the main passage are consulting rooms to the left and four passages leading off to the right where more consulting rooms, modality rooms, a lavatory, lockers and a rehabilitation room can be found. The clinic also has a room for students' comfort between appointments. There is a total of twenty-three consultation rooms. Each room has an examination table/ plinth, a chiropractic treatment bed and a desk with two chairs. Students are required to obtain permission to treat patients from the clinician on duty, after detailing the cases. There is either one or two clinicians present at any time during clinic hours. The number of students in the clinic per day depends

on the number of students completing their clinical practicum and usually includes any students who have research patients or are continuing with their clinical activity requirements. As such, the clinicians' office can get extremely busy, especially on an afternoon shift where 5th year students are seeing patients. A 5th year student takes longer to present a case to a clinician and, in turn, the clinician usually spends more time asking a 5th year student questions and ensuring they understand and are making good clinical decisions. This can leave little room for individual demonstration and supervision in DN techniques for HRM. These regions are not to be DN without direct clinician supervision at the DUT CDC, according to an email communication sent out to students on 18 April 2018, from the clinic administrator.

3.4 STUDY POPULATION AND PARTICIPANT SELECTION

The study population refers to a group of people from which the participants are chosen (Kumar 2014). These people have a common factor that connects them. This can be a place they choose to shop, their profession or all the people in the given population have children in a specified age group.

The population for this study consisted of consenting registered Master of Technology in Chiropractic, students who still needed to complete their clinical practicum requirements at the Durban University of Technology. The clinical practicum begins at the start of the students' 5th year, which is their first year of registration for their master's degree. The clinical practicum requirements are 35 new patients and 350 follow ups. This is the practical component of the Clinical Chiropractic V (5) module.

During this clinical practicum, students are still being taught and assessed on academic and practical competencies needed to treat patients. These competencies pertain to the extremities of the body (arms and legs). Each module addresses different parts of the limbs. As such, students are only allowed to treat these regions, in the DUT CDC, as they pass each module.

The students, in the clinical component of training, vary in ages and clinical experience. This is due to most students continuing their clinical practicum, after their 5th year, into their consecutive master's years. Some students also repeat the module, Clinical Chiropractic V (5), if they do not meet the requirements in the theory component, which forces them to restart their clinical practicum. The theory

component is comprised of geriatrics and paediatrics, orthopaedics and cases (clinical management scenarios).

All participants in the study had to have at least two months of activity in clinic, but due to Covid-19, no first-registration 5th year students were eligible at the time of recruitment. This resulted in all participants having at least one year of activity at the DUT CDC.

3.4.1 Recruitment

After all ethical and gate keeper permissions were attained, a list of eligible students, who met the inclusion criteria for the study, was obtained from the DUT CDC administrative staff. The researcher then contacted the students, via an electronic messaging system, WhatsApp messenger. A WhatsApp group was created by the researcher, with all eligible students to inform them of the research being done. The students were required to respond in a private message to ensure confidentiality and to give all eligible students the opportunity to participate. A total of five of the final participants selected volunteered for the study. The remaining participants were purposefully selected by the researcher.

The students were asked to be part of the study with no coercion. They were informed of their right to decline or withdraw from the study at any time should they no longer wish to participate. They were given the opportunity to review the letter of information and consent, which they were required to sign if they wished to join the study. These were collected prior to each interview.

3.4.2 Sampling

Sampling is the process of participant selection for a study (Terre Blanche, Durrheim and Painter 2006). The sample group of participants are selected from a study population, which is a group of individuals with a common factor which relates them.

This study used purposeful sampling which is a form of non-probability sampling that involves the deliberate selection of a sample population, by the researcher, to fulfil a specific purpose (Teddlie and Tashakkori 2003). Qualitative research is about producing dense and rich information and not necessarily about representing a population (Creswell 2013). This makes purposeful sampling ideal for this study.

3.4.3 Sample Size

In this study, eight (8) participants were interviewed. This number was not predetermined. Data were collected until data saturation was reached, whereby no new themes were being identified and no new insights were being extrapolated (Bowen 2008).

Qualitative research is a method of scientific enquiry which is mainly concerned with explaining social phenomena (Hancock, Ockleford and Windridge 2007). The main aim of qualitative research is to understand social constructs and explore subjective matters, such as views, perceptions, opinions, attitudes and experiences. Saturation is used to ensure that adequate and quality data are collected to support the study. This can be attributed to the fact that qualitative data are based on the principle of diminishing return, i.e. more data do not necessarily equate to more information (Ritchie, Lewis and Elam 2003), therefore data are collected until saturation is reached.

3.4.4 Inclusion Criteria

The inclusion criteria outline the factors that must be applicable to the participant in order for them to participate in the study. For this study, the criteria were as follows:

- Participants must consent to participating in the study.
- Participants must be registered for the master's level of the chiropractic programme.
- Participants must still be engaged in the requirements of the master's clinical practicum at the DUT CDC (must still be completing their 5th year numbers), with a minimum of 2 months' activity in the clinic.

3.4.5 Exclusion Criteria

The exclusion criteria outline the factors that would cause a prospective participant to not be accepted to participate in the study. For this study, the criteria were as follows:

- Students who refuse to participate or are not willing to read and sign a letter of information (Appendix 5A) and consent (Appendix 5B).
- Students who are not registered for the master's degree in the chiropractic programme at DUT.
- Students who have completed their master's clinical practicum requirements.

3.5 DATA COLLECTION METHODS AND INSTRUMENTS

For this qualitative study, the researcher chose to investigate students' experiences and opinions through an individual interviewing process with semi-structured interviews. This led to a rich understanding of the phenomenon being studied (Baraz, Memarian and Vanaki 2014). This type of model, with broad questions, allowed the researcher to guide the discussion to address the objectives of the study, while encouraging the participant to express themselves openly and without limitations. This safe space is facilitated through the method of questioning, as well as an emphasis on confidentiality and a suitable environment chosen by the participant.

A focus group was considered as a method of data collection or as a pilot study; however, students may have been reluctant to share in a group for fear of being judged on their differing opinions and depth of knowledge, therefore individual interviews were chosen as the most appropriate means.

This type of research has not been done before in this context. As such, there were very few guidelines or structure to skew the researchers focus on the observed phenomenon, thereby preventing generalization and assumption (Maxwell 2012). The researcher could then focus on creating ways to extrapolate and truly understand the phenomenon being studied.

The researcher created an interview schedule that addressed the aim and objectives of the study, using the knowledge and experience attained from the coursework and clinical practicum. This allowed the study to become more specific and relevant to the shared clinical environment.

3.5.1 Research Procedure and Methods

When ethical clearance was obtained, the researcher initiated the data collection process with the recruitment of participants as detailed in **3.4.1**. The students were thanked for their time and willingness to participate.

A few demographic data questions were asked prior to the interview including age, gender, race and year of study. The spoken language of the interviews was English due to the course being taught in English. The participants and the researcher had also previously conversed in English on numerous occasions. Due to the "reactivity" of participants to the researcher (Maxwell 2012), whereby the participants responses

can be influenced by the interviewer, certain factors were kept as consistent as possible. These factors included the manner of speaking and the style of clothing worn by the researcher. The interviewer was consistently the researcher of the study and so the demographics of the researcher were also consistent (Brink, van der Walt and van Rensburg 2012). This influence of the researcher on the participants cannot be controlled completely but can rather be limited to fewer variables to ensure consistency between interviews.

Once the voice or video call had started, the researcher engaged in a brief discussion on a personal level to help the participant feel more at ease. The participants were informed of their ability to stop the interview process at any time if they were not comfortable or ask any questions they had about the research. They were also assured of confidentiality and asked to speak openly without fear of repercussion.

Thereafter, the individual semi-structured interviews were held using the 'grand tour', which is an open-ended question method with probes and subsequent questioning. Structured interviews lack the flexibility for the participant to respond to insights that may develop; however, semi-structured interviews allow the researcher to ask relevant questions (with prompts) that allow an open and exploratory response (Maxwell 2012). The methodology was chosen based on the purpose of the study and the research questions. It is the most suitable approach as it affords students the opportunity to give their input regarding their clinical practicum experience of DN. Veerapen and McAleer (2010) described student feedback as an asset in providing insight for curriculum revision as well as improvements within the learning environment and assessing for efficacy and potential short comings thereof.

Before the grand tour question was asked, the researcher established on record that the participant was aware of the interview being recorded and had consented to it, as well as if they had signed and returned the informed consent. The grand tour question method allows the participant to share freely so that no aspects of their views are left out or missed due to the participant's response being directed or channelled in a particular direction by the question (Maxwell 2012). This allows the researcher to gauge the participant's understanding and attitudes in broad terms, which can then be explored further through probes and enquiry. Probes were used as a way to build on details that were lacking in a participant's answer to ensure that the research questions were answered fully and so that the researcher could clarify the intention and tone of

what was being said (Braun and Clarke 2013). Some participants speak freely and require little probing, answering most questions before they are asked, whilst others can be more reserved and require a more detailed questioning approach or repetition. As such, the researcher adapted to the style required to create the ideal environment for the participant to share their thoughts. The probing and subsequent questioning varied slightly between participants depending on their initial responses and the themes seen in previous interviews.

The interviews were conducted by means of electronic voice or video call, at a time of the participants' choosing, to ensure their health, safety, comfort and willingness to participate and share openly in a private environment in which they felt safe. The participants were informed that interviews would be recorded but remain confidential. This recording provides a detailed record of the interview so that the researcher could listen to it repeatedly and used it for transcription of the interview. This repetition and review of the interview ensured that the tone and meaning were not lost in translation between the time of the interview and the interpretation and discussion of the data. Participants were interviewed until data saturation was met. Later, the interviews were transcribed manually, verbatim, and analysed and coded by the researcher.

The interviews were loosely conducted as follows:

3.5.2 Interview Schedule/ Format

a. Participants were given the opportunity to review the letter of information and consent, which they were required to complete and sign if they wished to join the study. These were collected prior to each interview.
b. A few demographic data questions were asked over electronic messaging (WhatsApp), prior to the interview, including age, gender, race and year of study.
c. Once the voice or video call had started, the researcher engaged in a brief discussion on a personal level to help the participant feel more at ease.
d. The participants were informed of their ability to stop the interview process at any time if they were not comfortable or ask any questions they had about the research.
e. They were also assured of confidentiality and asked to speak openly without fear of repercussion.

f. Although written consent was already attained, the researcher established on recording that the student was aware of the interview being recorded and had consented to it and if the student had signed and returned the informed consent.
g. Thereafter, the individual semi-structured interview was held using the grand tour open ended question method. This allowed the participants to share freely so that no aspects of their views would be left out or missed due to the participants' responses being directed or channelled in a particular direction by the question (Maxwell 2012). This allows the researcher to gauge the their understanding and attitudes in broad terms which can then be explored further through probes and enquiry.
h. The participants were given the opportunity to respond as extensively as they wished, and the researcher only spoke again once the participant had concluded their answer.
i. The researcher responded to the participant with probes and subsequent questioning to extrapolate any information that was not covered in the participants response and to clarify the information provided by the participant. This method was used until no new information was being discussed.
j. The researcher thanked the participant for their time and their addition of value to the research.

This method of interviewing generated rich and detailed data that represent the participants' true feelings, thoughts, understandings, perceptions and practices, without limiting or directing their thoughts and responses. All participants in the research were made to feel at ease to encourage a conversational flow to the interview, instead of making them feel interrogated or tested. The length of the interviews varied depending on the participants' responses. The longest interview was 36m:20s, the shortest 13m:28s and the average duration 20m:14s. The interview recordings and notes were not made available to anyone other than the researcher and supervisors of the research.

3.6 DATA ANALYSIS

The collected data were analysed with the understanding and acknowledgment that themes are created and interpreted based on the pre-existing relationships and experiences shared between the researcher and the participants (Polit and Beck, 2012).

Figure 3.1 represents the data analysis process. Before the data were analysed, the researcher transcribed the interviews verbatim. The transcripts were proofread for errors that may have been made during transcription, whilst simultaneously listening to the interview being proof-read.

In order to become familiar with the data, the researcher became immersed in the data by reading the transcripts multiple times and repeatedly listening to the recordings, noting the tone and feeling in each interview and making notes of the common trends and themes.

The thematic analysis was guided by Braun and Clarke's (2006) method of thematic analysis to identify themes within the data. Commonly occurring trends in the interviews were highlighted in different colours and given codes, which were later collated into categories and further abstracted into possible themes, which were further reviewed. Sub-categories were created from overlapping thoughts, feelings, and sentiments. A table format was used to organize the codes and analyse the categories and themes into which they fitted (**Table 3.1**). Upon constant review, the themes were condensed, related back to the aims and objectives, given names, and refined, until a clear thematic map was created. Thereafter, the themes were reviewed once again, whilst selecting excerpts from the transcripts that best represented the themes, thereby creating an analysis report of the data. Throughout this process, the co-supervisor of the study was involved as a peer reviewer to increase the validity of the study (Creswell 2013) by emphasizing reliability and consistency (Houghton *et al*. 2013) and reducing bias. However, the participants' names and demographic information were omitted to ensure confidentiality. The interview transcripts were only identified by numerical labels.

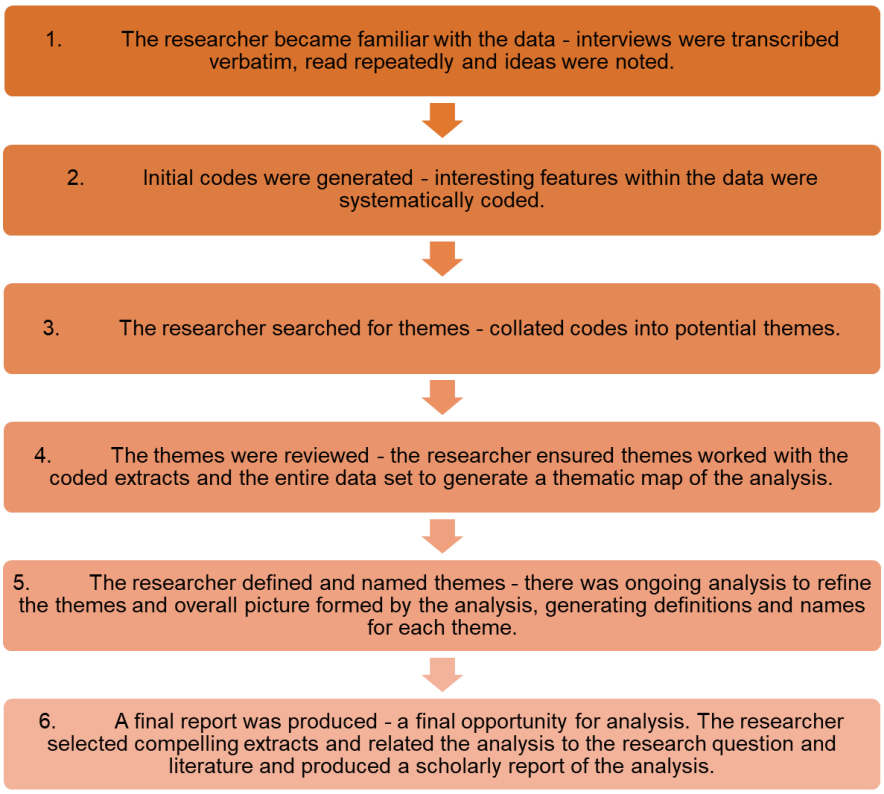

Figure 3.1: Flow diagram of the data analysis process

Creswell (2013) described this process of qualitative data analysis in three simple steps, making the process easier to understand. **Figure 3.2** represents this simple process of 1) transcription, 2) analysis and 3) interpretation, that was followed in this study.

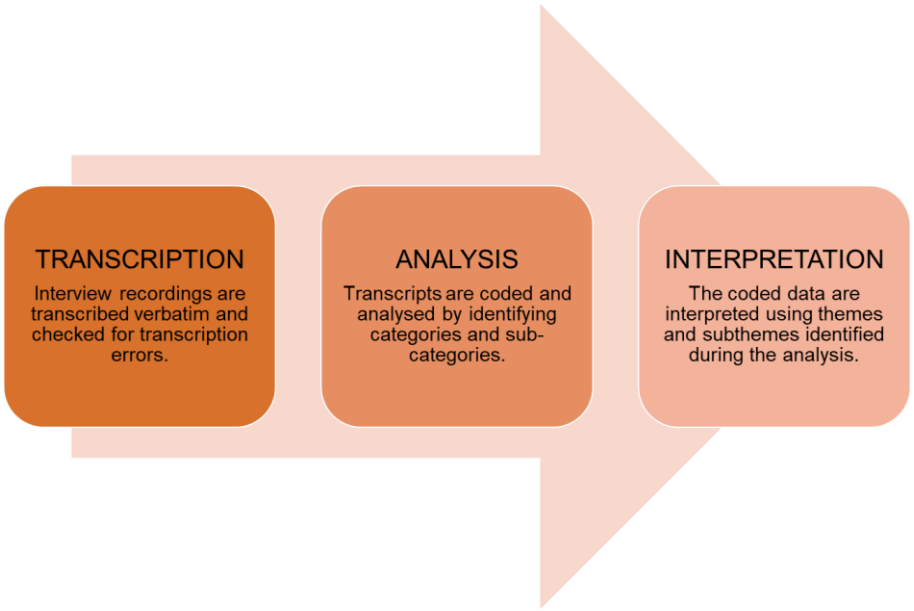

Figure 3.2: Flow diagram of the simplified data analysis process

To ensure dependability and reliability of the data, an audit trail was maintained. Related aspects of the data were continually compared to avoid over generalization or misrepresentation of the data (Flick 2009).

The process of interpreting the data involves relating the codes to one another and deriving meaning from the interpretation of how they relate to each other. The researcher drew conclusions based on these results and how prevalent these themes were throughout the data set. In this study, the data set is made up of transcripts from eight individual semi-structured interviews.

3.7 ETHICAL CONSIDERATIONS

Permission to conduct this study was obtained from the DUT Institutional Research and Ethics Committee (IREC), the Research Director, Head of the Chiropractic Department and the Clinic Director at the DUT CDC. All permissions were received prior to contacting any of the potential participants for the study. These approvals exist to ensure that the researcher is following ethical practices within the research process and is checked at different levels. In this study, the researcher needed permission to access DUT students in the chiropractic programme who were still making use of the DUT CDC for their clinical practicum. No vulnerable groups or individuals were involved in the research process.

The following ethical principals were considered throughout the study.

3.7.1 Autonomy, Respect for Human Dignity, Privacy, and Confidentiality

This was ensured through all participants being given the opportunity to volunteer for the study initially and later asked individually, with no coercion or deception, if they wished to join the study. All participants were given a letter of information, along with a consent form, to read and make an informed decision about joining the study. They were made aware of the ability to stop the interview process or leave the study at any time, as well as the strict confidentiality that would apply.

In compliance, no names were used in the interviewing process and the data was captured using the numerical replacements P1-8 (Participant 1-8). This eliminated the identification of participants through name and gender. Interview recordings were kept securely on a password protected laptop with no copies being made. The signed

informed consent and demographic sheet were kept separately to the interview recording and transcript and was not linked in any way or by any labelling system.

During the interview, only the researcher and the participant were present. The anonymous raw data were only available to the researcher, supervisor and co-supervisor.

3.7.2 Non-Malfeasance and Risks

No harm came to any of the participants in this study. This was achieved by allowing participants to withdraw at any time during the study, if they felt the need. The promise of confidentiality also allowed participants to speak freely without fear of repercussions. Each interview was private and in a safe space chosen by the participant with only the researcher and the participant present.

3.7.3 Beneficence

This study was conducted on a voluntary basis with no remuneration or direct benefit to the participants. Indirectly, the students may benefit from this study in the future if there is any curriculum change encouraged by the findings.

3.7.4 Justice

All participants were treated fairly with equal consideration and in a consistent manner. All eligible students were given equal opportunity to participate in the study and exit at any point. No participant was exploited or victimized in the research process and confidentiality and anonymity, in recording and reporting, applied to ensure no future victimization of participants.

3.7.5 Data Recording and Interpretation Accuracy

There were no acts of omission, inclusion or fraud committed in the data collection, transcription, analysis or reporting of data. The data were peer-reviewed by the research co-supervisor to ensure themes were not based on bias, and participants' opinions were correctly analysed. The raw data and all rough notes are stored and available for audit if required.

3.7.6 Dissemination of Results

All data will be stored for five years at the DUT Chiropractic Department, after which it will be shredded. After the thesis is completed and examined, the results of the study

will be disseminated to the participants via email. The participants should be informed of the outcomes and the impact of their feedback.

3.8 APPROACH TO RIGOUR AND INTEGRITY

Lincoln and Guba (1985) suggested that the trustworthiness of qualitative research can be obtained by using four quality enhancing strategies: credibility, transferability, dependability, and confirmability. These help to ensure the quality and rigour of the study. All research must implore methods and standards of authenticity to be considered a credible source of information and hold value in the scientific community. As such, a fifth strategy known as authenticity was added (Polit and Beck 2012). **Table 3.1** shows the different methods used to ensure that each aspect of trustworthiness was addressed, as extensively as possible, to create valid and reliable results.

Table 3.1: Quality enhancing strategies employed and the different components of trustworthiness they address

METHOD EMPLOYED	CREDIBILITY	TRANSFERABILTY	DEPENDABILTY	CONFIRMABILTY	AUTHENTICITY
PEER REVIEW	X		X		
AUDIT TRAIL	X			X	
CONFIRMING EVIDENCE	X	X		X	
DISCONFIRMING EVIDENCE	X				
THICK, VIVID DESCRIPTION	X	X			X
TRANSCRIPTION RIGOR	X				
DATA SATURATION	X	X			
AUDIO RECORDING AND VERBATIM TRANSCRIPTION	X				X
DISCLOSURE OF RESEARCHER'S BACKGROUND	X				
CAREFUL DOCUMENTATION, DECISION TRAIL			X	X	

Source: Adapted from Polit and Beck (2012)

A brief overview of the strategies utilized in this study are detailed:

3.8.1 Credibility

Credibility means that the interpretation of the data is true to the intentions and original views of the participants. The participants should be able to read the results of the study and recognize it as a reporting of their own experiences (Linda *et al*. 2016). This is often referred to as the confidence in the authenticity of the study and the

researcher's interpretations (Polit and Beck 2012). This was achieved in this study through:

- Disclosure of the researcher's background (registered master's chiropractic student) and the resultant prior relationships with the participants of the study.
- Transcription rigor (reading and re-reading for transcription errors).
- Peer-review by the research co-supervisor.
- Searching for and representation of disconfirming evidence.

3.8.2 Transferability

Transferability refers to the degree to which the results can be applied to the reader's life, thereby giving it external context (Polit and Beck 2012). It can also be viewed as the probability that the results of the study will have meaning to others in a similar situation (Carcary 2009). This was achieved through:

- A thick, vivid description of the methodology, setting, population, and sampling and the critical processes and procedures that have helped to construct, shape and connect meanings associated with the phenomena.
- Data were collected until saturation was reached.

3.8.3 Dependability

This is the ability to replicate the findings of the research with similar subjects in a similar context (Linda *et al*. 2016). To achieve this, a careful documentation of a transparent decision trail was utilised along with an inquiry audit whereby all the raw data, rough notes, findings, interpretations and recommendations were collated and stored, if required.

The documentation will be stored securely for five years, should an inquiry audit be necessary.

3.8.4 Confirmability

Confirmability refers to the objectivity, in the extent to which the researcher is aware of or accounts for individual subjectivity or bias (Polit and Hungler 1999). This was achieved through:

- Disclosure of the researcher's background and prior relationships with the participants.

- Transcription rigor.
- Disconfirming evidence that was reported on.

3.8.5 Authenticity

Authenticity is based on how fairly the researcher reports on the participants' responses and experiences. This was maintained through:

- Audio recording and verbatim transcribing, which were later peer reviewed by the co-supervisor.
- Participants verbatim quotes were reported in this research report to illustrate the categories which emerged from the data.

3.9 CONCLUSION

This study utilized a qualitative approach with an exploratory and descriptive design in an interpretive paradigm. The Chiropractic master's students who fitted the inclusion criteria were recruited by means of purposeful sampling and data saturation was reached at eight participants. The participants were individually interviewed over video conferencing calls using the grand tour open-ended question method with probes in a semi-structured format. The interviews were recorded, transcribed verbatim and analysed. The researcher interpreted the analysed data and formed themes.

This chapter addressed the methodology utilised, throughout the study, to obtain and analyse the data. It also detailed the sampling protocols and ethical considerations. The methods used to ensure trustworthiness were discussed along with their specific applications in this study.

The next chapter will present the results found from the data, after employing these methods.

CHAPTER FOUR: FINDINGS

4.1 INTRODUCTION

The aim of this study was to understand the knowledge, attitudes, and practices of chiropractic students during their clinical practicum at the DUT CDC. In this chapter, the results of data collected on this phenomenon are presented, noting the direct involvement of the researcher in the chiropractic course. Although the themes were formed based on the qualitative theoretical framework set out for the study, there is acknowledgement of the subjective nature of theme selection. The themes were discussed with the co-supervisor of the study for validation. The study revealed the students' experiences of their clinical practicum with specific focus on the DN component, in general and with regards to HRM.

The presented data in this chapter were extrapolated through thematic analysis from eight semi-structured interviews held with master's chiropractic students, who were completing their clinical practicum, in the year 2020. The chapter addresses the demographic data of participants, the relationship between the objectives and the grand tour question and subsequent probes, the themes and sub-themes derived from the data and excerpts from interviews that support them. This chapter also identifies potential areas for improvement in the chiropractic programme, regarding DN, and provides recommendations on how they can be addressed.

4.2 DEMOGRAPHIC DATA

Participant selection was based on purposeful sampling and not demographics. There was no discrimination based on the demographic data. This data have only been provided for contextual purposes, as participant responses may be influenced by their demographics. The data were collected prior to the interview and have been represented in **Table 4.1** below.

To summarise the demographic data of the eight participants:

- The age range of the participants was 24-26 years old. One participant was 26 (12,5%), two were 25 (25%) and the remaining five were 24 (62,5%).

- The majority (87,5%) of participants were female, with only one male participant (12,5%).
- Only one participant was White (12,5%), three were Black (37,5%), and four were Indian (50%).
- Two participants were registered for their 3rd year in the chiropractic master's degree (25%) and the remaining six participants were registered for their 2nd year in the chiropractic master's degree (75%).

Table 4.1: Demographic data of the study participants

PARTICIPANT CODE/ PSEUDONYM	DATE OF INTERVIEW	AGE	GENDER	RACE	YEAR OF STUDY IN THE MASTERS PROGRAMME
P1	22/04/2020	26	FEMALE	BLACK	3RD
P2	23/04/2020	25	MALE	WHITE	3RD
P3	05/05/2020	24	FEMALE	INDIAN	2ND
P4	14/09/2020	24	FEMALE	INDIAN	2ND
P5	15/08/2020	25	FEMALE	INDIAN	2ND
P6	07/10/2020	24	FEMALE	BLACK	2ND
P7	07/10/2020	24	FEMALE	INDIAN	2ND
P8	07/10/2020	24	FEMALE	BLACK	2ND

4.3 RELATIONSHIP BETWEEN OBJECTIVES AND INTERVIEW SCHEDULE

The interview schedule was designed carefully to address the objectives of the study in order to elicit rich information from participants. The researcher had to ensure the interview questions were not too prescriptive or leading to facilitate an open conversation, where the participants could freely share, with honesty and not influenced by the views of the researcher. For these reasons, a grand tour question was utilised with subsequent probes. The probes were constructed on the researcher's personal experience and the anticipated direction of the conversation with the participants.

The researcher created an interview schedule that addressed the aim and objectives of the study, using the knowledge and experience attained from the coursework and clinical practicum. This allowed the study to become more specific and relevant to the shared clinical environment.

The presentation of the relationship between the objectives and the interview schedule reflects that the objectives of the study were fulfilled by the data collection. The probes allowed the researcher to delve into aspects of the master's chiropractic students' experiences with the DN curriculum and the practise of DN in the DUT CDC and gain understanding of the students' knowledge, attitudes and practise of the DN modality.

The following objectives were detailed at the onset of the study. **Table 4.2** shows which objective/s are addressed by the grand tour question and each of the probes:

1. To describe the knowledge of chiropractic master's students on the use of dry needling.
2. To describe the attitudes of chiropractic master's students towards the use of dry needling.
3. To describe the practices of chiropractic master's students in the technique of dry needling.

Table 4.2: The relationship between the interview schedule and objectives of the study

INTERVIEW SCHEDULE- GRAND TOUR QUESTION AND PROBES	RELEVANT OBJECTIVES
As a chiropractic masters student, what do you know about dry needling and what are your thoughts, feelings and understanding on it as a treatment modality?	1 & 2
What is the difference between an active and latent trigger point (TP)?	1
What is your preferred technique or modality for the treatment and management of MFTPs and why?	2
Do you needle active TPs, latent TPs or both and why?	1 & 3
Do you needle all trigger points that you find or only a select few and, if so, how do you choose which ones to needle?	1 & 3
What method/ technique of dry needling do you use and why?	1 & 3
What are the benefits of dry needling?	1 & 2
What are the risks of dry needling?	1 & 2
Which muscles or regions of the body do you consider to be high risk or dangerous to dry needle and why?	1 & 2
What other techniques or methods of dry needling are you aware of?	1
Did you feel adequately prepared to dry needle patients in clinic?	2
Did you feel confident and competent in dry needling prior to your clinical practicum?	1 & 2
Do you feel confident and competent in dry needling?	1 & 2
Do you dry needle high risk muscles and regions and if so, what is your approach?	1, 2 & 3
Which muscles or regions would you never needle and why?	1, 2 & 3
Which muscles or regions do you substitute dry needling for another technique or modality and what is the alternative you would use and why?	1, 2 & 3
Do you feel you should be taught and encouraged to dry needle high risk muscles?	2 & 3
Do you feel prepared for clinical practice, in terms of your dry needling capability?	2

The semi-structured interview schedule allowed the researcher to meet the objectives by delving into the participants' thoughts, opinions, feelings, understanding, and the way in which they practice DN.

4.4 MAIN FINDINGS AND OVERARCHING THEME

The collected data from the eight interviews conducted were reviewed within a qualitative design using thematic analysis by reading and re-reading the interview transcripts. One main theme emerged with five sub-themes and seventeen categories identified as central to the discussion, presented in **Figure 4.1** below, and evidenced

thereafter using excerpts from the interview transcripts. The following overarching theme emerged from the qualitative data:

Dry needling is an important modality in the treatment of myofascial trigger points and is a clinical skill that is learnt through observation and practice to prevent patient harm.

This theme encompasses the general sentiment amongst all participants in this study. All participants utilize DN in their treatment of MFTPs and have learnt the skill through observation and built confidence in the procedure through practice of the technique.

Figure 4.1: Diagram depicting the sub-themes and their respective categories derived from the interview data

4.5 SUB-THEMES AND CATEGORIES

The five sub-themes that emerged from the data following analysis were categorized and supported by the excerpts extrapolated from the interview transcripts below.

4.5.1 Sub-Theme One: Trigger Point Treatment

When discussing trigger point treatment, participants addressed specific talking points that could be grouped into the following categories:

- **Knowledge of MFTPs.**
- **Approach to myofascial trigger point treatment.**

Knowledge of myofascial trigger points

A basic understanding of MFTPs lies in the knowledge of what active and latent TPs are. Participants volunteered the definition of an active MFTP confidently, but a latent TP less so. One participant did not address the topic of latent TPs. Only one participant was correct in their understanding of MFTPs, whereas most participants associated a latent TP with having no pain referral.

This statement reflects the knowledge of MFTPs shared by six of the eight participants:

> *"For active trigger points, er so, we are taught that it`s a hyper irritable spot in that area, but it also refers pain outwards. So, it can ref, cause pain somewhere else other besides where that trigger point is itself, compared to a latent trigger point where it causes pain just at that pain, at that point, so that local area. So er with active trigger points you can get other, other like other burning pain, other like a prickly feeling, pins and needles." – P4*

The excerpts below reinforced this understanding of MFTPs:

> *"My understanding of an active trigger point is basically if I'm palpating on that trigger point its gonna refer pain er pain patterns, so referral pain patterns is by active trigger points with latent, I can actually feel the trigger point, but I don't think it will be referring as much pain as the active would." – P7*

> *"An active trigger point is er uhm an area in the muscle that's going to refer pain. Uhm,it is has a, it is, it has a specific, er referral pain pat-tern. And the latent one doesn't necessarily have a er, er immediate pain pattern. It also*

doesn't have a jump response, ehm, when you palpate it readily but the active one does." – P8

One participant expressed the difference between an active and a latent MFTP correctly, documented in this quote:

"So active trigger points would be where you, where the patient feels pain, you feeling pain, feeling pain in your neck, you feeling pain somewhere in your, that will be an active trigger point and then a latent one is where, when I press on, when I apply pressure on that part of the muscle that's only when the patient will feel, will feel pain there." – P5

Approach to myofascial trigger point treatment

When discussing the treatment of trigger points, the participants voiced two schools of thought: placing importance on direct myofascial treatment using their preferred modality or utilising joint manipulation/ adjustments as an indirect way to affect change in myofascial tissue containing MFTPs. Of the participants, seven of the eight placed importance on the direct treatment of trigger points in muscles. There was one participant who did make use of joint manipulation/ adjustments to affect myofascial change as a substitute for direct myofascial treatment, only using direct MFTP treatment if the adjustment did not bring about enough relief. None of the participants refrained from commenting.

The majority of the participants fell into the sub-category of direct treatment of MFTPs with DN as their preferred modality, with one participant saying:

"I actually prefer dry needling on my patient, uhm I feel that er there's lots of er, there's favourable outcome." -P7

Similar sentiments were shared by four more participants, as illustrated by the responses below:

"So, uhm, I enjoyed dry needling my patients… I feel dry needling is very effective, it gets straight into the muscle." – P3

"I use dry needling for almost all my patients because I really enjoy it. I think that it works a hundred percent for, ninety percent of my patients, it works well." – P5

"I would like strongly recommend, er, dry needling as like, my like treatment, my treatment, like as a go-to treatment." – P6

"I love dry needling, to be honest." – P8

Others who expressed similar views of direct MFTP treatment, but with other modality preferences, stated:

"I'd say it's a fifty-fifty toss-up between needles and ischaemic compression." – P1

"I think I'd prefer using ischemic compression." – P4

However, only one participant preferred indirect treatment of MFTPs, using joint manipulation as the preferred protocol and only resorting to direct treatment when indirect treatment did not result in complete relief:

"My first line, like my first choice of therapy would be manipulation… if there's still some pain after the manipulation… I often do ischaemic compression." – P2

4.5.2 Sub-Theme Two: Pre-Clinic Teaching and Preparedness for Dry Needling

With a majority of participants using DN as their modality of choice for MFTP treatment, further analysis of the interview data was justified. The five categories were identified under this sub-theme from the interview recordings. These categories addressed the different aspects contributing to the participants preparedness for DN in the clinic, as well as evidence of their DN knowledge that should have been attained in their pre-clinic education which included:

- **Precautionary steps prior to dry needling.**
- **Knowledge of risks and adverse events associated with dry needling.**
- **Feelings regarding preparedness for dry needling in clinic.**
- **Attitude towards pre-clinic education in dry needling.**
- **External dry needling education.**

<u>Precautionary steps prior to dry needling</u>

In discussing their thoughts during the process of DN, participants mentioned the precautionary steps they take to ensure the patient is appropriately informed and consent is given to DN, students are sufficiently informed of any contra-indications to

DN and students have followed an aseptic technique to prevent patient harm. Others mentioned these during other parts of the interview when referring to how they select which modality they would use to treat or when discussing HRM and the need for more caution therein. However, some participants failed to mention all the essential precautions that are recited timeously in the training process for DN. Only one participant (P3) failed to mention any of those precautions.

A total of six participants mentioned at least one precautionary step that they would take prior to DN. Of the six, three participants stated two steps they take, with one participant saying:

> *"You first start by disinfecting the area, err then you'd, you would also disinfect your hands… so some patients can also… have other contra-indications." – P4*

Others voiced the similar steps they would take:

> *"There's like indications and contraindications associated with it and you don't dry needle every patient based on the contraindications… I use, uhm, alcohol swabs. I swab the area… " – P1*

> *"Then you clean the area with, er, an alcohol or disinfectant… firstly I check if the er, if there are no contra-indications to dry needling." – P6*

> *"If they've got any conditions that you know, that are going to limit me, or that are going to prevent me from dry needling the patient." – P8*

Only one participant of the eight stated all three precautionary steps taken prior to DN a patient, evidenced below:

> *"So I have to explain it to them like we said the risks, the benefit… if they have certain conditions or if they have certain er contra-indications basically I won't needle them… I will start with er, well wiping the area down, I'll most of the time use an alcohol swab." – P7*

<u>Knowledge of risks and adverse events associated with dry needling</u>

The participants' knowledge was assessed by the researcher based on responses in the interviews. The researcher attempted to gauge if each participant had a good knowledge, moderate knowledge or a lack of knowledge on the risks and adverse events associated with DN. Although the list given by each participant varied, the researcher paid attention to the number of responses given, the severity of each

response or the regard in which the participant held it, as well as ensuring that the most common and most dangerous events were noted. Higher regard for the participant's knowledge were held if there was mention of an adverse event that was severe, but not often discussed by other participants. Most participants had a good knowledge of the risks and adverse events associated with DN, but one participant was considered to have only a moderate knowledge and another poor knowledge.

One participant expressed:

> *"You wouldn't needle anywhere close to the carotids and the jugular vein for obvious reasons… can have a bit of a lame leg for like a few hours… how close it is to any blood vessels, major nerves, bones… if a needle is caught in a muscle… where the muscle just won't let go… contusion to the point of having haematoma… paraesthesias… hypersensitivity… collapsing of the lung… somebody has like a fibrous scapula as oppose to a proper bony scapula then you could needle straight through that scapula. Or the bone is very thin or whatever." – P1*

Others had similar responses:

> *"Your main thing is a pneumothorax… you get smaller things like… a haematoma… you can actually elicit more pain and inflammation… you can always hit like a nerve, uhm, cause like severe shooting, sharp shooting pain in that nerve's referral pattern… there could be some long-standing neural issues… some numb-numbness and tingling… hitting like a blood vessel." – P2*

> *"The risk involved in needling like needling too much gives you the scar tissue, also uhm the post-needling stiffness, the post needling soreness… the main risk is obviously a pneumothorax… if you needling like the glutes and stuff, you can, uhm, like the sciatic nerve is very close proximity to the glutes… the main thing that, I think that has to be spoken, especially with risk to needling is an infections that can be caused err, when needling… they actually get like goose flesh." – P7*

> *"Some pain afterwards… you can, get to areas that you don't want to get to for example blood vessels, nerves, you can hit bones… you can even go between the the ribs, and you know probably hit the pleura of the, of the lungs." – P8*

However, it became apparent that one participant had only a moderate knowledge of the risks and adverse events associated with DN, evidenced by the need for prompting, detailed in the excerpt below:

> *"The place where it was needled will get a bit er swollen… it may be a bit painful, maybe for that day, a little, for a little while… but I don't think there's any other risk to, risks involved with dry needling… you can hit a lung… can hit a nerve… you can hit an artery." – P5*

One participant was considered to have a lack of knowledge in this regard, as seen in the quoted statement:

> *"Sometimes the needle, the needle can get stuck… and also patient can bleed after you put the needle in." – P6*

<u>Feelings regarding preparedness for dry needling in clinic</u>

Students' preparedness for DN in clinic was based on their feelings of confidence in practicing the technique prior to the start of their clinical practicum. This included their opinions on whether their preclinic education was adequate in providing them with the knowledge, skill and practical experience they believed to be necessary for confidently practicing DN in clinic. Participants admitted to lacking confidence prior to the start of the clinical practicum and feeling inadequately prepared for DN in clinic. One student discussed the adequacy of the pre-clinic education despite admitting to a lack of confidence and knowledge prior to the start of the clinical practicum. As a result of the self-admitted lack of confidence and knowledge, this participant was considered to be inadequately prepared prior to the clinical practicum. Only one participant did not share this sentiment. This participant, however, felt prepared and confident to DN due to factors external to the formal preclinic education.

The excerpt below reflects the views of the majority:

> *"I don't think we learnt to dry needle, well okay, you can't learn everything but, uhm, I don't think I was adequately prepared to, for dry needling… when I started off in fifth year, I wasn't confident about dry needling… I didn't feel like I, I knew enough, I didn't do it enough er, during classes, during lessons, I didn't needle enough people or enough muscles to be confident." – P5*

This also became apparent from these responses:

> *"I don't know if I was adequately prepared for, for seeing patients in terms of needling." – P2*

> *"At the beginning of last year, just being thrown into clinic and er needling muscles and stuff I was not actually like prepared for it." – P7*

> *"I did not feel confident, confident or competent." – P8*

The student who lacked confidence and knowledge, but shared opinions of an adequate pre-clinic education was quoted saying:

> *"I don't think I knew enough before I went to clinic… I think I was, adequately prepared." – P6*

However, one participant shared about feelings of preparedness and confidence detailed in this statement:

> *"By the time I learnt how to dry needle, I was already needling myself… I was taught by older years and they showed me like, through their experiences how… I don't dry needle like the lecturer who taught me how to dry needle… I dry needle in a more gentle way… that's practiced by a lot of more experienced, uhm clinicians that I've interacted with. So ya, I felt competent enough to do it on my patients." – P1*

<u>Attitude towards pre-clinic education in dry needling</u>

The education in DN provided by DUT consistently came up during the interview process, with many students making mention of what and how they are taught. Upon further enquiry, participants began addressing perceived flaws in the pre-clinic DN education at DUT. One participant, however, felt like the pre-clinic education was sufficient and any further education was attainable once in the Day Clinic.

One student illustrated the flaws in the DN education at DUT which captured the sentiment of six other participants:

> *"Although we learnt about it in class and we did practice it in class… it also came down to practicing on your classmates who are also a bit sceptical and scared… I learnt how to needle uhm, certain muscles… but I think we weren't, when we are examined, we don't get examined by needling each other, it's just*

where's the trigger point, where's the attachments and that so being examined that's where you can be told 'No you needling this muscle wrong'… I don't think we've had much practice with needling under like one on one supervision to be told this is what you doing right, this is what you doing wrong." – P3

Others concurred, saying:

"I've seen a few people with questionable skills. That could be because we aren't taught how to needle certain spots… we haven't been taught how to do these things, but there are other ways of learning… Not that its part of the curriculum, but I mean, if you're keen to learn then there's always people willing to teach you… I was more comfortable with certain areas than others purely because we, you know, er, practiced that a bit more and people are more willing to, you know, let you needle their traps than they are to let you needle their neck muscles or uhm, gluts." – P2

"We didn't have as much practice, it was just basically one year of our course having to dry needle and we don't do that many different areas as well. We just learn a few points here and there, and when we do have classes we do dry needle but not all the time, we don't always get the opportunity to actually dry needle." – P4

"I was so scared, so scared to dry needle my first patient because when we were taught how to dry needle, our lecturer would literally just, he would walk around, but I was able to escape it… I was able to escape not needling and not being dry needled. My first patient, I dry needled without ever being dry needled by anyone. I didn't know what it felt like… whenever we wrote our myofascial er tests or exams, we did not dry needle, we just showed how we would hold the muscle, we showed what the referral was, we were taught about these definitions that we needed to regurgitate, but no one actually checked in a test situation how to perform dry needling." – P8

Although seven of the eight participants shared the same opinion, one student did not address any flaws in the pre-clinic education, but shared the following:

"I don't think I knew enough before I went to clinic. I think some of the things I learnt here in clinic, like with patients." – P6

External dry needling education

Of the eight participants in this study, none mentioned attending any courses, educational workshops, or seminars on DN, external to the DUT curriculum; three commented on YouTube videos and other resources; three admitted to having no external exposure to DN and two made no comment on the topic. Self-study and independent research can be key to learning a modality such as DN due to the inconclusive physiological mechanism of action and evolving nature of the literature on the subject. Only two of the participants, who did use DN resources external to the DUT curriculum, made note of the importance of independent learning.

This statement demonstrates the initiative of half the participants who responded on the topic:

> *"There are other ways of learning… if you're keen to learn then there's always… other sources you can use to, to learn." – P2*

Others who shared similar views said:

> *"If people cared enough to research… there's a chiropractor that I follow on YouTube." – P1*

> *"I have watched a few YouTube videos, like I've seen how other people, umm chiropractors, er oversees, how they, their, their techniques of doing it, what their opinion is." – P5*

The other half who spoke on the topic admitted to having no external education in DN, represented in the excerpt below:

> *"I haven't had any other exposure to needling." – P4*

4.5.3 Sub-Theme Three: Appraisal of Dry Needling During the Clinical Practicum

Although feelings of being inadequately prepared existed amongst the participants prior to the clinical practicum, all the participants shared perceptions of the clinical practicum bridging the theory practice gap and aiding in the building of their DN confidence. Many also commented on the support and supervision by clinicians during the clinical practicum and how they felt about their preparedness for clinical practice after being exposed to patients in clinic for at least a year.

The following categories were created to describe the participants' experiences of the clinical practicum at the DUT CDC:

- **Attitude towards practicing dry needling in clinic.**
- **Supervision and support from clinicians.**
- **Preparedness and confidence to dry needle in clinical practice.**

Attitude towards practicing dry needling in clinic

All participants discussed the beneficial nature of the clinical practicum and identified its role to be in bridging the theory-practice gap and providing a foundation and building on their DN knowledge, confidence, and skill. This was usually attributed to their need to gain experience. Participants noted that the coursework did not provide this exposure due to students' unwillingness to be needled and a lack of variety in patient body types, as well as time constraints and other factors that prevented students from performing the technique often and with supervision. The one participant who did consider the pre-clinic education to be adequate, had only done so with the consideration that the clinical practicum provided the additional learning that was not previously attained (**4.5.2 Sub-Theme Two: Pre-Clinic Teaching and Preparedness for Dry Needling**).

This quote is representative of the attitude shared by all eight participants:

> *"I feel much more confident because of the experience that I have had and needling certain muscles that keep popping up amongst the general population, it makes me more confident because I get more practice… I feel like I am okay with needling, um especially (*be*)cause I've had one full year of clinical experience." – P3*

Other supporting statements included:

> *"So, a year's worth of experience… so a year's worth of experience, you, you eventually, after you actually do needle, you do start to get more and more confident er needling patients also when I go for sports events… you get a lot of experience… I think practice and experience makes a big difference." – P4*
>
> *"I think I learnt more, being in clinic… you can only develop that over experience." – P5*

"Now that I'm sixth year, and I've started needling in fifth year, I would say now I'm more equipped to needling… with experience and with more patients I'm seeing, and different conditions, I'm getting used to it, I'm much more prepared this year." – P7

Supervision and support from clinicians

The participants were not questioned about the clinicians or the supervision provided for DN in the clinic but five participants shared their experience of the role played by the clinicians. These participants noted the assistance from clinicians in clinic and at sports events, with more reliance on clinicians to assist with regions of high-risk and in areas where students may lack knowledge and/or confidence. Of the five, two students identified clinician supervision to be crucial in the development of their own practice style and technique of DN. Only one participant did not share that exact sentiment, noting the willingness of clinicians to demonstrate only but not allowing students to needle HRM under their supervision. The other three participants did not comment on their experience of the supervision during their clinical practicum.

These participants recounted the beneficial nature of the supervision and mentorship provided in the clinic setting by the clinicians. The statement below reflects the views of the majority:

"I dry needle in a more gentle way, but that's just as effective and that's practiced by a lot of more experienced, uhm clinicians that I've interacted with… there are clinicians that are willing to do it… I prefer a guided, like, a guided example from an experienced clinician to be able to give me the confidence to do what I need to do." – P1

This sentiment was shared by others, reflected in the excerpts below:

"I've often asked clinicians to come in and needle and they've also, uhm, you know, assisted me and, and shown me how to do it… there are other ways of learning and, you know, other methods of teaching that we use, and ask the clinicians, they'll assist you." – P2

"There were times when I called in the clinician because I had never needled any extremity prior uhm, to clinic so I would call the clinician in, to, uhm, observe me and just to guide me just to be safe… I feel like I am okay with needling, um

especially cos I've had one full year of clinical experience… with er, supervision with certain clinicians as well, when I was not confident." – P3

"Someone was watching me, a clinician was… was watching me… I hadn't developed my own technique or what I thought was a good one… what works what doesn't work… we only learnt that, you learnt that from clinicians in the clinic." – P5

One participant expressed slightly different feelings on the subject:

"When we need to needle we have to call the clinician in to do it themselves and we see how they do it but we ourselves aren't exactly allowed to do er to needle those areas as well t… before I actually do do that on patients I would actually ask someone to actually show me and supervise when I do it." – P4

Preparedness and confidence to dry needle in clinical practice

Considering the praise for the clinical practicum in terms of the knowledge and confidence gained through mentorship and experiential practice, participants understandably felt more prepared for clinical practice in terms of DN. However, HRM were the exception to this, with participants having varied views on how they would consider treating these regions, as well as their feelings of preparedness for these regions. All participants did not feel adequately prepared to DN HRM in clinical practice.

One participant expressed feelings of being prepared and confident to DN in clinical practice, knowing that there are alternative treatment modalities that can be used for muscles considered to be high-risk. This participant had also claimed to be confident in DN prior to the commencement of the clinical practicum:

"Having had the experiences that I've had, I've seen that there's, there are many ways to kill said bird… we as Chiros have like a whole arsenal of uhm, tools in our belt." – P1

Three others concurred saying:

"I do needle some of those high-risk areas… there's a lot of ways you can get around it… I feel fairly confident." – P2

"Now that I'm sixth year, and I've started needling in fifth year, I would say now I'm more equipped to needling, and I've also found a lot of err other treatments in, in say that, if I don't needle, I can use this as an alternative." – P7

"I'd rather do ischaemic compression … now I'm very, I'm very comfortable." – P8

Another three participants shared similar feelings of not being prepared to DN HRM, but saw this as a hindering factor in their clinical practice and did not offer alternate modalities as a solution for treatment:

"In clinic we're not allowed to like needle certain muscles… but some clinicians do do that after practice so we not ad, gonna be adequately prepared also, to be able to do that when we go into practice." – P4

"When you go out in practice, and you need to needle them, you can't just say 'oh, I didn't learn it or, we weren't taught it so I can't do it now.' And if that's the only other modality that you can use to treat the part you will, you will try to avoid high risk things as much as possible but you must know how to do these things, and you must be confident if you need to do it." – P5

"I'm not confident in dry needling some muscles… Sometimes I feel scared dry needling those, cause it's near the high-risk area." – P6

However, one participant did not fit into either school of thought, expressing the desire to have the clinical judgement to decide how to treat HRM once in practice:

"I think that once I'm in practice I will be okay and I'll be able to judge whether or not it's a good idea to attempt any muscle I shouldn't be aiming for." – P3

4.5.4 Sub-Theme Four: Choice of Dry Needling Practice Style

Understanding the way in which the participants select trigger points for treatment and their attitudes towards the use of DN for these trigger points, elucidated what influences a student's practice style. Included in this category was the technique used by participants when practicing DN. Participants' practise style varied, with some practising the techniques taught in the pre-clinic DN education and others utilising techniques taught by clinicians at the DUT CDC.

These categories were used to describe the practise styles of the participants in this study:

- **Attitudes towards dry needling for MFTPs.**
- **Trigger point selection method.**
- **Dry needling technique.**

Attitudes towards dry needling for MFTPs

Despite all participants utilising DN in their practice, some participants did not utilize DN for all patients with MFTPs. Only half the participants used DN for majority of their patients who had MFTP. The other half believed that DN was not for all patients and that often the alternatives were more appropriate. This was often associated with treating patients in a non-invasive manner.

Half of the participants concurred with the following statement:

> *"You don't dry needle every patient based on the contraindications but also just based on, uhm, the nature of their ailment… some people don't always react… the best to needles. So, going the less invasive, or non-invasive route may be better. Especially if they are new patients, they haven't been needled before… because again, needling may not always be the best modality depending on the condition that they have etc." – P1*

Other examples of this sentiment included:

> *"If there's no need for dry needling at the time, I try and steer away from it because you, you cause almost like a reliance on that, on that therapy that you use. So, then every time your patient comes in, they want needles." – P2*

> *"It's an invasive approach or treatment modality… I tend to use modalities more than dry needling because I find patients have way too many trigger points and all of them are rated the same in terms of severities. So, instead of sticking in a hundred needles at a time, I prefer to use modalities because it's less invasive." – P3*

> *"When I have used it on patients it has worked so I do believe it's a good form of treatment… especially like er athletic patients… nowadays I usually, if its active then I'm more prone to actually needle that patient… the pain is just localized just over that area then I'd rather do a bit of ischemic in that area and*

some active release… if its er not too bad and the patient doesn't feel that much pain then I'd rather do ischemic." – P4

This statement illustrates the attitude shared by the other four participants:

"I use dry needling for almost all my patients." – P5

This attitude was also demonstrated by other participant who were quoted saying:

"I would like strongly recommend, er, dry needling as like, my like treatment, my treatment, like as a go-to treatment, as compared to other modalities." – P6

"I also, I, I, most of my patients I use dry needling on. Err and they do have favourable outcomes." – P7

"I only select a few that I'm going to needle. I don't want to, first of all I don't want to traumatize the patient especially if it's their first visit… I love dry needling, to be honest. So I always advise a patient… I'll tell them that I prefer dry needling, I'll you know, tell them why." – P8

Trigger point selection method

When participants did choose to needle a patient with MFTPs, their methodology for selecting trigger points was dependant on activity and the pain of the trigger points. However, the data indicated that participants did not fully understand the difference between an active and latent trigger point. As such, pain and referred pain seemed to be the indicator for activity in a trigger point. Most of the participants claimed to DN only the most painful or active trigger points, with three participants DN both active and latent trigger points.

A student mentioned only selecting active trigger points to DN:

"If its active then I'm more prone to actually needle that patient… but if its more latent so the pain is just localized just over that area then I'd rather do a bit of ischemic." – P4

This reflected the practices of the majority, supported by the excerpts below:

"The most tender trigger points you could needle, in my case I'll probably needle 2 or 3 trigger points, uhm, the, the worst ones." – P2

"I do not dry needle latent trigger point… I select a few. I choose the one that are most painful." – P6

"If I have a muscle that has active trigger points, I'm not gonna needle all the points, I'll find the most active, the ones that's referring pain the most and I'll needle that and uhm and if there's latent trigger points around it… then I'll ischaemic or do maybe like PNF of the latent trigger point." – P7

One participant shared a different method for trigger point selection, seen in the excerpt below:

"I'll choose the most active and most painful trigger point… I mostly try to (stammer), try to needle only active trigger points, however there are cases where I will needle a latent trigger point as well… I do needle active and latent trigger points." – P1

Dry needling technique

The four aspects of DN technique were noted upon enquiry. These included the depth of insertion, the number of insertions per needle site, importance placed on eliciting a local twitch response and the duration for which the needle was left in situ.

All participants practiced deep DN as taught at DUT. Participants noted decreasing the penetration depth in HRM to reduce risk but none practiced superficial DN, evidenced by these quotes:

"So, you might go, you know, all the way in, 2 to 3cm, you might do the full length of the needle depending on the, the, you know, the size of the patient and the muscle bulk." – P2

"So it depends on the patient as well and on the muscle bulk… If it's a small muscle then I won't put the needle… the whole way through… if it's like a gluteal muscle then you would use a bigger needle and you would use, and then I would put it deeper." – P4

"It depend which muscle you needling. For example if the muscle is like superficial, then, you don't insert the whole needle. And if you dry needling for example, let say gastroc muscle, then you have to put the needle like deep deep deep." – P6

"For the larger muscles, like the glutes, I use the bigger muscle, I mean the bigger needle. I think it's the 1.5, and then the smaller muscles like the levator scap, the rhomboids, I usually use the 0.5… push the needle in." – P7

The majority of the participants used both single and multiple insertion (pistoning/fanning) depending on the patient's needs:

> *"I'll agitate the needle by rolling it, rather than actually fanning it if the pain is like super acute or if the person has a low pain threshold. However, people that don't fall into that category, I'll fan the needle depending again on which muscle it is, how close it is to any blood vessels, major nerves, bones, etc." – P1*

> *"You can do a fanning technique, uhm you can just put it in and leave it there… that's all dependant on the patient." – P2*

> *"I fan when the muscle is like active, super-active. But if it is not like that active then I don't fan." – P6*

But one participant utilised only multiple insertion:

> *"I feel like fanning it for just a few seconds and leaving it has a better effect than just, you know, hacking your way at the muscle." – P*5

And another used only single insertion:

> *"You would er needle into that knot or that bump you feel in the muscle. So you would leave it there." – P4*

Of the five participants who commented on eliciting a LTR, the majority thought it to be a necessity when DN:

> *"If you go in and you find the, you elicit the twitch response, where the muscle twitches, you can leave the needle there for a little bit and then you go into it, you kind of reangle your needle and find, you know, another twitch response." – P2*

> *"…looking for that twitch response." – P3*

> *"You know you at, you're at an active trigger point when you get a twitch response, so I think it's pointless, and just painful for the patient, er we just bring them discomfort when we do it at a place where you not getting a twitch response." – P5*

There were two participants, however, who were not insistent on eliciting a LTR when DN:

> *"Sometimes you don't even need to hit the trigger point." – P1*
>
> *"Like a jump in the muscle like that twitch so then you know that you hit the right spot, sometimes you won't always get it." – P4*

When discussing duration in situ, only six participants specified their preferences. Of the participants, three left the needle in for one minute or less:

> *"Leave it there for a few seconds, uhm, anywhere from 20 seconds to a minute." – P2*
>
> *"Take the needle out after about five seconds and then if it's not relieving at all and if especially if the needle is stiffening the muscle I'll let it rest in there for a while, maybe up to a minute." – P3*
>
> *"You leave the needle for about, er, five, what ten to twelve seconds." – P6*

Two participants preferred a two to three minute duration:

> *"I'll leave it for maybe two to three minutes." – P5*

But one participant chose to leave the needles in for no more than ten minutes:

> *"I don't like to keep needles in for more than 10 minutes" – P1*

4.5.5 Sub-Theme Five: Dry Needling High-Risk Muscles

A clear point of contention among participants was HRM. A lot of fear, confusion and frustration surrounded this topic due to the DUT CDC rule which prohibits students from DN these regions without permission and direct supervision or clinician demonstration, based on the prerogative of the clinician on duty. No participants were able to give a complete list of HRM as stipulated by the DUT CDC and all participants included other muscles that were not on this list. The following categories grouped the points of discussion among the participants in this regard:

- **Feelings towards the DUT CDC rules for dry needling high-risk muscles.**
- **Muscles considered to be high-risk.**
- **Attitude towards dry needling high-risk muscles.**
- **Injury avoidance in high-risk muscles.**

Feelings towards the DUT CDC rules for dry needling high-risk muscles

While the majority believed that students should be taught and encouraged to DN HRM, three other participants had varying views in this regard.

The one participant's feelings represented that of the majority:

> *"We should be encouraged to do it, because when you go out in practice, when you go out in practice, and you need to needle them, you can't just say 'oh, I didn't learn it or, we weren't taught it so I can't do it now.'… I think we should be encouraged, we should be taught… The place to learn is now, not when we in practice, so I think it's best to know it now." – P5*

Others concurred saying:

> *"I definitely think if we were taught to needle that it will benefit us, as students, as future chiropractors, as clinicians." – P7*

> *"We should (said with emphasis) know how to dry needle them, but obviously there's a risk for it." – P8*

The other three participants all had differing views from each other, and the majority, evidenced below. Another participant (P2) felt that students should be taught but not encouraged, participant 3 suggested the decision be region dependent and participant 6 did not think students should be taught or encouraged due to the risk involved:

> *"I definitely feel that we should be taught to needle them. I wouldn't say encouraged because (groan), there's a few, I've seen a few people with questionable skills. That could be because we aren't taught how to needle certain spots." – P2*

> *"To a certain extent depending on which area it is, because I would not needle any structures in the neck." – P3*

> *"I don't think err we should be encouraged to dry needle high risk areas, because when the lecturer teaches you to dry needle, you have to dry needle afterwards. How they gonna make sure that you dry needling it correctly? What will happen if something goes wrong, during like practicing? So, I don't think we should be encouraged to dry needle those." – P6*

Muscles considered to be high-risk

Every participant gave an incomplete list of muscles considered to be high-risk by DUT. Furthermore, all participants noted additional muscles that they considered to be high-risk. This was often based on fear and caution but could also attributed to a lack of knowledge of the DUT CDC rules regarding HRM.

A student listed the muscles which were believed to be high-risk:

> *"The locations that I'm not like the most comfortable with are mainly the muscles that are on the, in the clinician's office, there's like this list of no-no's for needling… it includes like the popliteal fossa, the cubital fossa, uhm, the outer quadrant of glut, uhm lower inner quadrant of glut, uhm, where else did they mention?... I think it was also like the front of the chest… uhm, pecs, pec major especially, near the sternal attachment, especially on the left… the lateral and medial heads of gastroc… SCM… the face." – P1*

Other examples to substantiate this finding can be seen in the following excerpts:

> *"In the trap area… another high-risk area would be, be er dry needling in the piriformis… up in the sub-occipitals… I also try to stay away from rhomboids." – P5*

> *"The neck ones… the ones in the sub-occipital region, we also can't dry needle those… especially er the pec, the pec major one… near the cubital fosa, and also er mmm, the gluteal ones… in the middle… the gluteal clef… some muscles like near the neck region like scalene, like er like TP1 of the traps." – P6*

> *"The muscle I don't ever needle… I don't ever needle anything in the neck… The only muscle that I do needle is traps… I don't ever needle posterior cervicals or even SCMs… the piriformis… I'm fine needling the glutes… pec major." – P7*

Attitude towards dry needling high-risk muscles

All participant responses illustrated a general avoidance of DN HRM where possible. However, two participants avoid DN HRM entirely, due to fear. No participants were willing to DN all muscles considered to be high-risk, but three participants were willing to DN some HRM, but only under supervision. Another three participants were willing

to DN some muscles considered to be high-risk without supervision, but only provided they had previously been supervised or given permission to do so.

The three participants most confident in DN HRM shared the following:

> *"The popliteal fossa, uhm, I've needled it, since I know this is confidential… I've needled not in the popliteal fossa but just like the lateral and medial heads of gastroc, which apparently is also contraindicated… I got permission beforehand… I prefer a guided, like, a guided example from an experienced clinician to be able to give me the confidence to do what I need to do… another place that has been contraindicated for needling is the face… I'm fine with needling in the face." – P1*

> *"I do needle the piriformis now, um sub-occipitals… I would do um traps, that's fine for me, I do piriformis." – P5*

> *"Uhm so I'm fine needling the glutes… we were not taught, we were shown how to find the trigger points and where it referred to but we weren't taught how to needle the posterior cervical, so I felt if we were taught to actually needle it, and actually get to the muscle without targeting your nerves or your veins or any other of the important vessels er that run in the neck , it would help to relieve the pain for the patient." – P7*

Another three participants expressed their sentiments on the topic, detailed in these excerpts:

> *"In the clinic setting, I've often asked a clinician to come in and, and er, show me how to needle for example, er, posterior cervicals or uhm sub-occipitals, er, glut, when it's more on the inner border or you're not on that safety zone of the outer third of the bum… I've never needled the SCM though, and I don't plan on doing it either… popliteal fossa, there's no need to needle that." – P2*

> *"I have needled, er, gluteus, er, muscle trigger points that was deemed fine by the clinician who observed me that was nowhere near the sciatic nerve. That's as far as I got to needling a high-risk area." – P3*

> *"I've never needled any of the high-risk muscles as of yet… before I actually do do that on patients, I would actually ask someone to actually show me and supervise when I do it." – P4*

However, only two participants avoided DN all high-risk, evidenced by this quote that represents the shared attitude:

> *"I don't want to land up in jail… something will go wrong. So, I will never, never never never, dry needle those." – P6*

Injury avoidance in high-risk muscles

When discussing injury avoidance in HRM, seven of the eight participants noted using an alternative modality. All participants made recommendations for injury avoidance, while DN, especially for HRM, including tangential needling, pincer technique, bone bracketing, attention to needle size, a consideration of the adjacent anatomy and a decrease in penetration depth. These are all the precautions emphasized in the DN learning at DUT.

At least two recommendations for HRM were made by five participants, illustrated in these quotes:

> *"A good pincer grip… bony structure to, to protect… if your orientation is right, then you're going to hit the vertebral body, you're not going to hit any structures… the thorax, you might uhm, you'll hit the rib and that will protect you from hitting the more vital structure like the lung." – P2*

> *"I always aim for bone when I needle, I don't needle in-between. I'm avoiding the intercostal space in other words, so I aim for the rib and if I'm needling the superspinatus or interspinatus muscle very shallow needling… so for example the traps, I definitely lift TP 2 up… I would do ischemic compression, uhm this can be like an active, er, myofascial release." – P3*

> *"I do a bit of ischemic with some active relief as well so I give some stretches to do… if it's near a higher risk area then you'd also er want to make sure that… when you are near the lungs or anything that you going to be hitting a bone if it does go. You don't want to push in too much also." – P4*

> *"I rather do other modalities… if you don't, if you go to, go toward the rib, and you go in between, then that's a.. that's a lung risk… I'll hold the muscle between my fingers and I'll needle it… I'm holding up the muscle so it's not going into any important structures." – P5*

The other three participants only recommended the use of an alternate modality for HRM, evidenced in the excerpts:

> *"I do not dry needle… I use soft tissue therapy, as well as ischemic compression, and stretching." – P6*
>
> *"Ischemic compression and sometimes I just like to stretch out the muscle, just to elongate it, just to stretch it out and err, and also most of the time I use PNF, so those are my three go to if I don't needle." – P7*
>
> *"Never, I'd rather do ischaemic compression er, yes basically that's what I do most of the times. Just soft tissue work." – P8*

4.6 CONCLUSION

The data extrapolated from the interviews revealed trends that lend themselves to illustrating the experiences of the chiropractic master's student in their learning and execution of DN. Some of the main insights of this study have been presented in this chapter and included findings of attitudes, knowledge and practices shared by the majority.

The analysis revealed positive and negative aspects of the DN student experience at DUT, with praise for some and flaws in other areas. Participants seemed to have a good knowledge of many aspects of myofascial trigger points but lacked a basic understanding of a latent trigger point. This was surprising due to the importance they placed on the need to treat MFTPs. The sentiment was that direct TP treatment was the best practice and most preferred to do so utilising DN. There was intentional caution when discussing DN and most participants considered precautionary measures prior to DN and were aware of the risks involved.

The participants also voiced feelings of being inadequately prepared and lacking confidence prior to the clinical practicum, addressing aspects of the pre-clinic education which they considered to be flawed. However, the clinical practicum was praised for bridging the theory practice gap that existed. It provided students with the knowledge, skills and confidence they previously lacked. They attributed this to their year of clinical experience and the judgement gained through treating patients of differing body types with different cases and conditions, as well as the support and

supervision provided by the clinicians. This contributed to the participants feeling prepared for clinical practice, while also equipping them with alternatives for DN HRM.

However, the participants expressed a preference to be taught and encouraged to DN HRM so that they were better prepared for clinical practice. Resulting from fear, none of the participants were willing to needle all muscles considered to be high-risk, even with supervision. Instead, there was avoidance of HRM and a preference for using other modalities in these regions. Participants were not able to provide a complete list of muscles considered to be high-risk by DUT and added muscles, that were not on the DUT list, which they considered to be high-risk.

All participants in this study practiced deep DN but other aspects of their DN execution varied, with the majority placing importance on eliciting a local twitch response, leaving the needle in situ for a short duration of one minute or less and using either single insertion or multiple insertion (fanning), depending on the patient case.

The next chapter will conclude the research by summarising the study and discussing its findings in the context of the literature. The researcher will provide recommendations for further research, curriculum revision at DUT and the chiropractic profession in this regard. The researcher will reflect on the research and provide the reader with the strengths and limitations of the study.

CHAPTER FIVE: CONCLUDING DISCUSSION AND RECOMMENDATIONS

5.1 INTRODUCTION

The findings of this study have been expounded upon in the previous chapter and will be explored and discussed further in this chapter, with particular reference to the relevant literature. This proved challenging with a limited body of literature on chiropractic education, specifically pertaining to dry needling. Mrozek *et al.* (2006) and Adams and Gatterman (1997) have made recommendations for the investigation of the chiropractic education process to ensure growth in the profession but there is still a paucity of the literature in this regard. There has been a recent focus on chiropractic education through research by chiropractic students, such as Ganesh (2017), who focused on the student perspective, and Vogl (2018), who focused on the clinical instructor perspective. However, these studies were based on the clinical practicum portion of the chiropractic course at DUT and were not specific to DN. Furthermore, this study provides insight into the pre-clinic education component of DN which impacts students' preparedness for the clinical practicum and their attitude towards and practice of DN.

Sub-themes and categories have been used in the previous chapter to group opinions and make the findings of the study more accessible to the reader. However, to discuss the findings and develop an understanding of how the sub-themes and categories relate to each other and the objectives of the study, the findings would be best described in the context of the knowledge, attitudes and practices observed. This would work to address the aim of this study. As such, the findings will not be discussed in the sub-themes and categories which were set out in the previous chapter.

5.2 DISCUSSION OF THE FINDINGS

The aim of this study was to describe the knowledge, attitudes and practices of registered Master of Technology in Chiropractic students on the usage of dry needling (DN) during their clinical practicum. These supporting objectives have been used to discuss the findings of this study.

Objective one – To describe the knowledge of chiropractic master's students on the usage of dry needling.

Objective two – To describe the attitudes of chiropractic master's students towards the usage of dry needling.

Objective three – To describe the practices of chiropractic master's students in the technique of dry needling.

As such, the researcher's interpretation of the findings have been detailed under each of these components in the discussion below:

5.2.1 Knowledge

Badenhorst *et al.* (2006) described knowledge as a body of information that forms the basis of insight and judgement. Knowledge can be gained through experience and education through observation and attaining facts, information, and skills. Some aspects of students' knowledge, such as how DN knowledge is attained and the DN training at DUT, were discussed in the interviews. Other aspects were interpreted, by the researcher, through participants' responses to knowledge-based probes. The researcher further observed the impact of this knowledge on participants' attitudes towards and practices of DN.

While participants demonstrated a very clear understanding of an active MFTP, perhaps the most surprising finding of this study was that, only one participant was able to provide an accurate description of a latent MFTP. Many participants described a latent TP with hesitation and were not able to accurately define it. The general assumption was that a latent TP did not have referred pain. This was troubling as it forms the basis of understanding MFTPs and differentiating also aids in TP selection when DN.

Participants selected TPs for DN based on pain and activity. This is because DN a primary TP can reduce the activity in satellite trigger points as observed in a study by Hsieh *et al.* (2007). Being strategic about TP selection decreases the number of active TPs that need to be DN in the zone of referred pain, allowing for fewer needles to be inserted. This seemed to be the main area where there was a paucity in knowledge, as participants were able to describe the proposed physiological theories underpinning the DN mechanism of action that was taught at DUT and generally showed a good knowledge of MFTPs and DN.

Another area lacking in knowledge was the various DN techniques available to a practitioner. Participants in this study had a limited awareness of superficial dry needling as an independent technique, but only made suggestions of reducing the depth of the needle in regions that pose a risk for injury. Furthermore, students were not aware of the beneficial outcome of leaving a needle in situ. This is due to the DN teaching practices at DUT, where the technique taught is largely based on the practice style or preferences of the lecturer rather than evidence-based practice. Students have not merely selected this practice style themselves, but rather, have not been exposed to the other options that exist and the outcomes that validate their application. The respondents from a study at DUT (Naidoo 2018) thought evidence should be used in practice to improve the quality of care through informed clinical decision making. More studies are showing young chiropractors leaning towards an evidence-based practice model (Banzai *et al.* 2011; Walker *et al.* 2013).

Participants showed a good knowledge and understanding of the risks involved in DN and the potential adverse events that could result. Many were able to identify regions where more caution would be required to prevent injury but none of the participants could provide the complete list of HRM, as dictated by DUT. This may be due to a lack of knowledge of the rules or not understanding the muscles that present risk, but is more likely due to fear avoidance of regions loosely based on the clinic list, but more so on their own clinical judgement. This clinical judgement is likely based on their knowledge of anatomy, their confidence in DN and their previous clinical experiences. This will be explored in **5.2.2 Attitudes**, as participants seemed to be aware of the DUT list but included additional muscles. This could indicate that participants are aware of the practice guidelines available from the AHPCSA, which include a more extensive list of muscles that require caution. The muscles that were not included by some participants were most likely omitted due to an inability to recall them. However, it may be students' confidence resulting in them considering certain muscles to not be of concern. This was not a test situation, and the list can be considered lengthy. This list is available in the clinicians' office for the students' viewing at any point and, as such, it is not a requirement for students to remember the entire list as they are required to go to the clinicians' office at least once before treating a patient.

A good knowledge of human anatomy and topographic anatomy underpins a practitioner's ability to DN safely, especially as it pertains to these HRM. The

practitioner needs to know which muscles pose an anatomical risk and where large blood vessels and nerves lie. Participants in this study demonstrated a good understanding of anatomy when discussing the regions and they avoid DN due to underlying structures or the absence of bone to practice bracketing as a precaution. A participant in this study added “as long as you know your anatomy you should be fairly fine” (P2). This is incongruent with the findings of Ward (2010), who suggested that there may be a disconnection for students between basic sciences and the rest of the chiropractic curricula, due to the sciences being taught in isolation.

This study also noted “some clinicians do do that after practice” (P4) in reference to practitioners who DN HRM. As such, it can be deduced that DN HRM does not, and should not, fall outside the scope or knowledge and skill set of a South African trained chiropractor. Guidelines have been made available, for safe practice in this regard, by the AHPCSA (2020), to be used within the discretion of the chiropractor with the exception of those muscles (discussed in **2.4.6 Risks for Patients and Adverse Events**). Practice guidelines are a condensed revision of the best available evidence to improve care and outcomes (Chou *et al.* 2007). Naidoo (2018) found that DUT chiropractic students were aware of practice guidelines available for various aspects of practice and utilized them. Furthermore, they identified the previous clinical experience and the utilisation of evidence-based practice as a tool in safeguarding the patient and practitioner by providing reliable and reproducible care. However, anatomical variations exist and was noted by participants of this study as a factor to consider. Guidelines can be rendered useless in such cases. A sample of general practitioners and nurses had doubts about the application of practice guidelines to differing patients within their differing settings (Retsas 2000; Cranney *et al.* 2001).

5.2.2 Attitudes

Coon and Mitterer (2007) suggested that an attitude is formed based on a belief and emotion created by preceding events and experiences, which inclines a person to respond positively or negatively to a person, object, or institution. Proctor (2001) also included that an attitude predisposed a person to a particular behaviour. The researcher explored the participants’ attitudes to MFTPs, DN, the DN education at DUT and DN challenges, such as HRM, and identified the resultant behavioural outcomes in their choice of practice style.

The areas of knowledge paucity identified in this study could be addressed through encouraging the active seeking of knowledge rather than the passive recipient attitude towards the attaining of knowledge identified among the participants. The researcher recommends an investigation of the literature, in the form of an assignment, at the start of the DN module, to expose students to the physiological theories, practice guidelines and practice techniques that exist. The literature is ever changing due to the constant development of new knowledge in the field of DN and, as a result, this will encourage an awareness and practice of evidence based DN practice.

A DUT study found that practice guidelines were more likely to be used by those who had the knowledge and skill to critically appraise literature (Naidoo 2018). This is a large focus of the research component of the master's programme; however, this can be applied from earlier on, at a fundamental level, in the learning of modalities and techniques used by chiropractors through the assignments, as suggested. Unlike research, where new knowledge is developed or existing knowledge is supported, evidence-based practice is about appraising the best knowledge that exists to guide clinical decision making and practice (O'Donnell 2004). Naidoo (2018) identified "research and clinical" as themes used by participants in clinical decision making. These components are used in the development of clinical practice guidelines so, while some may disregard practice guidelines as not being practically applicable, they are important to encourage the safe practice of DN, especially as it pertains to HRM.

There seemed to be a split in participants' modality of choice for MFTPs. The researcher observed a trend of a preference of "less invasive non-invasive" treatment options, "especially if they are new patients" (P1). The participants were careful to not scare patients if they had not previously been DN. Other concerns included patients who had a "fear of needles" (P2) and patients having "too many trigger points" (P3) to treat all with DN. A systematic review and meta-analysis study supported this concern, noting that although the prevalence of needle fear and phobia seemed to decrease with age, it was still thought to be 20-30% in young adults, with a greater prevalence amongst females (McLenon and Rogers 2019). However, despite the reservations of some, most participants selected DN as their modality of choice for the treatment of MFTPs.

Some participants, however, were more reluctant to DN at the start of the clinical practicum due to their lack of preparedness in this regard. Feelings of anxiety and self-

doubt at the start of the practicum are common and have also been identified by Ganesh (2017). Only one participant felt prepared for DN in the clinic due to the knowledge and skill gained from peers in the higher years of study who had more clinical experience. The findings from a study by Vogl (2018) correlated with the lack of confidence demonstrated by participants in this study. Vogl (2018) reported that clinicians at the DUT CDC commented on a lack of clinical confidence among students.

Peer coaching has been recommended as an evidenced practice to help students in areas of clinical learning (Sevenhuysen *et al.* 2013; Moore, Westwater-Wood and Kerry 2016). Sole *et al.* (2012) found that students feel more comfortable asking someone familiar, such as a peer, a question. Ganesh (2017) explained that while the pre-clinical practical initiatives at DUT (**2.7 The MTech: Chiropractic Programme**) contributed to clinical learning, they did not provide sufficient immersion to instil feelings of preparedness for the clinical practicum among students. Some participants did highlight the beneficial nature of attending the informal clinic setup at sports events in the pre-clinic and clinical years.

The most notable finding, in terms of clinical preparedness for DN, was that all but one participant attributed their lack of preparedness to flaws they identified in the pre-clinic DN education. While initial clinical anxiety is common (Joolaee, Amiri and Farahani 2015; Sharif and Masoumi 2005), the education flaws identified in this study, which resulted in a lack of preparedness, were inconsistent with the known causes of such anxiety. Some of the commonly explored reasons for this initial anxiety experienced when transitioning from the pre-clinic phase to the clinical learning environment (Kaneko and Momino 2015; Elliott 2020) are the theory practice gap that exists; the difference in teaching style and learning environment; navigating new relationships with superiors, peers and patients; fears of making mistakes; and uncertainty of their role and responsibilities, among others (Kaneko and Momino 2015; Sharif and Masoumi 2005; Mason 2006; Radcliffe and Lester 2003). The education flaws discussed in this study cannot be attributed to initial clinical anxiety or the theory practice gap phenomenon which relates to a student's inability to apply theoretical knowledge in practice (Landers 2001). These were not the pitfalls expressed by the participants. The participant feedback indicated that students perceived their education to be inadequate in preparing them to DN in clinic.

The pre-clinic DN education at DUT was scrutinised by students participating in this study, who linked its flaws to their lack of knowledge, skill and confidence to DN in clinic. There seemed to be a general sense of discontentment with the pre-clinic education for DN. Ganesh (2017) expressed the importance of understanding the students' perspective on their pre-clinic education to evaluate their preparedness for clinical practice. Unlike the findings of Ganesh (2017), where participants shared differing views on their level of satisfaction with the pre-clinic education, only one participant in this study found the pre-clinic education to be adequate in preparing students for clinic, despite admitting to lacking knowledge and confidence prior to the start of the clinical practicum. This participant expressed this on the basis that the clinical practicum provided additional knowledge that was not attained during the pre-clinic education phase. Other participants deemed the pre-clinic education to be inadequate and addressed specific aspects which they identified to be flaws. Some of these included:

- A lack of practical experience and knowledge:
    - Not enough focus on practice during class or not enough opportunity for practice. This was consistent with the findings of Ganesh (2017), who found that students were dissatisfied with the practical component of the chiropractic undergraduate programme. This trend was noted by Morgan and Morgan (2006), whereby chiropractic training was found to be disproportionate, with a larger focus on theoretical learning than practical training.
    - Not enough patient type variety (in terms of morphology/ body habitus) during learning – only practicing on the same group of peers.
    - Not enough muscle variety covered theoretically or practically – due to peers being fearful or reluctant to have certain muscles DN and due to the lecturer only covering a limited list of muscles throughout the module.
- No reassurance of proper technique or correction of improper technique:
    - A lack of one-on-one supervision in class to ensure correct techniques and encourage confidence in students.
    - Poor examination practices where DN is not tested practically, and students are not assessed on technique. Instead, the theory component is verbally tested in these practical tests. This theory focus is often a

complaint amongst medical students (Rotthoff *et al*. 2015). Similarly, Palmgren and Chandratilake (2011) found that chiropractic curriculum tends to be more focused on the retention of facts than the acquiring of practical skills.

- A “taboo” on HRM which prevented learning to DN these muscle for fear of causing harm due to the association with danger. Students are advised against DN HRM, instead of being taught how to safely DN HRM and advising caution and restraint where possible. The implementation of a clinic rule prohibits DN HRM in clinic without the consent and direct supervision from a clinician. Some students are not granted permission to DN a HRM under supervision and therefore may never do so themselves, but may only observe the clinician do so, resulting in ill-preparation for clinical practice.

While these obstacles may have been detrimental to the development of the DN skills of DUT chiropractic students, the clinical practicum was praised for its role in bridging the foundational knowledge and skill gap that existed, as well as further developing the necessary confidence that was lacking following the pre-clinic education phase. The participants attributed this to the clinical experience gained from a minimum of a year in the clinical practicum with some participants commenting on the supervision and support provided by clinicians, which was beneficial in the development of their technique. Vogl (2018) found that the clinicians at DUT perceived themselves to fill a guidance role to students, rather than filling the role of dictating treatment protocols.

A major point of contention among the participants seemed to be the rule surrounding DN HRM at the DUT CDC. This study explored participants’ attitudes towards HRM and the DUT CDC rule on DN HRM. The participants were in opposition to the rule and believed that students should be taught and encouraged to DN HRM or at the very least taught to do so safely, to ensure that there were no gaps in their knowledge which would prevent them from providing a patient with the best care. Furthermore, the list of HRM provided by the participants differed from those provided by the DUT CDC. The lists provided by the participants compared to that provided by DUT were incomplete and included other muscles. The common muscles included were trapezius, pectoralis, and muscles of the thorax, which pose a risk of lung injury, such as the intercostal muscles and the rhomboids. These muscles are included as muscles that should either never be DN or require caution when DN, in the guidelines provided

by the AHPCSA (2020). The researcher attributed this negative attitude towards HRM to the creation of a taboo which imposed negative emotions and connotations which were shaped by fear. This fear made participants wary of DN these muscles which seemingly had an impact on their behaviours.

The avoidance of DN HRM led participants to believe they were not capable to do so and left them feeling ill-prepared in this regard for clinical practice. While this absence in confidence left all participants feeling inadequately equipped to DN HRM in clinical practice, some were confident that alternative treatment options would suffice for these muscles. Others saw this as a hinderance to their ability to practice and did not consider utilizing other forms of treatment. The participants may have required an additional year of experience to feel clinically competent in this regard, as it seemed like participants discussing their second clinical year were given the opportunity to DN HRM more than those discussing their first. This is supported by Hodgetts *et al.* (2007), who suggested that gaining clinical competency can take up to two years.

All participants, however, did feel prepared in all other aspects of DN and felt confident for clinical practice in terms of their DN capabilities. They attributed the development of skill, knowledge and confidence to the experience gained through the clinical practicum. This finding is congruent with that of Porter, Morphet and Raymond (2013), who observed that the confidence of students increased with clinical experience during the clinical practice component of their learning. It is also aligned with studies by Palmgren and Chandratilake (2011) and Talberg and Scott (2014) which found that students perceived their clinical education to be adequate in preparing them for clinical practice. However, this is dissimilar to a study by Ganesh (2017) which noted mixed feelings among students regarding their preparedness for clinical practice following the first year of their clinical practicum, explaining that they did not see the clinic experience to be synonymous with the real world.

5.2.3 Practices

A student's knowledge of, and attitude towards DN, may shape their behaviour, goals, desires, perceptions, and the way in which they practice in the clinical context. Although there are many aspects that may influence a student's practice style or choices, their knowledge influences their clinical judgement and decision making and their attitudes towards dry needling impact their behaviours and actions. The transcript

data was used to understand the impact of participants' knowledge and attitudes on their practice style and further explored other factors which contributed to the participants' practice styles.

This study established that the participants approached chiropractic management of MFTPs in a direct manner, choosing DN as their main modality. This style of practice is expected from a DUT student, with DN being a large focus when compared with other modalities. One participant listed some of the benefits of DN to be "compact… you can take a lot of them with you… fast, inexpensive and effective" (P3). Students selected the TPs for dry needling based on which were the most painful and active. However, the participants did not fully understand the difference between an active and latent trigger point. As such, local and referred pain intensity seemed to be the indicator for activity in a trigger point.

In their practice of DN, the participants noted the pre-treatment steps they follow with patients to ensure there are no contra-indications to DN: they attained informed consent from a patient, and they use an aseptic technique to prevent infection. The participants were not directly asked for this information. The researcher enquired about the process each participant followed when DN. These components are recited timeously during the DN training and they are required in a test situation. Students are aware of these steps and are well versed in implementing them in practice.

Participants seemed to DN the way they were taught at DUT, with all participants practicing deep DN. A LTR was an important aspect of effective DN to participants and duration in situ was not much of a consideration, with the majority leaving the needle in for 5 seconds to 3 minutes. Interestingly, one participant maintained the needle in situ for not more than "ten minutes" (P1) but also noted that this style of practice was common among clinicians.

The only aspect that differed from that taught at DUT, was that students did not use multiple insertion/ dynamic needling for all patients. Instead, they used either single or multiple insertion depending on the needs of the patient. This may be related to the fear of scaring patients off by being too aggressive in their practice, which was also identified in participants' reluctance to DN new patients. This is supported by the findings of Robbertze (2018), who noted that only five of the 14 participants mentioned

DN as part of a chiropractor's scope of practice when interviewing first time chiropractic patients.

DN HRM is another aspect of practice where students follow the protocol taught at DUT. The participants generally avoided DN HRM, with some never approaching it at all and others being more selective in the muscles they avoided. None of the participants were willing to DN all the muscles considered to be high risk. The students involved in this study only practiced DN on HRM when given permission to do so and only felt confident in doing so if they had done so previously under guided supervision. When DN in general, but more so when considering HRM, participants indicated that they utilise bone bracketing, needle tangentially, use a pincer grip on the muscle, pay attention to the needle size they choose to use and make note of the relevant anatomy in the region. This is in keeping with guidelines for safe DN practice from the AHPCSA (2020).

This study also identified that when unable to DN a muscle, due to the risk involved, the participants utilised alternative treatment modalities or therapies. While the majority mentioned mostly manual therapies, some indicated the use of electrical modalities may be helpful, without considering that most muscles considered to be high risk may be contraindicated to treatment with those modalities. The commonly highlighted therapies included stretching (in its various forms) and soft tissue manipulation. Ischaemic compression was noted by all participants as an appropriate alternative to DN HRM.

5.3 STRENGTHS OF THE STUDY

The qualitative nature of this study produced rich data from participants regarding their experience of learning and practicing DN at DUT. There is currently no literature on this topic specifically and, as such, this study contributes new knowledge and can serve as a foundation for future research.

Research that was conducted at DUT by Ganesh (2017) highlighted the students' clinical experiences during the clinical practicum. Another study at DUT explored the experiences of the clinical instructor at DUT (Vogl 2018). However, this study focuses specifically on DN and, while it addresses some aspects of DN clinical education, there is also focus on the pre-clinic education. It also provides multiple insights on DN for

high-risk muscles. The qualitative nature of the interviews allowed participants to share their opinions on aspects of DN, into which the researcher may not have delved. The biggest strength of the study was the input of the student participants who shared invaluable insights of their first-hand experiences.

Other studies (Singh 2018) recognise indirect insights as a limitation in their research and make recommendations to include those directly involved in the study phenomenon. These participants also had at least a year of clinical experience, which equipped them to point out flaws that existed in the pre-clinic education and during the clinical practicum and even make recommendations for curriculum revision. Another strength of the study was the method of data collection. A qualitative interview was utilised rather than a questionnaire, which allowed participants to clarify when they did not understand, or the interviewer to reword the question if the participant misunderstood the question.

5.4 CHALLENGES AND LIMITATIONS OF THE STUDY

Upon reflection, the limitations and challenges of this study are listed below with suggestions for resolution if the study were to be conducted in the future:

- The researcher was inexperienced in the skill of interviewing which may have limited the depth of information and insight gained:
    - A pilot study, of 3 individual interviews, may have been sufficient practice, while also allowing the researcher to gain insight on what may be discussed during the interviews in the main data collection. This would have added value by enabling an edit of the interview schedule to add any topics that the researcher had not previously included.
- A small sample size, which is normal for qualitative research, but does not ensure generalizability of findings which may be necessary when advocating for any change in an educational setting, such as the curriculum in a university:
    - Increase the minimum sample size, which is necessary regardless of when data saturation is reached.
- Due to the Covid-19 pandemic resulting in clinic closure, only 6th and consecutive year master's students met the inclusion criteria for clinical

experience. Therefore, no first-time master's registration students (5th year) were included in this study.

- Conduct a similar study including either only first-time master's registration students or with the same inclusion criteria used for this study, but with the inclusion of 5th year students when purposeful sampling takes place.
- The grand tour question was too lengthy and caused confusion amongst participants, requiring repetition for clarity:
    - The grand tour question may be reworded to be more concise, excluding all non-essential information that does not contribute to the intended focus of the question. This needs to be worded for the benefit of the participant and their understanding, rather than to include all technicalities required for a thesis title.
    - The participants were not specifically questioned on the role of the clinicians in their DN education and as a result, not all participants commented on this aspect of the clinical education and those who did comment, were vague in their feedback. This is an important component of the clinical learning environment due to the intimate role the clinician plays in the supervision and teaching of DN, but also in the personal and professional growth of the students (Papastavrou *et al.* 2016; Chan, Tong and Henderson 2017). In a study by Ganesh (2017), chiropractic students expressed the value that clinicians' guidance adds during their clinical practicum. The inclusion of this line of enquiry would clarify if this were applicable to the dry needling component of the clinical practicum. Smedley and Morey (2010) showed that students considered a good relationship with the clinical educator to be the most important factor in the clinical learning environment.

5.5 RECOMMENDATIONS

These recommendations have been developed through the researcher's experience in the chiropractic programme and in conducting this research project, the investigation of reviewing the literature, and suggestions from participants in this study, as well addressing the shortcomings expressed by participants during the interview process.

5.5.1 For Future Research

Explorative research creates a baseline of ideas from which future research can develop (Maxwell 2012).

- Improvements can be made to the interview schedule:
  - Ask about high-risk muscles instead of high-risk regions to get more specific answers.
  - Enquire about the role of the clinician in the learning of dry needling at the DUT CDC. This was discussed by some participants but was not explored with all participants, as it was not the focus of the study and was not part of the interview schedule. The participants had varied responses on the topic.
  - Ask what other needling techniques the participant is aware of instead of asking what *dry* needling techniques the participant is aware of, to allow the participant to share their knowledge of wet needling.
- Each component of this study (knowledge, attitudes and practices) is large and can be explored separately and more completely in future research to add valuable knowledge to the existing literature, thereby using this study as a base to work from.
- A longitudinal study or qualitative research with recent DUT chiropractic graduates in practice may investigate their dry needling experiences once in practice and if it has resulted in more fine-tuned DN skill and confidence.
- Future research should focus on chiropractic education and clinical experiences from the students' perspective to gain insights that can help to enhance chiropractic education in South Africa and possibly patient outcomes as a result. It is important to create a repository of literature on the student experience to help guide the process of curriculum development in countries trying to start a chiropractic programme.
- A similar study can be conducted at the University of Johannesburg, within their chiropractic department, to compare the DN education between the two South African universities that offer a chiropractic programme. This can be of benefit to one or both universities should the data prove to be transferable in the South African context.

- This study can be done again at the DUT CDC as there has been curriculum revision and restructure which did not affect the participants of this study and, as such, this study does not reflect the dry needling education of the new curriculum. This study is only representative of the students involved in the curriculum at the time of the study. The findings of a similar study in the future can be compared to this study to determine if the shortcomings revealed in this study still exist.

5.5.2 For Dry Needling Education

- A literature-based, investigative assignment can be given to students at the start of the DN module to encourage students to gain an independent understanding of the physiology theories and practice styles that exist, so that they can know more than just what is taught in class.
- Start DN education earlier in the chiropractic programme to allow time for a reinforcement of knowledge in the master's years of study (Bruno, Ongaro and Fraser 2007) and more time for pre-clinic practical experience under supervision (Eyal and Cohen 2006).
- Students can be paired on rotation with a roster system to ensure the lecturer observes all students dry needling and being dry needled multiple times throughout the module and is able to advise the students, individually, on how to improve their technique. This will also help to expose students to multiple body types and prevent them from practicing on the same peers all the time.
- DN should be tested in a practical manner rather than an oral theory test. Students should be observed in the technique of needling and not just assessed on their ability to remember the theory behind it.
- An independent educational regulatory body that monitors more closely than an international accreditation board and uses the lecturer and subject evaluation forms completed by students to inform their objectives and recommendations may be introduced.
- DN teaching, for theory and practical components, should be based on current literature evidence rather than the subjective practice style of the lecturer.
- The 4th year mock patient programme can include a treatment component which takes place under direct supervision to ensure clinical competence and help with pre-clinic confidence. Ganesh (2017) reported on the dissatisfaction

of students with the mock patient programme which lacked a treatment or management component, which they suggested could be beneficial in an enhanced clinical experience. Ralph *et al.* (2008) found the real-life application of learnt skills to be beneficial.

- Standardize the note taking for DN in the clinic to ensure accurate recording of specific information that may be required in a malpractice case. This is considered best practice for qualified chiropractors and should be practiced from the university level. Standard care practices require all details to be noted (Gutheil 2004).
- Peer coaching can aid in DN learning in a clinical education setting, such as the DUT CDC, as it has been shown to be effective in nursing and medicine (Sevenhuysen *et al.* 2013). This can be through a mentorship programme where 6th and consecutive year mentors are rewarded with internship hours. A participant from this study noted the beneficial nature of this type of learning, which contributed to gaining knowledge and confidence in DN. Students often feel more comfortable approaching someone who is familiar to them, like a peer, to ask questions (Sole *et al.* 2012). A study conducted with physiotherapy students showed a 6% improvement in clinical academic achievement after peer coaching was used (Moore, Westwater-Wood and Kerry 2016).
- The rule on HRM at the DUT CDC may be replaced with a protocol for if a patient needs a HRM treated, and if the student suggests DN. Henzi *et al.* (2006) and Bray (2013) suggested that the inconsistencies and variability of having multiple clinicians with differing protocols was a negative aspect of clinical learning. As such, this should not be at the clinicians' discretion, as it can lead to bias and discrimination which can impact students' confidence and unfairly limit the exposure and learning for some students. Furthermore, a student who is refused the opportunity may feel belittled if another student was given permission to do so. Rowbotham and Owen (2015) suggested that clinical instructors who criticize or belittle students may hinder a student's clinical learning.
- More clinicians in the clinic may be necessary to provide the clinical support required for allowing students to DN HRM under supervision.

- A clinic orientation component of formalized training for 5th year students to reiterate the risks of DN and provide guidelines for safe practice as well as specialist training in the DN of HRM involving demonstration and practice. Holland, Middleton and Uys (2012) showed that student self-confidence increases when they observe the techniques of a qualified practitioner.
- The dry needling education for high-risk muscles may be formalized so that the knowledge and skill among students may be standardized.

5.5.3 For the Profession

- Ensure all practitioners are equally skilled in the minimal requirements to fulfil their scope of practice safely and competently and to avoid cases of malpractice and disrepute to the profession.

5.6 CONCLUSION TO THE STUDY

This chapter discussed the findings of this study in the context of the literature. While many parallels could be drawn, some findings contradicted the literature. The paucity of literature exploring the student experience, especially of DN, was made evident. The student experience is critical in the evaluation of the systems, processes, and curricula in education facilities. This study produced rich knowledge on this neglected topic and provides recommendations for future research in this field, as well as to improve the DN education at DUT and regulate DN among the chiropractic profession in South Africa.

This research study was aimed at describing the knowledge, attitudes, and practices of registered Master of Technology in Chiropractic students on the usage of dry needling during their clinical practicum. The findings of this study satisfied the research question by addressing the objectives detailed at the commencement of the study. The researcher pursued this outcome through a detailed review of the literature, the development of a research question that accurately framed the phenomenon to be studied, the creation of objectives that broke down the aim into logical components, a rigorous investigation into the phenomenon in question and a resultant extensive analysis and interpretation of the interview transcripts, with another close examination of the supporting and disconfirming literature.

The researcher chose a qualitative approach with an exploratory and descriptive design within an interpretive paradigm to best address the research question. The researcher demonstrated how the research aim was met through the objectives:

Objective one was to describe the knowledge of chiropractic master's students on the usage of dry needling. Participants' knowledge was seen to have an impact on their attitudes towards DN HRM and their practice in this regard. Students had a good knowledge of MFTPs, DN and HRM but lacked in their understanding of a latent TP, DN techniques not taught at DUT and how to DN most HRM. A good knowledge of anatomy and topographic anatomy is prevalent among participants and underpins their ability to DN safely. Despite the participants feeling ill-prepared to DN HRM, due to a lack of knowledge, they shared a good understanding of the techniques that are used to avoid injury.

Objective two was to describe the attitudes of chiropractic master's students towards the usage of dry needling. Participants' attitudes predispose them to specific behaviours and therefore dictates their practice style. An attitude of passive recipience existed, towards education and attaining knowledge, among students. Despite being apprehensive towards DN because of the invasive nature of the modality, the majority of the participants preferred DN for patients presenting with MFTPs due to its convenience and effectiveness. A generally negative attitude towards the pre-clinic DN education existed, stemming from feelings of anxiety and self-doubt caused by a lack of DN preparedness. This discontentment and lack of confidence was attributed to specific flaws addressed by the participants. Conversely, there was a generally positive attitude towards the clinical practicum, praised for its role in developing students' DN skills, knowledge and confidence. A very negative attitude can be attributed to the topic of HRM and the applicable DUT CDC rule. Students felt that they should be taught and encouraged to DN HRM so there would be no gaps in their knowledge which could prevent them from providing their patients with the best care in clinical practice. The participants seemed to base their list of HRM less on the DUT list, but more so on their own clinical judgement. The researcher attributed the inclusion of other muscles to a negative attitude towards HRM, which stems from the negative emotions and connotations imposed by the creation of a taboo, shaped by fear and causing avoidance. Despite feelings of preparedness for DN in clinical practice, the participants still maintained a negative attitude towards HRM due to their

feelings of being ill-prepared in this regard. The majority, however, shared their positive attitudes towards DN in clinical practice, with alternative treatment options for HRM.

Objective three was to describe the practices of chiropractic master's students in the technique of dry needling. Participants' practice of DN was majorly influenced by their knowledge of and attitude towards different aspects of DN. Participants chose direct treatment of MFTPs with DN as their modality of choice. Students practice safe DN, observing precautions such as checking for contra-indications to DN, practicing an aseptic technique, and ensuring they obtain patient consent. Participants practice deep DN, with a focus on eliciting a local twitch response, and very little consideration for duration in situ, which is taught at DUT. However, despite multiple insertion being taught at DUT, participants used either single or multiple insertion, based on the patient's needs. This may relate to the reason why some participants avoided DN new patients. The concern is that a less conservative approach may deter patients. Participants also avoided DN HRM, only doing it with permission and direct supervision or with a history thereof. No participant was willing to DN all HRM. Participants were well versed in the techniques that could be utilised to avoid patient injury. When unable to DN HRM, participants used manual therapies, most commonly ischaemic compression.

The findings of this study revealed that despite the flaws in the pre-clinic education, the clinical practicum and general precaution practiced at DUT provided students with adequate knowledge, skills and confidence to DN in clinical practice. Although the participants displayed fear and self-doubt about DN HRM, they seemingly have the ability to do so.

This study is a contribution of new knowledge to the scientific literature and offers a valuable perspective for the chiropractic profession, as it worked to describe the student's experience of DN at DUT. It highlighted aspects of students' knowledge, attitudes, and practices in this regard. This study is the first in this field of enquiry, and the qualitative nature allowed for rich data to be drawn. However, further investigation is required to validate and challenge the findings of this study and develop new knowledge. This study is specific to the chiropractic students who attended the Durban University of Technology.

REFERENCES

Adams, A. H. and Gatterman, M. 1997. The state of the art of research on chiropractic education. *The Journal of Manipulative and Physiological Therapeutics*, 20(3): 179-84.

Adams, J., Broom, A. and Jennaway, A. 2008. Qualitative methods in chiropractic research: one framework for future inquiry. *Journal of manipulative and physiological therapeutics*, 31(6): 455-460.

Affaitati, G., Costatini, R., Fabrizio, A., Lapenna, D., Tafuri, E. and Giamberardino, M. A. 2011. Effects of treatment of peripheral pain generators in fibromyalgia patients. *European Journal of Pain,* 15(1): 61-69.

Allied Health Professions Council of South Africa. 2020. *Safety Guidelines: Chiropractic and Osteopathy: Dry needling (Myofascial Trigger Point Therapy Using Fine Filament Needles).* Pretoria: Government Printer.

Alvarez, D.J. and Rockwell, P.G. 2002. Trigger points: Diagnosis and management. *American family physician,* 65(4): 653- 661.

American Physical Therapy Association. 2012. *Physical Therapists and the Performance of Dry Needling: An Educational Resource Paper*. Alexandria, VA. American Physical Therapy Association.

Audette, J.F., Wang, F. and Smith, H. 2004. Bilateral activation of motor unit potentials with unilateral needle stimulation of active myofascial trigger points. *American journal of physical medicine & rehabilitation,* 83(5), 368-374.

Austin, Z. and Sutton, J., 2014. Qualitative research: Getting started. *The Canadian journal of hospital pharmacy*, 67(6), 436- 440.

Australian Society of Acupuncture Physiotherapists. 2013. *Guidelines for safe Acupuncture and Dry needling Practice*. Available: https://www.dryneedling.com.au/wp-content/uploads/2016/01/ASAP_Guidelines_2013.pdf

Bachmann, S., Colla, F., Grobli, C., Mungo, G., Reilich, P. and Weissmann, R. 2014. *Swiss Guidelines for Safe Dry Needling*. Available: https://www.dryneedling.ch/fileadmin/documents/Swiss_Guidelines_for_safe_1.7_Dry_Needling_01.pdf

Bajaj, P., Bajaj, P., Graven-Nielsen, T. and Arendt-Nielsen, L. 2001. Trigger points in patients with lower limb osteoarthritis. *Journal of Musculoskeletal Pain*, 9(3): 17-33.

Bakhshialiabad, H., Bakhshi, H. and Hassanshahi, G. 2015. Students' perceptions of the academic environment in seven medical science courses based on DREEM. *Advances in Medical Education and Practice*, 6(2): 195- 203

Baldry, P. 1995. Superficial dry needling at myofascial trigger point sites. *Journal of Musculoskeletal pain*, 3(3): 117-126.

Baldry, P. 2002. Management of Myofascial Trigger Point Pain. *Acupuncture in medicine: Journal of the British Medical Acupuncture Society*, 20(1): 2-10.

Baldry, P. 2002. Superficial versus deep dry needling. *Acupuncture Medicine,* 20: 78-81.

Baldry, P.E. 1989. *Acupuncture, trigger points and musculoskeletal pain*. Edinburgh: Churchill Livingstone.

Banzai, R., Derby, D. C., Long, C. R. and Hondras, M. A. 2011. International web survey of chiropractic students about evidence-based practice: a pilot study. *Chiropractic & Manual Therapies*, 19(6): 1-9.

Baraz, S., Memarian, R. and Vanaki, Z. 2014. The diversity of Iranian nursing students' clinical learning styles: a qualitative study. *Nurse Education in Practice*, 14(5): 525-531.

Bassaw, B., Roff, S., McAleer, S., Roopnarinesingh, S., De Lisle, J., Teelucksingh, S. and Gopaul, S. 2003. Students' perspectives on the educational environment, Faculty of Medical Sciences, Trinidad. *Medical teacher*, 25(5): 522-526.

Bennett, P. and Murphy, S. 1997. *Psychology and Health Promotion*. Open University Press, Buckingham.

Benson, J., 2013. Evaluation of a Clinical Practicum Evaluation Tool to Address the Education to Practice Gap in Nursing. Doctoral dissertation, Kent State University.

Biella, G., Sotgiu, M.L., Pellegata, G., Paulesu, E., Castiglioni, I. and Fazio, F. 2001. Acupuncture produces central activations in pain regions. *Neuroimage*, 14(1): 60-66.

Biga, L.M., Dawson, S., Harwell, A., Hopkins, R., Kaufmann, J., LeMaster, M., Matern, P., Morrison-Graham, K., Quick, D. and Runyeon, J. (2019). *10.2 Skeletal Muscle*. Available: https://open.oregonstate.education/aandp/chapter/10-2-skeletal-muscle/.

Bowen, G. A. 2008. Naturalistic inquiry and the saturation concept: a research note. *Qualitative Research*, 8(1): 137-152.

Brady, S., McEvoy, J., Dommerholt, J. and Doody, C. 2014. Adverse events following trigger point dry needling: a prospective survey of chartered physiotherapists. *Journal of Manual and Manipulative Therapy*, 22(3): 134-140.

Braun, V. and Clarke, V. 2006. Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2): 77-101.

Braun, V. and Clarke, V. 2013. *Successful qualitative research*. Thousand Oaks, CA: Sage.

Brav, E.A. and Sigmond, H. 1941. The local and regional injection treatment of low back pain and sciatica. *Annals of Internal Medicine*, *15*(5): 840-852.

Bray, F. 2013. Student views on their early clinical learning experiences. PhD, Health Science Education, Stellenbosch University.

Brink, H., van der Walt, C. and van Rensburg, G. 2012*. Fundamentals of research methodology for healthcare professionals*. Cape Town: Juta.

Bruno, P., Ongaro, A. and Fraser, I. 2007. Long-term retention of material taught and examined in chiropractic curricula: its relevance to education and clinical practice. *The Journal of the Canadian Chiropractic Association*, 51(1): 14-16.

Butler, D.S. and Jones, M.A. 1991. *Mobilisation of the nervous system*. Amsterdam: Elsevier health sciences.

Calandre, E.P., Hidalgo, J., García-Leiva, J.M. and Rico-Villademoros, F. 2006. Trigger point evaluation in migraine patients: an indication of peripheral sensitization linked to migraine predisposition. *European journal of neurology*, *13*(3): 244-249.

Carcary, M. 2009. The Research Audit Trial - Enhancing trustworthiness in qualitative inquiry. *Electronic Journal of Business Research Methods*, 7(1): 11-23.

Carnes, D., Mullinger, B. and Underwood, M. 2010. Defining adverse events in manual therapies: a modified Delphi consensus study. *Manual therapy*, *15*(1): 2-6.

Casanueva, B., Rivas, P., Rodero, B., Quintial, C., Llorca, J., Gonzalez-Gay, M.A. 2013. Short-term improvement following dry needle stimulation of tender points in fibromyalgia. *Rheumatology International*, 34: 861-866.

Chan, M.W., Wu, X.Y., Wu, J.C., Wong, S.Y. and Chung, V.C. 2017. Safety of acupuncture: overview of systematic reviews. *Scientific reports*, *7*(1): 1-11.

Chan, Z., Tong, C. and Henderson, S. 2017. Power dynamics in the student-teacher relationship in clinical settings. *Nurse Education Today*, 49(1): 174-179.

Chen, J.T., Chung, K.C., Hou, C.R., Kuan, T.S., Chen, S.M. and Hong, C.Z. 2001. Inhibitory effect of dry needling on the spontaneous electrical activity recorded from myofascial trigger spots of rabbit skeletal muscle. *American journal of physical medicine & rehabilitation*, 80(10): 729-735.

Chou, R., Qaseem, A., Snow, V., Casey, D., Cross, J. T., Shekelle, P. and Owens, D. K. 2007. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. *Annals of Internal Medicine*, 147(7): 478-491.

Churchill, J.M. 1821. *Treatise on Acupuncturation, Being a Description of a Surgical Operation Originally Peculiar to the Japanese and Chinese, and by Them Denominated zin-king, Now Introduced into European Practice, with Directions for its Performance and Cases Illustrating its Success*. London: Simpkin Marshall Co.

Conn, J.J., Lake, F.R., McColl, G., Bilszta, J.L.C. and Woodward-Kron, R. 2012. Clinical teaching and learning: from theory and research to application. *The Medical Journal of Australia*, 190(8): 527.

Coon, D. and Mitterer, J. 2007. *Introduction to Psychology*. Belmont: Wadsworth

Copeman, W.S.C. and Burt, H.A. 1940. The treatment of muscular rheumatism by injection. *Postgraduate medical journal*, *16*(179): 293.

Couto, C., de Souza, I. C. C., Torres, I. L., Fregni, F. and Caumo, W. 2014. Paraspinal stimulation combined with trigger point needling and needle rotation for the treatment of myofascial pain: a randomized sham-controlled clinical trial. *The Clinical journal of pain*, 30 (3): 214-223.

Cranney, M., Warren, E., Barton, S., Gardner, K. and Walley, T. 2001. Why do GPs not implement evidence-based guidelines? A descriptive study*. Family Practice*, 18(4): 359-363.

Creswell, J. 2013. *Research design: qualitative and quantitative approaches*. Thousand Oaks, CA: Sage.

Cummings, M., Ross-Marrs, R. and Gerwin, R. 2014. Pneumothorax complication of deep dry needling demonstration. *Acupuncture in Medicine*, *32*(6): 517-519.

Cummings, T. M. and White, A. R. 2001. Needling therapies in the management of myofascial trigger point pain: a systematic review. *Archives of Physical Medicine and Rehabilitation*, 82 (7): 986-992.

Da Encarnação, A.P., Teixeira, J.N., Cruz, J.L. and Oliveira, J.E. 2014. Pneumothorax sustained during acupuncture training: a case report. Acupuncture in Medicine, 32(6): 514-516.

Daniels, J. M., Ishmael, T. and Wesley, R. M. 2003. Managing myofascial pain syndrome: sorting through the diagnosis and honing treatment. *The Physician and Sports medicine*, 31(10): 39-45.

Desai, M.J., Saini, V. and Saini, S. 2013. Myofascial pain syndrome: a treatment review. *Pain and therapy*, *2*(1): 21-36.

DiLorenzo, L., Traballesi, M., Morelli, D., Pompa, A., Brunelli, S., Buzzi, M.G. and Formisano, R. 2004. Hemiparetic shoulder pain syndrome treated with deep dry needling during early rehabilitation: a prospective, open-label, randomized investigation. *Journal of Musculoskeletal Pain*, *12*(2): 25-34.

Dommerholt, J. 2011. Dry needling—peripheral and central considerations. *Journal of Manual & Manipulative Therapy*, *19*(4): 223-227.

Dommerholt, J. and Fernández-de-las-Peñas, C. (2013) *Trigger point dry needling: an evidence and clinical-based approach*. London: Churchill Livingstone/Elsevier. Available: https://search.ebscohost.com/login.aspx?direct=true&AuthType=sso&db=cat08969a&AN=dut.ce89370f.24ed.4a6c.b7d1.996370c453e3&site=eds-live&scope=site (Accessed 2 August 2021).

Dommerholt, J. and Simons, D. G. 2008. Myofascial Pain Syndrome-Trigger Points. *Journal of Musculoskeletal Pain*, 16(3): 211-228.

Dommerholt, J., del Moral, O.M. and Grobli, C. 2006. Trigger Point Dry Needling. *The Journal of manual & manipulative therapy*, 14(4): 70E-87E.

Dornan, T., Boshuizen, H., King, N. and Scherpbier, A. 2007. Experience-based learning: a model linking the processes and outcomes of medical students' workplace learning. *Medical education*, 41(1): 84-91.

Dornan, T., Littlewood, S., Margolis, S.A., Scherpbier, A., Spencer, J. and Ypinazar, V. 2006. How can experience in clinical and community settings contribute to early medical education? A BEME systematic review. *Medical Teacher*, 1(2): 3-18.

Dunning, J., Butts, R., Mourad, F., Young, I., Flannagan, S. and Perreault, T. 2014. Dry needling: a literature review with implications for clinical practice guidelines. *Physical therapy reviews*, 19(4): 252-265.

Elliott, M. 2002. The clinical environment: a source of stress for undergraduate nurses. *The Australian Journal of Advanced Nursing, 20*(1).

Encyclopedia.lubopitko-bg.com. (n.d.). *Skeletal Muscles of the Body. Basic Principles of Skeletal Muscles*. Available: http://encyclopedia.lubopitko-bg.com/Skeletal_Muscles_of_the_Body.html.

Evans, N. 1994. *Experiential Learning for All*. London: Cassell Education.

Eyal, L. and Cohen, R. 2006. Preparation for clinical practice: a survey of medical students and graduates' perceptions of the effectiveness of their medical school curriculum. *Medical Teacher*, 28(6): 162-170.

Eyler, J. 2009. The power of experiential education. *Liberal Education*, 95(4): 72-81.

Fernández-Carnero, J., Binderup, A.T., Ge, H.Y., Fernandez-De-Las-Penas, C., Arendt-Nielsen, L. and Madeleine, P. 2010. Pressure pain sensitivity mapping in experimentally induced lateral epicondylalgia. *Medicine and science in sports and exercise*, 42(5): 922-927.

Findley, T., Chaudhry, H., Stecco, A. and Roman, M. 2012. Fascia research–a narrative review. *Journal of bodywork and movement therapies*, 16(1): 67-75.

Flick, U. 2009. *Designing qualitative research*. London: SAGE.

Fogelman, Y. and Kent, J. 2015. Efficacy of dry needling for treatment of myofascial pain syndrome. *Journal of Back and Musculoskeletal Rehabilitation*, 28(1): 173-179.

Freeman, M.D., Nystrom, A. and Centeno, C. 2009. Chronic whiplash and central sensitization: an evaluation of the role of a myofascial trigger points in pain modulation. *Journal of Brachial Plexus and Peripheral Nerve Injury*, 4(01): e13-e20.

Furlan, A. D., van Tulder, M., Cherkin, D., Tsukayama, H., Lao, L., Koes, B. and Berman, B. 2005. Acupuncture and dry needling for low back pain: an updated systematic review within the framework of the cochrane collaboration. *Spine*, 30(8): 944-963.

Gall, M.D., Gall, J.P. and Borg, W.R. 2003. *Education research: An introduction*. 7th ed. Boston: Pearson Education.

Ganesh, N. 2017. Clinical experiences of first-time registered master's chiropractic students during their clinical practicum. M.Tech. Chiropractic, Durban University of Technology.

Gaspersic, R., Koritnik, B., Eržen, I. and Sketelj, J. 2001. Muscle activity-resistant acetylcholine receptor accumulation is induced in places of former motor endplates in ectopically innervated regenerating rat muscles. *International Journal of Developmental Neuroscience*, 19(3): 339-346.

Ge, H.Y., Fernández-de-Las-Peñas, C. and Yue, S.W. 2011. Myofascial trigger points: spontaneous electrical activity and its consequences for pain induction and propagation. *Chinese medicine*, 6(1): 1-7.

Ge, H.Y., Nie, H., Madeleine, P., Danneskiold-Samsøe, B., Graven-Nielsen, T. and Arendt-Nielsen, L. 2009. Contribution of the local and referred pain from active myofascial trigger points in fibromyalgia syndrome. *PAIN*®, 147(1-3): 233-240.

Ge, H.Y., Wang, Y., Danneskiold-Samsøe, B., Graven-Nielsen, T. and Arendt-Nielsen, L. 2010. The predetermined sites of examination for tender points in fibromyalgia syndrome are frequently associated with myofascial trigger points. *The Journal of Pain*, 11(7): 644-651.

Ge, H.Y., Wang, Y., Fernández-de-las-Peñas, C., Graven-Nielsen, T., Danneskiold-Samsøe, B. and Arendt-Nielsen, L. 2011. Reproduction of overall spontaneous pain pattern by manual stimulation of active myofascial trigger points in fibromyalgia patients. *Arthritis research & therapy*, 13(2): 1-7.

George, S.Z., Wittmer, V.T., Fillingim, R.B. and Robinson, M.E. 2010. Comparison of graded exercise and graded exposure clinical outcomes for patients with chronic low back pain. *journal of orthopaedic & sports physical therapy*, 40(11): 694-704.

Gerwin, R.D. 2006. Treatment of myofascial pain syndrome. In: Boswell, M.V. and Cole, B.E. eds. *Weiner's pain management: a practical guide for clinicians*. 11th ed. Oxford: Routledge.

Gerwin, R.D. 2008. The taut band and other mysteries of the trigger point: an examination of the mechanisms relevant to the development and maintenance of the trigger point. *Journal of Musculoskeletal Pain*, 16(1-2): 115-121.

Gerwin, R.D., Dommerholt, J. and Shah, J.P. 2004. An expansion of Simons' integrated hypothesis of trigger point formation. *Current pain and headache reports*, *8*(6): 468-475.

Ghia, J.N., Mao, W., Toomey, T.C. and Gregg, J.M. 1976. Acupuncture and chronic pain mechanisms. *Pain*, *2*(3): 285-299.

Giamberardino, M.A., Tafuri, E., Savini, A., Fabrizio, A., Affaitati, G., Lerza, R., Di Ianni, L., Lapenna, D. and Mezzetti, A. 2007. Contribution of myofascial trigger points to migraine symptoms. *The Journal of pain*, *8*(11): 869-878.

Gifford, L.S. and Butler, D.S. 1997. The integration of pain sciences into clinical practice. *Journal of Hand Therapy*, 10(2): 86-95.

Grieve, R., Clark, J., Pearson, E., Bullock, S., Boyer, C. and Jarrett, A. 2011. The immediate effect of soleus trigger point pressure release on restricted ankle joint dorsiflexion: A pilot randomised controlled trial. *Journal of bodywork and movement therapies*, 15(1): 42-49.

Guest, G., Namey, E. and Mitchell, M. 2013. *Collecting qualitative data: a field manual for applied research*. Thousand Oaks, CA: Sage.

Gunn, C.C. 1997. Radiculopathic pain: diagnosis and treatment of segmental irritation or sensitization. *Journal of Musculoskeletal Pain*, *5*(4): 119-134.

Gutheil, T.G. 2004. Fundamentals of medical record documentation. *Psychiatry (Edgmont)*, 1(3): 26-28.

Habbal, O.A., El-Mardi, A.E. and Inuwa, I. 2007. The Preclinical-Clinical Divide: Building Bridges. *Sultan Qaboos University Medical Journal*, 7(2): 97- 103.

Halle, J.S. and Halle, R.J. 2016. Pertinent dry needling considerations for minimizing adverse effects–part one. *International journal of sports physical therapy*, *11*(4): 651.

Halle, J.S. and Halle, R.J. 2016. Pertinent dry needling considerations for minimizing adverse effects–part two. *International journal of sports physical therapy*, *11*(5): 810.

Hancock, B., Ockleford, E. and Windridge, K. 2007. *An introduction to qualitative research*. Yorkshire and Humber: The National Institute for Health Research Design.

Hart, H. and Rothem, A. 1995. The clinical learning environment: nurses' perceptions of professional development. *Nurse Education Today*, 15(1): 3- 10.

Harte, S.E., Harris, R.E. and Clauw, D.J. 2018. The neurobiology of central sensitization. *Journal of Applied Biobehavioral Research*, 23(2): 12137.

Henzi, D., Davis, E., Jasinevicius, R. and Hendricson, W. 2006. North American dental students' perspectives about their clinical education. *Journal of Dental Education*, 70(4):361-377.

Hidalgo-Lozano, A., Fernández-de-las-Peñas, C., Alonso-Blanco, C., Ge, H.Y., Arendt-Nielsen, L. and Arroyo-Morales, M. 2010. Muscle trigger points and pressure pain hyperalgesia in the shoulder muscles in patients with unilateral shoulder impingement: a blinded, controlled study. *Experimental brain research*, 202(4): 915-925.

Hodges, P.W. and Tucker, K. 2011. Moving differently in pain: a new theory to explain the adaptation to pain. *Pain*, 152(3): S90-S98.

Hodgetts, S., Hollis, V., Triska, O., Dennis, S., Madill, H. and Taylor, E. 2007. Occupational Therapy students‟ and graduates‟ satisfaction with professional education and preparedness for practice. *SAGE Journals*, 74(3): 148-160.

Holland, K., Middleton, L. and Uys, B. 2012. The sources of professional confidence in occupational therapy students. *South African Journal of Occupational Therapy*, 42(3): 19-25.

Honet, J.E., Honet, J.C. and Cascade, P. 1986. Pneumothorax after electromyographic electrode insertion in the paracervical muscles: case report and radiographic analysis. *Archives of physical medicine and rehabilitation*, 67(9): 601-603.

Hong, C.Z. 1994. Considerations and recommendations regarding myofascial trigger point injection. *Journal of Musculoskeletal Pain*, 2(1): 29-59.

Hong, C.Z. and Simons, D.G. 1998. Pathophysiologic and electrophysiologic mechanisms of myofascial trigger points. *Archives of physical medicine and rehabilitation*, 79(7): 863-872.

Hong, C.Z. and Torigoe, Y. 1994. Electrophysiological characteristics of localized twitch responses in responsive taut bands of rabbit skeletal muscle fibers. *Journal of Musculoskeletal Pain*, 2(2): 17-43.

Hong, C.Z., Chen, Y.N., Twehous, D. and Hong, D.H. 1996. Pressure threshold for referred pain by compression on the trigger point and adjacent areas. *Journal of Musculoskeletal Pain*, 4(3): 61-79.

Hong, C.Z., Kuan, T.S., Chen, J.T. and Chen, S.M. 1997. Referred pain elicited by palpation and by needling of myofascial trigger points: a comparison. *Archives of physical medicine and rehabilitation*, 78(9): 957-960.

Hong, C.Z., Torigoe, Y. and Yu, J. 1995. The localized twitch responses in responsive taut bands of rabbit skeletal muscle fibers are related to the reflexes at spinal cord level. *Journal of Musculoskeletal Pain*, 3(1): 15-33.

Hopkins, P.M. 2006. Skeletal muscle physiology. *Continuing Education in Anaesthesia, Critical Care & Pain*, 6(1): 1-6.

Houghton, C., Casey, D., Shaw, D. and Murphy. K. 2013. Rigour in qualitative case study research*. Nurse researcher*, 20(4): 12-17.

Hoyle, J.A., Marras, W.S., Sheedy, J.E. and Hart, D.E. 2011. Effects of postural and visual stressors on myofascial trigger point development and motor unit rotation during computer work. *Journal of electromyography and kinesiology*, 21(1): 41-48.

Hsieh, J.C., Belfrage, M., Stone-Elander, S., Hansson, P. and Ingvar, M. 1995. Central representation of chronic ongoing neuropathic pain studied by positron emission tomography. *PAIN*®, 63(2): 225-236.

Hsieh, J.C., Tu, C.H., Chen, F.P., Chen, M.C., Yeh, T.C., Cheng, H.C., Wu, Y.T., Liu, R.S. and Ho, L.T. 2001. Activation of the hypothalamus characterizes the acupuncture stimulation at the analgesic point in human: a positron emission tomography study. *Neuroscience letters*, 307(2): 105-108.

Hsieh, Y.L., Kao, M.J., Kuan, T.S., Chen, S.M., Chen, J.T. and Hong, C.Z. 2007. Dry needling to a key myofascial trigger point may reduce the irritability of satellite MTrPs. *American journal of physical medicine & rehabilitation*, 86(5): 397-403.

Hui, K.K., Liu, J., Makris, N., Gollub, R.L., Chen, A.J., I. Moore, C., Kennedy, D.N., Rosen, B.R. and Kwong, K.K. 2000. Acupuncture modulates the limbic system and subcortical gray structures of the human brain: evidence from fMRI studies in normal subjects. *Human brain mapping*, 9(1): 13-25.

Hunt, D. P., and Hassmén, P. 1994. Human self-assessment in multiple-choice testing. *Journal of educational measurement*, 31(2): 149-160.

Ijaz, N. and Boon, H. 2019. Evaluating the international standards gap for the use of acupuncture needles by physiotherapists and chiropractors: A policy analysis. *PloS one*, 14(12): e0226601.

Irish Society of Chartered Physiotherapists. 2012. Guidelines for dry needling practice. Available: https://www.colfisiocv.com/sites/default/files/Guidelines%20for%20Dry%20Needling%20Practice%20ISCP%202012.pdf

Itoh, K., Katsumi, Y. and Kitakoji, H. 2004. Trigger point acupuncture treatment of chronic low back pain in elderly patients–a blinded RCT. *Acupuncture in Medicine*, 22(4): 170-177.

Itoh, K., Katsumi, Y., Hirota, S. and Kitakoji, H. 2007. Randomised trial of trigger point acupuncture compared with other acupuncture for treatment of chronic neck pain. *Complementary Therapies in Medicine*, 15(3): 172-179.

Jackson, J. 2005. Assessing Intercultural Learning through Introspective Accounts. *Frontiers: The interdisciplinary journal of study abroad*, 11:165-186.

Jarrell, J. 2004. Myofascial dysfunction in the pelvis. *Current pain and headache reports*, 8(6): 452-456.

Jensen, M.P., Fishman, S.M., Ballantyne, J.C. and Rathmell, J.P. 2010. *Bonica's management of pain*. Baltimore: Lippincott, Williams and Williams.

Joolaee, S., Amiri, S.R.J. and Farahani, M.A. 2015. Iranian nursing students' preparedness for clinical training: A qualitative study. *Nurse Education Today*, 35(10): e13-e17.

Kalichman, L. and Vulfsons, S. 2010. Dry needling in the management of musculoskeletal pain. *Journal of the American Board of Family Medicine*, 23(5): 640-646.

Kaneko, S. and Momino, K. 2015. Stress factors and coping behaviors in nursing students during fundamental clinical training in Japan. *International Journal of Nursing and Clinical Practice*, 2(138): 2.

Kassardjian, C. D., O'gorman, C. M. and Sorenson, E. J. 2016. The risk of iatrogenic pneumothorax after electromyography. *Muscle & nerve*, 53(4): 518-521.

Kellgren, J.H. 1938. Referred pains from muscle. *British medical journal*, 1(4023): 325.

Kelly, M. 1941. The treatment of fibrositis and allied disorders by local anaesthesia. *Medical journal of Australia*, 1(10): 294-298.

Kietrys, D.M., Palombaro, K.M., Azzaretto, E., Hubler, R., Schaller, B., Schlussel, J.M. and Tucker, M. 2013. Effectiveness of dry needling for upper-quarter myofascial pain: a systematic review and meta-analysis. *Journal of orthopaedic & sports physical therapy*, 43(9): 620-634.

Kuan, T.S., Hsieh, Y.L., Chen, S.M., Chen, J.T., Yen, W.C. and Hong, C.Z. 2007. The myofascial trigger point region: correlation between the degree of irritability and the prevalence of endplate noise. *American journal of physical medicine & rehabilitation*, 86(3): 183-189.

Kumar, S. 2014. *Sampling and its types*. Research scholar. [Online]. Available: www.slideshare.net

Landers, M.G. 2001. The theory-practice gap in nursing: The role of the nurse teacher. *Journal of Advanced Nursing*, 32(6): 1150-1156.

Lari, A.Y., Okhovatian, F., sadat Naimi, S. and Baghban, A.A. 2016. The effect of the combination of dry needling and MET on latent trigger point upper trapezius in females. *Manual therapy*, 21:204-209.

Lavelle, E. D., Lavelle, W. and Smith, H. S. 2007. Myofascial Trigger Points. *Anesthesiology Clinics*, 25(4): 841-851.

Legge, D. 2014. A history of dry needling. *Journal of Musculoskeletal Pain*, 22(3): 301-307.

Lewit, K. 1979. The needle effect in the relief of myofascial pain. *Pain*, 6(1): 83-90.

Liboff, A.R. 1997. Bioelectromagnetic fields and acupuncture. *The Journal of Alternative and Complementary Medicine*, 3(supplement 1): s-77.

Lincoln, Y.S. and Guba, E.G. 1985. *Naturalistic inquiry*. Thousand Oaks, CA.: Sage.

Linda, B., Suzanne, S., Debbie, C., Christine, C. and Fiona, W. 2016. Member Checking: A tool to enhance trustworthiness or merely a nod to validation? *Qualitative Health Research*, 26(13): 1802-1811.

Lindsay, J. 2010. Healthy living guidelines and the disconnect with everyday life. *Critical Public Health*, 20(4): 475-487.

Longo, M.R., Iannetti, G.D., Mancini, F., Driver, J. and Haggard, P. 2012. Linking pain and the body: neural correlates of visually induced analgesia. *Journal of Neuroscience*, 32(8): 2601-2607.

Lucas, K.R., Polus, B.I. and Rich, P.A. 2004. Latent myofascial trigger points: their effects on muscle activation and movement efficiency. *Journal of bodywork and movement therapies*, 8(3): 160-166.

Lucas, K.R., Rich, P.A. and Polus, B.I. 2010. Muscle activation patterns in the scapular positioning muscles during loaded scapular plane elevation: the effects of latent myofascial trigger points. *Clinical Biomechanics*, 25(8): 765-770.

Lund, I. and Lundeberg, T. 2006. Are minimal, superficial or sham acupuncture procedures acceptable as inert placebo controls? *Acupuncture in medicine*, 24(1): 13-15.

Lundeberg, T. and Stener-Victorin, E. 2002. Is there a physiological basis for the use of acupuncture in pain? In *International congress series*, 1238: 3-10. Amsterdam: Elsevier.

MacIntosh, B.R., Gardiner, P.F. and McComas, A.J. 2006. *Skeletal muscle: form and function*. Champaign, IL.: Human Kinetics.

Mason, S.L. 2006. Radiography student perceptions of clinical stressors. *Radiologic Technology*, 77(6): 437-450.

Matveev, A.V. 2002. The advantages of employing quantitative and qualitative methods in intercultural research: Practical implications from the study of the perceptions of intercultural communication competence by American and Russian managers. *Theory of Communication and Applied Communication*, 1(1): 59-67.

Maxwell, J. 2012. *Qualitative research design: an interactive approach*. 3rd ed. Thousand Oaks, CA: Sage.

Mayoral del Moral, O. 2005. Fisioterapia invasiva del síndrome de dolor miofascial. *Fisioterapia (Madr., Ed. impr.)*: 69-75.

Mayoral, O. and Torres, R. 2003. Tratamiento conservador y fisioterápico invasivo de los puntos gatillo miofasciales [Spanish: Conservative treatment and invasive physical therapy of myofascial trigger points]. *Patología de partes blandas en el hombro*.

McCutcheon, L. and Yelland, M. 2011. Iatrogenic pneumothorax: safety concerns when using acupuncture or dry needling in the thoracic region. *Physical therapy reviews*, 16(2): 126-132.

McLenon, J. and Rogers, M.A. 2019. The fear of needles: A systematic review and meta-analysis. *Journal of advanced nursing*, 75(1): 30-42.

Melzack, R. 1981. Myofascial trigger points: relation to acupuncture and mechanisms of pain. *Archives of physical medicine and rehabilitation*, 62(3): 114-117.

Melzack, R. 2001. Pain and the neuromatrix in the brain. *Journal of dental education*, 65(12): 1378-1382.

Mense, S. 2010. How do muscle lesions such as latent and active trigger points influence central nociceptive neurons? *Journal of Musculoskeletal Pain*, 18(4): 348-353.

Mense, S. and Gerwin, R.D. eds. 2010. *Muscle pain: diagnosis and treatment*. Berlin: Springer Science & Business Media.

Mense, S. and Masi, A.T. 2010. Increased muscle tone as a cause of muscle pain. *Muscle pain: understanding the mechanisms*: 207-249. Berlin: Springer.

Mense, S., 2010. Functional anatomy of muscle: muscle, nociceptors and afferent fibers. *Muscle pain: understanding the mechanisms*: 17-48. Berlin: Springer.

Merriam, S. and Tisdell, E. 2016. *Qualitative research*. 4th ed. San Francisco, CA.: Jossey-Bass.

Milton, C. R. 1981. *Human behaviour in organization*. Englewood Cliffs: Prentice-Hall.

Mohr, C., Binkofski, F., Erdmann, C., Büchel, C. and Helmchen, C. 2005. The anterior cingulate cortex contains distinct areas dissociating external from self-administered painful stimulation: a parametric fMRI study. *Pain*, 114(3): 347-357.

Moore, C., Westwater-Wood, S. and Kerry, R. 2016. Academic performance and perception of learning following a peer coaching teaching and assessment strategy. *Advances in Health Sciences Education*, 21(1): 121-130.

Morgan, W.E. and Morgan, C.P. 2006. “Iron Sharpens Iron”: Experiential Learning Strategies in Chiropractic Education. *Journal of Chiropractic Humanities*, 13: 21-26.

Moseley, G.L. 2003. A pain neuromatrix approach to patients with chronic pain. *Manual therapy*, 8(3): 130-140.

Moseley, G.L. 2012. Teaching people about pain: why do we keep beating around the bush? *Pain management*, 2(1): 1-3.

Mrozek, J. P., Till, H., Taylor-Vaisey, A. L. and Wickes, D. 2006. Research in chiropractic education: an update. *Journal of Manipulative and Physiological Therapeutics,* 29(9): 762- 773.

Naidoo, D. 2018. The knowledge, attitudes, perceptions and perceived barriers of chiropractors within the eThekwini municipality towards evidence-based practice. M.Tech. Chiropractic, Durban University of Technology.

Neal, B.S. and Longbottom, J. 2012. Is there a role for acupuncture in the treatment of tendinopathy? *Acupuncture in Medicine*, *30*(4): 346-349.

Niddam, D.M., Chan, R.C., Lee, S.H., Yeh, T.C. and Hsieh, J.C. 2007. Central modulation of pain evoked from myofascial trigger point. *The Clinical journal of pain*, *23*(5): 440-448.

Niddam, D.M., Chan, R.C., Lee, S.H., Yeh, T.C. and Hsieh, J.C. 2008. Central representation of hyperalgesia from myofascial trigger point. *Neuroimage*, 39(3): 1299-1306.

Nijs, J., Van Houdenhove, B. and Oostendorp, R.A. 2010. Recognition of central sensitization in patients with musculoskeletal pain: application of pain neurophysiology in manual therapy practice. *Manual therapy*, 15(2): 135-141.

Nyman, T., Grooten, W.J.A., Wiktorin, C., Liwing, C., and Norrman, L. 2007. Sickness absence and concurrent low back and neck–shoulder pain: results from the MUSIC-Norrtälje study. *European spine journal*, 16(5): 631-638.

O'Donnell, C. A. 2004. Attitudes and knowledge of primary care professionals towards evidence-based practice: a postal survey. *Journal of Evaluation in Clinical Practice*, 10(2): 197-205.

Olausson, H., Lamarre, Y., Backlund, H., Morin, C., Wallin, B.G., Starck, G., Ekholm, S., Strigo, I., Worsley, K., Vallbo, Å.B. and Bushnell, M.C. 2002. Unmyelinated tactile afferents signal touch and project to insular cortex. *Nature neuroscience*, 5(9): 900-904.

Osborne, N.J. and Gatt, I.T. 2010. Management of shoulder injuries using dry needling in elite volleyball players. *Acupuncture in medicine*, 28(1): 42-45.

Palmgren, P.J. and Bolander-Laksov, K. 2015. Exploring chiropractic students" experiences of the educational environment in healthcare professional training: a quantitative study. *BMC Medical Education*, 15(3): 128- 135.

Palmgren, P.J. and Chandratilake, M. 2011. Perception of educational environment among undergraduate students in a chiropractic training institution. *Journal of Chiropractic Education*, 25(2): 151-163.

Palmgren, P.J., Sundberg, T. and Laksov, K.B. 2015. Reassessing the educational environment among undergraduate students in a chiropractic training institution: A study over time. *Journal of Chiropractic Education*, 29(2): 110-126.

Papastavrou, E., Dimitriadou, M., Tsangari, H. and Andreou, C. 2016. Nursing students" satisfaction of the clinical learning environment: a research study. *BMC Nursing*, 15(44): 1-10.

Paulett, J.D. 1947. Low back pain. *Lancet*, 2: 272–276.

Pearcey, P. and Elliot, B. 2004. Student impressions of clinical nursing. *Nurse Education Today*, 24(2): 382-387.

Perez-Palomares, S., Oliván-Blázquez, B., Magallón-Botaya, R., De-la-Torre-Beldarrain, M.L., Gaspar-Calvo, E., Romo-Calvo, L., Garcia-Lazaro, R. and Serrano-Aparicio, B. 2010. Percutaneous electrical nerve stimulation versus dry needling: effectiveness in the treatment of chronic low back pain. *Journal of musculoskeletal pain*, 18(1): 23-30.

Peterson, M. and Betchel, A. 2000. Combining the arts: An applied critical thinking approach in the skills laboratory. *Nursing Connections*, 13(2): 43-49.

Peyron, R., Garcıa-Larrea, L., Gregoire, M.C., Convers, P., Richard, A., Lavenne, F., Barral, F.G., Mauguiere, F., Michel, D. and Laurent, B. 2000. Parietal and cingulate processes in central pain. A combined positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) study of an unusual case. *Pain*, *84*(1): 77-87.

Polit, D. and Beck, C. 2012. *Nursing research: generating and assessing evidence for nursing practice*. 9th ed. Philadelphia, PA.: Lippincott, Williams & Wilkins.

Polit, D. and Hungler, B. 1999. *Nursing Research: Principles and Methods*. 6th ed. Philadelphia, PA.: Lippincott, Williams & Wilkins.

Porter, J., Morphet, J. and Raymond, A. 2013. Preparation for high-acuity clinical placement: confidence levels of final-year nursing students*. Advances in Medical Education and Practice*, 4(1): 83-89.

Proctor, M. 2001. Measuring attitudes. In: Gilbert, N. *Researching Social Life*. 2nd ed. London: Sage.

Rachlin, E. S. 1994. *Myofascial pain and fibromyalgia: Trigger point management*. St. Louis: Mosby.

Radcliffe, C. and Lester, H. 2003. Perceived stress during undergraduate medical training: a qualitative study. *Medical Education*, 37(1): 32-38.

Ralph, E., Walker, K., Randolph, W. 2009. Practicum and clinical experiences: Post practicum students‟ views. *Journal of Nursing Education*, 48(8): 434-440.

Ralph, E.G., Walker, K. and Wimmer, R. 2008. The clinical practicum experience in professional preparation: Preliminary findings. *McGill Journal of Education*, 43(2): 157-172.

Retsas, A. 2000. Barriers to using research evidence in nursing practice. *Journal of Advanced Nursing*, 31(3): 599-606.

Rha, D.W., Park, G.Y., Kim, Y.K., Kim, M.T. and Lee, S.C. 2013. Comparison of the therapeutic effects of ultrasound-guided platelet-rich plasma injection and dry needling in rotator cuff disease: a randomized controlled trial. *Clinical rehabilitation*, *27*(2): 113-122.

Rha, D.W., Shin, J.C., Kim, Y.K., Jung, J.H., Kim, Y.U. and Lee, S.C. 2011. Detecting local twitch responses of myofascial trigger points in the lower-back muscles using ultrasonography. *Archives of physical medicine and rehabilitation*, *92*(10): 1576-1580.

Ritchie, J., Lewis, J. and Elam, G. 2003. Designing and selecting samples. London: Sage. Qualitative research practice: A guide for social science students and researchers: 77-108.

Robbertze, J. 2018. Perceptions, expectations and experiences of first- time chiropractic patients when consulting chiropractic students at a teaching clinic in KwaZulu-Natal. M.Tech. Chiropractic, Durban University of Technology.

Rotthoff, T., Schneider, M., Ritz-Timme, S. and Windolf, J. 2015. Theory in practice instead of theory versus practice–curricular design for task-based learning within a competency- oriented curriculum. *GMS Zeitschrift für Medizinische Ausbildung*, 32(1).

Rowbotham, M. and Owen, R. M. 2015. The effect of clinical nursing instructors on student self-efficacy. *Nurse Education in Practice*, 15(6): 561-566.

Rozenfeld, E., Sapoznikov Sebakhutu, E., Krieger, Y. and Kalichman, L. 2020. Dry needling for scar treatment. *Acupuncture in Medicine*, 38(6): 435-439.

Sand, J.N., Elison-Bowers, P., Wing 2nd, T.J. and Kendrick, L. 2014. Experiential learning and clinical education. *Academic Quarterly Exchange*, 18(4):1-7.

Sawamoto, N., Honda, M., Okada, T., Hanakawa, T., Kanda, M., Fukuyama, H., Konishi, J. and Shibasaki, H. 2000. Expectation of pain enhances responses to nonpainful somatosensory stimulation in the anterior cingulate cortex and parietal operculum/posterior insula: an event-related functional magnetic resonance imaging study. *Journal of Neuroscience*, 20(19): 7438-7445.

Sevenhuysen, S., Nickson, W., Farlie, M., Raitman, L. and Keating, J. 2013. The development of a peer assisted learning model for clinical education of physiotherapy students. *Journal of Peer Learning*, 6(1).

Shah, J.P. and Gilliams, E.A. 2008. Uncovering the biochemical milieu of myofascial trigger points using in vivo microdialysis: an application of muscle pain concepts to myofascial pain syndrome. *Journal of bodywork and movement therapies*, 12(4): 371-384.

Shah, J.P., Danoff, J.V., Desai, M.J., Parikh, S., Nakamura, L.Y., Phillips, T.M. and Gerber, L.H. 2008. Biochemicals associated with pain and inflammation are elevated in sites near to and remote from active myofascial trigger points. *Archives of physical medicine and rehabilitation*, 89(1): 16-23.

Shah, J.P., Phillips, T., Danoff, J.V. and Gerber, L.H. 2003. A novel microanalytical technique for assaying soft tissue demonstrates significant quantitative biochemical differences in 3 clinically distinct groups: normal, latent, and active. 1. *Archives of Physical Medicine and Rehabilitation*, 84(9): E4.

Shah, J.P., Phillips, T.M., Danoff, J.V. and Gerber, L.H. 2005. An in vivo microanalytical technique for measuring the local biochemical milieu of human skeletal muscle. *Journal of applied physiology*, 99(5): 1977-1984.

Sharif, F. and Masoumi, S. 2005. A qualitative study of nursing student experiences of clinical practice. *BMC nursing*, 4(1): 1-7.

Simons, D.G. 1993. Janet G. Travell, MD. *Journal of Musculoskeletal Pain*, 1(1): 17-22.

Simons, D.G. and Mense, S. 1998. Understanding and measurement of muscle tone as related to clinical muscle pain. *Pain*, 75(1): 1-17.

Simons, D.G., Travell, J.G. and Simons, L.S. 1999. *Travell & Simons' myofascial pain and dysfunction: upper half of body* (Vol. 1). Philadelphia, Penn.: Lippincott Williams & Wilkins.

Singh, C. 2018. An Exploratory Study of Spiritually Based Healing Interventions in a Child and Youth Care Context. M.Tech. Chiropractic, Durban University of Technology. Available: http://hdl.handle.net/10321/3312

Skovholt, T.M. and Ronnestad, M.H. 2003. Struggles of novice counsellor and therapists, *Journal of Career Development*, 30(1): 45-58.

Smedley, A. and Morey, P. 2010. Improving learning in the clinical nursing environment: perceptions of senior Australian bachelor of nursing students. *Journal of Research in Nursing*, 15(1).

Sole, G., Rose, A., Bennett, T., Jaques, K. and Rippon, Z. 2012. A student experience of peer assisted study sessions in physiotherapy. *Journal of Peer Learning*, 5(1).

South African Society of Physiotherapists. 2017. *Minimum Standards on Dry Needling for Physiotherapists in South Africa*. Available: http://dryneedling.co.za/wp-content/uploads/2018/02/Minimum-Standards-for-Dry-Needling-in-SA_Rev-0_Jan-2017.pdf

Speed, C.A. 2003. Injection therapies for soft-tissue disorders. *Best Practice & Research Clinical Rheumatology*, 17(1): 167-181.

Speed, C.A., 2007. Injection therapies for soft-tissue lesions. *Best Practice & Research Clinical Rheumatology*, 21(2): 333-347.

Srbely, J. Z. 2010. New trends in the treatment and management of myofascial pain syndrome. *Current Pain and Headache Reports*, 14(5): 346-352.

Srbely, J.Z., Dickey, J.P., Lee, D. and Lowerison, M. 2010. Dry needle stimulation of myofascial trigger points evokes segmental anti-nociceptive effects. *Journal of rehabilitation medicine*, 42(5): 463-468.

Stecco, C., Macchi, V., Porzionato, A., Duparc, F. and De Caro, R. 2011. The fascia: the forgotten structure. *The Fascia: The Forgotten Structure*: 127-138.

Steindler, A. 1940. The interpretation of sciatic radiation and the syndrome of low-back pain. *JBJS*, *22*(1): 28-34.

Svensson, P., Minoshima, S., Beydoun, A., Morrow, T.J. and Casey, K.L. 1997. Cerebral processing of acute skin and muscle pain in humans. *Journal of neurophysiology*, 78(1): 450-460.

Tagami, R., Moriya, T., Kinoshita, K. and Tanjoh, K. 2013. Bilateral tension pneumothorax related to acupuncture. *Acupuncture in Medicine*, 31(2): 242-244.

Takeshige, C., Kobori, M., Hishida, F., Luo, C.P. and Usami, S. 1992. Analgesia inhibitory system involvement in nonacupuncture point-stimulation produced analgesia. *Brain research bulletin*, 28(3): 379-391.

Talberg, H. and Scott, D. 2014. Do physiotherapy students perceive that they are adequately prepared to enter clinical practice? An empirical study. *African Journal of Health Professions Education*, 6(1): 17-22.

Teddlie, C. and Tashakkori, A. 2003. Issues and Dilemma in Teaching Research Methods Courses in Social and Behavioural Sciences: US Perspective. *International Journal of Social Research Methodology*, 6(1): 61-77.

Tekin, L., Akarsu, S., Durmuş, O., Çakar, E., Dinçer, Ü. and Kıralp, M.Z. 2013. The effect of dry needling in the treatment of myofascial pain syndrome: a randomized double-blinded placebo-controlled trial. *Clinical rheumatology*, 32(3): 309-315.

Terre Blanche, M., Durrheim, K. and Painter, D. 2006. *Research in practice: applied methods for the social sciences*. 2nd ed. Cape Town, South Africa: University of Cape Town Press.

Tortora, G.J. and Derrickson, B. 2009. *Principles of anatomy and physiology*. Hoboken, NJ.: John Wiley & Sons.

Tough, E. A., White, A. R., Cummings, T. M., Richards, S. H. and Campbell, J. L. 2009. Acupuncture and dry needling in the management of myofascial trigger point pain: a systematic review and meta-analysis of randomised controlled trials. *European Journal of Pain*, 13(1): 3-10.

Travell, J. and Rinzler, S.H. 1952. The myofascial genesis of pain. *Postgraduate medicine*, 11(5): 425-434.

TRAVELL, J., RINZLER, S. and HERMAN, M. 1942. Pain and disability of the shoulder and arm: treatment by intramuscular infiltration with procaine hydrochloride. *Journal of the American Medical Association*, 120(6): 417-422.

Travell, J.G. and Simons, D.G. 1983. *Myofascial pain and dysfunction: the trigger point manual* (Vol. 2). Philadelphia, Penn.: Lippincott Williams & Wilkins.

Tsai, C.T., Hsieh, L.F., Kuan, T.S., Kao, M.J., Chou, L.W. and Hong, C.Z. 2010. Remote effects of dry needling on the irritability of the myofascial trigger point in the upper trapezius muscle. *American Journal of Physical Medicine & Rehabilitation*, 89(2): 133-140.

Unverzagt, C., Berglund, K. and Thomas, J. 2015. Dry needling for myofascial trigger point pain: a clinical commentary. *International journal of sports physical therapy*, 10(3): 402.

Vecchiet, L., Giamberardino, M.A., Dragani, L., De Bigontina, P. and Albe-Fessard, D. 1990. Latent myofascial trigger points: changes in muscular and subcutaneous pain thresholds at trigger point and target level. *J Manual Medicine*, 5: 151-154.

Veerapen, K. and McAleer, S. 2010. Students' perception of the learning environment in a distributed medical programme. *Medical education online*, 15(1): 5168.

Vernon, H. and Schneider, M. 2009. Chiropractic management of myofascial trigger points and myofascial pain syndrome: a systematic review of the literature. *Journal of manipulative and physiological therapeutics*, 32(1): 14-24.

Vizniak, N.A. 2011. Quick reference evidence based muscle manual. Available: https://prohealthsys.com/products/digital/Web%20Sample%20MM.pdf.

Vogl, E. 2018. Clinical instructor's experiences of clinical education at a Chiropractic teaching clinic in KwaZulu-Natal. M.Tech. Chiropractic, Durban University of Technology.

Vulfsons, S., Ratmansky, M. and Kalichman, L. 2012. Trigger point needling: techniques and outcome. *Current pain and headache reports*, 16(5): 407-412.

Walker, A., Yong M., Pang, L. and Fullarton, C, Costa, B. and Dunning, T. 2013. Work readiness of graduate health professionals. *Nursing Education Today*, 33(2):116-122.

Ward, K. P. 2010. Horizontal integration of the Basic Sciences in the Chiropractic Curriculum. *The Journal of Chiropractic Education.* 24(2): 194- 197.

Wenrich, M, Jackson, M.B, Scherpbier, A.J, Wolfhagen, I.M, Ramsey, P.G and Goldstein, E.A. 2010. Ready or not? Expectations of faculty and medical students for clinical skills preparation for clerkships. Medical Education Online, 15: 529-538.

Westerman, M., Teunissen, P. W., Fokkema, J. P., Van der Vleuten, C. P., Scherpbier, A. J., Siegert, C. E. and Scheele, F. 2013. The transition to hospital consultant and the influence of preparedness, social support, and perception: a structural equation modelling approach. *Medical teacher*, 35(4): 320-327.

White, A. 2004. A cumulative review of the range and incidence of significant adverse events associated with acupuncture. *Acupuncture in Medicine*, 22(3): 122-133.

White, A., Hayhoe, S. and Ernst, E. 1997. Survey of adverse events following acupuncture. *Acupuncture in Medicine*, 15(2): 67-70.

White, P.F., Craig, W.F., Vakharia, A.S., El-sayed, A.G., Ahmed, H.E. and Hamza, M.A. 2000. Percutaneous neuromodulation therapy: does the location of electrical stimulation effect the acute analgesic response? *Anesthesia & Analgesia*, 91(4): 949-954.

Witt, C.M., Pach, D., Brinkhaus, B., Wruck, K., Tag, B., Mank, S. and Willich, S.N. 2009. Safety of acupuncture: results of a prospective observational study with 229,230 patients and introduction of a medical information and consent form. *Complementary Medicine Research*, 16(2): 91-97.

Wu, M.T., Hsieh, J.C., Xiong, J., Yang, C.F., Pan, H.B., Chen, Y.C.I., Tsai, G., Rosen, B.R. and Kwong, K.K. 1999. Central nervous pathway for acupuncture stimulation: localization of processing with functional MR imaging of the brain—preliminary experience. *Radiology*, 212(1): 133-141.

Wu, M.T., Sheen, J.M., Chuang, K.H., Yang, P., Chin, S.L., Tsai, C.Y., Chen, C.J., Liao, J.R., Lai, P.H., Chu, K.A. and Pan, H.B. 2002. Neuronal specificity of acupuncture response: a fMRI study with electroacupuncture. *Neuroimage*, 16(4): 1028-1037.

Young, P., Ehler, E. and Gautel, M. 2001. Obscurin, a giant sarcomeric Rho guanine nucleotide exchange factor protein involved in sarcomere assembly. *The Journal of cell biology*, 154(1): 123-136.

Zhou, K., Ma, Y. and Brogan, M.S. 2015. Dry needling versus acupuncture: the ongoing debate. *Acupuncture in Medicine*, 33(6): 485-490.

APPENDICES

APPENDIX 1: LETTER OF PERMISSION TO THE CHIROPRACTIC CLINIC DIRECTOR

248 Kenyon Howden Road
Montclair
4004
29/06/2019

Request for Permission to Conduct Research

Dear Dr Varatharajullu

I hereby request permission to conduct research at the Durban University of Technology Chiropractic Day Clinic. The title of the research study is: **The knowledge, attitudes and practice of registered, Masters Chiropractic students on the usage of dry needling for myofascial pain syndrome, during their clinical practicum.** The aim of this study is to explore the experiences of Chiropractic Masters degree students in the usage of dry needling for Myofascial pain syndrome at the DUT CDC.

I am hereby seeking your consent to conduct research at the Durban University of Technology Chiropractic Day Clinic. Please find attached a copy of the research proposal. Should you require further information about this study, please do not hesitate to contact me.

If you require any further information, please do not hesitate to contact my supervisor, Dr Praveena Maharaj, Email: praveenam@webmail.co.za or my co-supervisor, Dr Penelope Orton, Email: pennyo@dut.ac.za.

Thank you for your time and consideration in this matter.

Yours sincerely,

……
Talia Govender
Durban University of Technology
Cell number: 0711155933
Email address: taliacherisegovender@gmail.com

APPENDIX 2: LETTER OF PERMISSION TO GATEKEEPERS PERMISSION COMMITTEE

248 Kenyon Howden Road

Montclair

4004

29/06/2019

Request for Permission to Conduct Research

Dear Professor Duffy

I hereby request permission to conduct research at the Durban University of Technology Chiropractic Day Clinic. The title of the research study is: **The knowledge, attitudes and practice of registered, Masters Chiropractic students on the usage of dry needling for myofascial pain syndrome, during their clinical practicum.** The aim of this study is to explore the experiences of Chiropractic Masters degree students in the usage of dry needling for Myofascial pain syndrome at the DUT CDC.

I am hereby seeking your consent to conduct research at the Durban University of Technology Chiropractic Day Clinic.

I have provided you with a copy of my proposal which includes copies of the data collection tools and consent forms to be used in the research process, as well as a copy of the approval letter which I received from the Institutional Research Ethics Committee (IREC).

If you require any further information, please do not hesitate to contact my supervisor, Dr P. Maharaj, Email: praveenam@webmail.co.za or my co-supervisor, Dr Penelope Orton, Email: pennyo@dut.ac.za.

Thank you for your time and consideration in this matter.

Yours sincerely,

……

Talia Govender
Durban University of Technology
Cell number: 0711155933
Email address: taliacherisegovender@gmail.com

APPENDIX 3: LETTER OF PERMISSION TO THE HEAD OF THE CHIROPRACTIC DEPARTMENT

248 Kenyon Howden Road

Montclair

4004

29/06/2019

Request for Permission to Conduct Research

Dear Dr O' Connor

I hereby request permission to conduct research at the Durban University of Technology Chiropractic Day Clinic. The title of the research study is: **The knowledge, attitudes and practice of registered, Masters Chiropractic students on the usage of dry needling for myofascial pain syndrome, during their clinical practicum.** The aim of this study is to explore the experiences of Chiropractic Masters degree students in the usage of dry needling for Myofascial pain syndrome at the DUT CDC.

I am hereby seeking your consent to conduct research at the Durban University of Technology Chiropractic Day Clinic. Please find attached a copy of the research proposal. Should you require further information about this study, please do not hesitate to contact me.

If you require any further information, please do not hesitate to contact my supervisor, Dr P. Maharaj, Email: praveenam@webmail.co.za or my co-supervisor, Dr Penelope Orton, Email: pennyo@dut.ac.za.

Thank you for your time and consideration in this matter.

Yours sincerely,

……
Talia Govender
Durban University of Technology
Cell number: 0711155933
Email address: taliacherisegovender@gmail.com

APPENDIX 4: REQUISITION LETTER

To whom it may concern

Please may you provide a list of students who are still completing their clinical practicum (5th year numbers), at the Durban University of Technology Chiropractic Day Clinic, for the purposes of data collection as per my methodology. Please find my PG2a attached for reference.

Title of research: The knowledge, attitudes and practice of registered, Masters Chiropractic students of dry needling during their clinical practicum.

Should you require any further information, please feel free to contact me on 0711155933 or at taliacherisegovender@gmail.com

Thank you for your time

Regards

Talia Govender

APPENDIX 5A: LETTER OF INFORMATION

Thank you for agreeing to participate in this study.

Title of the Research Study: The knowledge, attitudes and practice of registered, Masters Chiropractic students on the usage of dry needling for myofascial pain syndrome, during their clinical practicum.

Principal Investigator/s/researcher: Miss Talia Govender (M: Tech: Chiropractic).

Co-Investigator/s/supervisor/s: Supervisor: Dr P. Maharaj (M. Tech: Chiropractic), Co-supervisor: Dr P. Orton (PhD: Nursing)

Brief Introduction and Purpose of the Study: Dry needling can be dangerous in some regions and muscles of the body which have resultantly been classified as high risk. Chiropractic Masters students may be reluctant to dry needle these high-risk regions due to fear of causing harm or injury to a patient and may resultantly be inadequately prepared or competent prior to clinical practice, as dry needling is a learned skill that requires accuracy. As such, understanding the knowledge, attitudes and practice of registered, Chiropractic Masters students on the usage of dry needling for MPS is necessary to gauge their confidence, judgement and clinical ability in the technique to ensure patient safety.

Outline of the Procedures: You are kindly requested to participate in an interview session that will be conducted by the researcher. The interview will be undertaken at the place and time that is convenient to you. The interview session will take between 20 minutes to 30 minutes. Permission is required to record the interview for data capturing and storing purposes.

Risks or Discomforts to the Participant: There are no foreseeable risks or discomfort by participating in this study.

Benefits: This study will add new knowledge so that future chiropractors can treat myofascial pain more effectively and confidently.

Reason/s why the Participant May Be Withdrawn from the Study: You are free to withdraw from the study at any given time without any form of penalty. Participants may be excluded if they do not meet the inclusion criteria.

Remuneration: There is no remuneration for participation in the study. A drink and snack will be provided at the interview.

Costs of the Study: There is no cost associated with participating in the study.

Confidentiality: All answers are confidential and will not be linked to your participation. The informed consent form and interview answers will be kept in separate sealed boxes.

Research-related Injury: There is no anticipated risk of injury.

Persons to Contact in the Event of Any Problems or Queries:

Please contact

Miss Talia Govender on 0711155933

Supervisor- Dr P. Maharaj on 0312627490

Institutional Research Ethics Administrator on 031-373 2375

Complaints can be reported to the Director: Research and Postgraduate Support, Professor Kevin Duffy on 031-373 2326/2577

APPENDIX 5B: CONSENT FORM

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Ms Talia Govender about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

_____	_____	_____	_____
Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**

I, Talia Govender herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Talia Govender	_____	_____
Full Name of Researcher	**Date**	**Signature**

_____	_____	_____
Full Name of Witness	**Date**	**Signature**

APPENDIX 6A: INTERVIEW SCHEDULE

Grand tour question:

As a Chiropractic Master's student, what do you know about dry needling and what are your thoughts, feelings and understanding on it as a treatment modality?

Probes:

- What is the difference between an active and latent trigger point (TP)?
- What is your preferred technique or modality for the treatment and management of MFTPs and why?
- Do you needle active TPs, latent TPs or both and why?
- Do you needle all trigger points that you find or only a select few and if so, how do you choose which ones to needle?
- What method/ technique of dry needling do you use and why?
- What are the benefits of dry needling?
- What are the risks of dry needling?
- Which muscles or regions of the body do you consider to be high risk or dangerous to dry needle and why?
- What other techniques or methods of dry needling are you aware of?
- Did you feel adequately prepared to dry needle patients in clinic?
- Did you feel confident and competent in dry needling prior to your clinical practicum?
- Do you feel confident and competent in dry needling?
- Do you dry needle high risk muscles and regions and if so what is your approach?
- Which muscles or regions would you never needle and why?
- Which muscles or regions do you substitute dry needling for another technique or modality and what is the alternative you would use and why?
- Do you feel you should be taught and encouraged to dry needle high risk muscles?
- Do you feel prepared for clinical practice, in terms of your dry needling capability?

APPENDIX 6B: DEMOGRAPHIC DATA FOR INTERVIEW PARTICIPANTS

Participant Code: 

Date of interview: …….

1. Age: ……..
2. Gender: ……..…
3. Race: ……
4. Year of study: ……

APPENDIX 7A: PERMISSION LETTER FOR THE USE OF THE CHIROPRACTIC DAY CLINIC

MEMORANDUM

To : Prof Adam
Chair: IREC

From : Dr Laura O'Connor
Head of Department: Chiropractic

Dr Desiree Varatharajullu
Clinic Director: Chiropractic Day Clinic: Chiropractic

Date : 26.11.2019

Re : Request for permission to use the Chiropractic Day Clinic for research purposes

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Permission is hereby granted to:

Ms Talia Govender (Student Number: 21318002)

Research title: "The knowledge, attitudes and practice of registered Masters Chiropractic students of dry needling during their clinical practicum.".

Ms Govender is requested to submit a copy of her FRC / IREC approved proposal along with proof of her M.Tech:Chiropractic registration to the Clinic Administrators before she starts with her research in order that any special procedures with regards to her research can be implemented prior to the commencement of her seeing patients.

Thank you for your time.

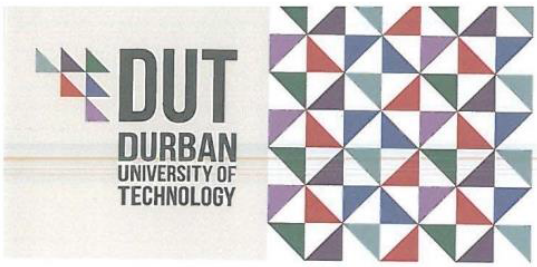
Kind regards

Dr L O'Connor
Head of Department:
Chiropractic

Dr Desiree Varatharajullu Clinic
Director: Chiropractic Day Clinic:
Chiropractic

Cc: Mrs Linda Twiggs: Chiropractic Day Clinic
Dr P. Maharaj: Supervisor
Dr P. Orton: Co-supervisor

APPENDIX 7B: PERMISSION LETTER FROM GATEKEEPER TO CONDUCT THE STUDY AT DUT



Directorate for Research and Postgraduate Support
Durban University of Technology
Tromso Annexe, Steve Biko Campus
P.O. Box 1334, Durban 4000
Tel.: 031-3732576/7
Fax: 031-3732946

26th February 2020

Ms Talia Govender
c/o Chiropractic and Somatology
Faculty of Health Sciences
Durban University of Technology

Dear Ms Govender

PERMISSION TO CONDUCT RESEARCH AT THE DUT

Your email correspondence in respect of the above refers. I am pleased to inform you that the Institutional Research and Innovation Committee (IRIC) has granted **Full Permission** for you to conduct your research "The knowledge, attitudes and practice of registered Masters Chiropractic students of dry needling during their clinical practinum." at the Durban University of Technology.

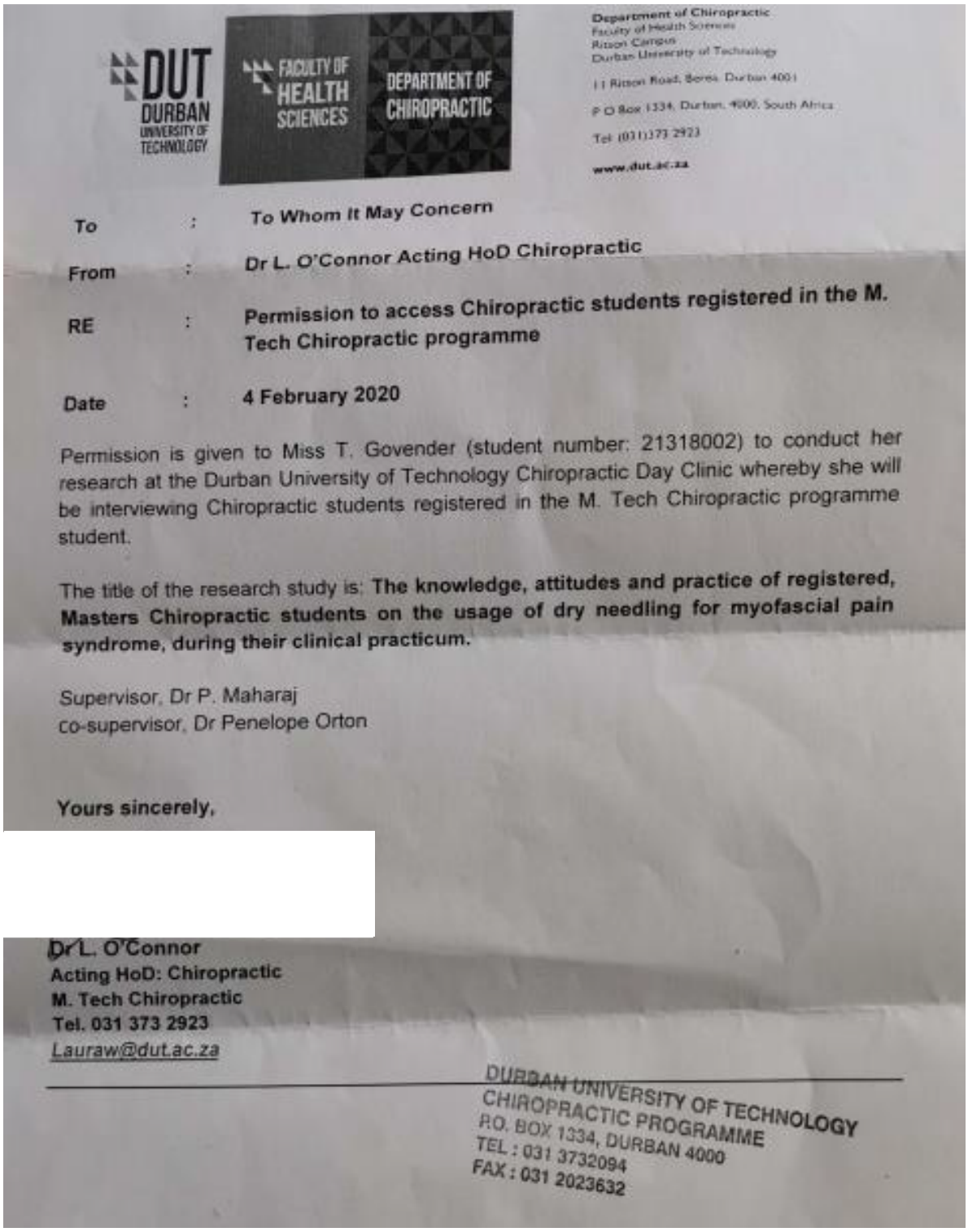
The DUT may impose any other condition it deems appropriate in the circumstances having regard to nature and extent of access to and use of information requested.

We would be grateful if a summary of your key research findings can be submitted to the IRIC on completion of your studies.

Kindest regards
Yours sincerely

PROF KEVIN DUFFY
ACTING DIRECTOR: RESEARCH AND POSTGRADUATE SUPPORT DIRECTORATE

APPENDIX 7C: PERMISSION LETTER FROM THE HEAD OF THE CHIROPRACTIC DEPARTMENT



DUT DURBAN UNIVERSITY OF TECHNOLOGY

FACULTY OF HEALTH SCIENCES

DEPARTMENT OF CHIROPRACTIC

Department of Chiropractic
Faculty of Health Sciences
Ritson Campus
Durban University of Technology
11 Ritson Road, Berea, Durban 4001
P O Box 1334, Durban, 4000, South Africa
Tel: (031) 373 2923
www.dut.ac.za

To : To Whom It May Concern

From : Dr L. O'Connor Acting HoD Chiropractic

RE : **Permission to access Chiropractic students registered in the M. Tech Chiropractic programme**

Date : **4 February 2020**

Permission is given to Miss T. Govender (student number: 21318002) to conduct her research at the Durban University of Technology Chiropractic Day Clinic whereby she will be interviewing Chiropractic students registered in the M. Tech Chiropractic programme student.

The title of the research study is: **The knowledge, attitudes and practice of registered, Masters Chiropractic students on the usage of dry needling for myofascial pain syndrome, during their clinical practicum.**

Supervisor, Dr P. Maharaj
co-supervisor, Dr Penelope Orton

Yours sincerely,

Dr L. O'Connor
Acting HoD: Chiropractic
M. Tech Chiropractic
Tel. 031 373 2923
Lauraw@dut.ac.za

DURBAN UNIVERSITY OF TECHNOLOGY
CHIROPRACTIC PROGRAMME
P.O. BOX 1334, DURBAN 4000
TEL : 031 3732094
FAX : 031 2023632

APPENDIX 8A: ETHICS PERMISSION FROM IREC

Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwyn Court
Gate 1, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375
Email: lavishd@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

19 March 2020

Ms T C Govender
248 Kenyon Howden Road
Montclair
Durban
4004

Dear Ms Govender

The knowledge, attitudes, and practice of registered Masters Chiropractic students of dry needling during their clinical practicum
Ethical Clearance number IREC 177/19

The Institutional Research Ethics Committee acknowledges receipt of your gatekeeper permission letters.

Please note that FULL APPROVAL is granted to your research proposal. You may proceed with data collection.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC Standard Operating Procedures (SOP's).

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely

Professor J K Adam
Chairperson: IREC

APPENDIX 8B: IREC AMENDMENT APPROVAL

Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwyn Court
Gate 1, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

22 April 2020

Ms T C Govender
248 Kenyon Howden Road
Montclair
Durban
4004

Dear Ms Govender

Application for Amendment of Approved Research Proposal

The knowledge, attitudes, and practice of registered Masters Chiropractic students of dry needling during their clinical practicum

I am pleased to inform you that your application to change the proposed research site has been approved. Data can be collected via electronic voice/ video communication to prevent the spread of Covid-19.

Yours Sincerely

Professor J K Adam
Chairperson: IREC

APPENDIX 9: TRANSCRIPT EXAMPLE

Transcript 3

T: …this interview is being recorded

P3: Yes

T: and you're ok with that?

P3: I do. Yes, I'm fine with that.

T: ok cool. And, you have signed the informed consent and returned it to me?

P3: Yes, I have.

T: Okay cool. I'm gonna start with the big question and uh you can explain as much as you like on it. The question is as follows… As a chiropractic master's student what do you know about dry needling and what are your thoughts, feelings and understanding on it as a treatment modality?

P3: ok, my understanding of dry needling is, it's, it's a bit in-, it's an invasive approach or treatment modality that's offered to patients that suffer with, er, muscle spasms or problems with their muscles and it's called dry needling because there's no fluid inserted into the needle or no fluid is going into the patient's body, er, that why it's called dry needling. And the purpose of it is to help to, er, release or reduce muscle spasms, relieve tension in the muscle and activate the muscle and get it firing up again. Uhm, in other words, stimulating the muscle. So, uhm, I enjoyed dry needling my patients, that's how I feel about it, uhm, but I am very cautious when I dry needle. In my experience, I tend to use modalities more than dry needling because I find patients have way too many trigger points and all of them are rated the same in terms of severities. So, instead of sticking in a hundred needles at a time, I prefer to use modalities because it's less invasive. Uhm, I think that dry needling is a very good treatment modality , and I've seen good eff-, er, good results when I do needle, uhm, some of my patients, uhm it reduces their spasms , it restores their movement, increases their range of motion in other words and ya, it just, it does benefit them, it relieves their pain as well and makes them less tense and helps with their posture as well.

T: okay, and you say, er, trigger points, what, what do you mean by trigger points?

P3: So the trigger point is, er, an area in the muscle, it's more like a, you can actually feel it's like a palpable bulge in the muscle and what happens is that the area, er, in the muscle that takes the most amount of strain and as a result when you palpate over those areas they, er, that particular part of the muscle can produce pain which can either be, which can make it either a latent or active trigger point, meaning that if it is latent it produces local pain on palpation but if it is active the patient will complain about pain in the region that the, er, muscle-er- trigger point actually refers to.

T: and er, do you needle latent trigger points, active trigger points or both, and why?

P3: I needle both depending on the severity of the patient, uhm it er depends on how far the pain refers uhm, in, in other words some patients will come and tell me that I've, that they got pain over their traps, uhm whether they, er, at rest or whether they moving around doing any daily activity and if I can feel that that pain, er, when I palpate the muscle, if it reproduces the pain that the patient has, then I go ahead and needle the patient. I do a combination of both, although I do prefer to needle the active trigger points more, and I generally do ischaemic compression or something more gentle for the latent.

T: okay

P3: Just depends on the severity

T: So you say that you, uhm, you said in the last, er, question, in the last statement that you use multiple types of modalities instead of using dry needling and you prefer to do that and now you've told me that you like to use ischemic compression. What is your absolute preferred technique or modality in the treatment of myofascial trigger points and why?

P3: I feel dry needling is very effective, it gets straight into the muscle. I tend to use ischaemic compression only when I feel it's not a safe area to needle, uhm, and also if I know it's a latent trigger point I will use ischemic compression more often than dry needling. Uhm, but I only, er, use other modalities if the patient has way too many trigger points that require attention so that I'm not sticking in too many needles into them.

T: Okay. And when you do needle, what is your method or technique of needling? And why?

P3: So it depends on each area in the body that I'm going to be targeting. So, for example if it's along the spine, if it's the paraspinal muscles or the rhomboids, I always needle away from the spine at an angle, so, tangential, that's how I was taught and I apply that in my practice, er, in the chiropractic clinic at DUT, uhm so you alw-, I always needle away from the spine and, uhm, like TP2 of trapezius I always lift the trigger point up , lots of people stick the needles in but I prefer to keep it up whilst the needle is in just for my own, er, caution so that I know I'm not going anywhere near the lung, and then it just depends on the, the way the fibers run in the muscles as well. So, uhm, if it's along the, if it's your quadratus lumborum, or let's rather say your uhm, your paraspinal muscles, I always aim for bone when I needle, I don't needle in-between. I'm avoiding the intercostal space in other words, so I aim for the rib and if I'm needling the superspinatus or interspinatus muscle very shallow needling because obviously it's a shallow muscle.

T: okay, and then you, err, told me about the benefits of dry needling. What are the risks associated with dry needling, cos I know now that you said you lift the, er, trap muscle to avoid the lung, what are the risks associated with dry needling?

P3: okay, so with dry needling there's always a risk of hitting a structure that you shouldn't, this can be a nerve, this can be an artery, this can be a vein, any kind of blood vessel in other words, uhm but the problem with it is you have to know your high risk areas, so I wouldn't needle near the sciatic nerve, I wouldn't needle in the popliteal fossa or the cubital fossa because of the innervation or the nerve supply and the blood supply in that area as well. We want to needle into the muscle, but we always have to outweigh the risk versus benefit and see what, uhm, would benefit the patient more without causing any harm to them, so for example the traps, I definitely lift TP 2 up, uhm lots of people tell me they, once it's in they leave the muscle down, but for my er own, uhm, comfort I keep it up to avoid the lung fields or the apex of the lungs, in other words. I never ever needle, uhm, in the neck, er, posterior cervicals, even the scalenes or SCMs. So, it depends on what structures are in the area uhm, that determines what the risks are, because if you hit a nerve, if you hit a blood vessel, there's gonna be bleeding, there's gonna be neurological symptoms as well and the patient is going to get injured.

T: okay so, in giving me the risks, you basically brought up the topic of, uhm, high risk muscles.

P3: Ya.

T: What, what muscles do you consider high risk?

P3: definitely the sternocleidomastoid muscles, the scalene muscles in the region of neck and also the posterior er cervical muscles because of the, the great vasculature in that area as well, then obviously coming into the cubital fossa, that's an area as well, uhm, so we have to be careful because certain muscles branch over the cubital fossa when we needling, uhm, then also the popliteal fossa and then when it comes to the, er, gluteal region the only area I would needle is the upper , outer quadrant of the glutes because the other areas are considered high risk areas for hitting the sciatic nerve. Uhm, so, I would not needle the piriformis muscle at all, I'd needle the outside or the, the boundary trigger points of the gluts, not anywhere near the coccyx, or the er location of the sciatic nerve which is where the piriformis lies. So, I also wouldn't needle the, the inguinal region as well, we've got our reproductive organs there, particularly males, so I know that doesn't have to do with muscle but, ya.

T: Okay. Um do you ever needle any of these high-risk regions?

P3: Never

T: Okay, um, so when you needed to treat these areas what would you do to substitute for needling?

P3: I would do ischemic compression, uhm this can be like an active, er, myofascial release sometimes where I do apply ischemic compression and get the muscle moving. Er, I have needled, er, gluteus, er, muscle trigger points that was deemed fine by the clinician who observed me that was nowhere near the sciatic nerve. That's as far as I got to needling a high-risk area but I always do ischemic compression, I don't usually do massage because uhm, I try to get deep into the muscle to activate it and to stimulate it, um to relieve the tension in the muscle so after doing ischemic compression I'll advise the patient i-, uhm, to either use ice or heat depending on whether it's acute or chronic.

T: Okay. Did you feel like you were prepared and confident to needle patients when you, before you got into clinic, when it was time to start your clinical practicum?

P3: Er, to be honest, no, I did not feel confident at all, because although we learnt about it in class and we did practice it in class, uhm I just didn't feel confident. Uhm, it also came down to practicing on your classmates who are also a bit sceptical and scared, uhm, so that did make me very nervous but when I went into, uhm, clinic, it was quite uhm, challenging for me because I came to realise that every patient is different, every patient's structures are different although there's an area where certain structures are found, um basically the anatomy is different, uhm, as you get to the next patient. So, I do not, I did not feel confident because now I was left on my own without any supervision uhm but when it came to moving down to the extremities as we passed module there were times when I called in the clinician because I had never needled any extremity prior uhm, to clinic so I would call the clinician in, to, uhm, observe me and just to guide me just to be safe cos, I , I don't take risks.

T: Okay, and do you now feel confident and competent in dry needling?

P3: I do. I do, I feel much more confident because of the experience that I have had and needling certain muscles that keep popping up amongst the general population, it makes me more confident because I get more practice.

T: Do you feel like you should be taught and encouraged to needle, to learn and to needle high-risk muscles.
P3: I think to a certain extent depending on which area it is, because I would not needle any structures in the neck, or that's my personal view, uhm just going back to the previous er question, uhm, I learnt how to needle uhm, certain muscles in the extremities but I think we weren't, when we are examined, we don't get examined by needling each other, it's just where's the trigger point, where's the attachments and that so being examined that's where you can be told 'No you needling this muscle wrong'. So I just want to clarify that I have, we have been taught how to needle, but I don't think we've had much practice with needling under like one on one supervision to be told this is what you doing right, this is what you doing wrong.

T: Okay, and then do you feel prepared then knowing that you are not gonna take any risks with dry needling uhm, those specific muscles, do you feel prepared for clinical practice, in terms of dry needling and your capability in dry needling?

P3: err to those high-risk areas?

T: in general

P3: in general, No, I feel like I am okay with needling, um especially cos I've had one full year of clinical experience and also with er, supervision with certain clinicians as well when I was not confident but I think that once I'm in practice I will be okay and I'll be able to judge whether or not it's a good idea to attempt any muscle I shouldn't be aiming for.

T: okay, and then lastly do you know of any other technique or techniques or methods of dry needling that you may have come across in any other research that you've done on your own or anything that you've been taught at varsity, other than what you've explained to me as what you do?

T: Did you get my question?

P3: No, I didn't. Please repeat it, the er, screen froze.

T: That's fine. I just asked, uhm are there any other techniques or methods of dry needling that you are aware of or that you have learnt either through university or in- on your own through independent research?

P3: Okay, so I have observed a few chiropractors and also while studying uhm, different muscles require different techniques. Some muscles you can fan when you are needling them, so that's the technique, the fanning technique uhm, with your pincer palpation and and , ya that, but certain muscles they are in areas that are not high high-risk areas that I would want to avoid, but I wouldn't want to go where I'm not supposed to go with a needle so, uhm, the technique is to understand where the fibers run and needle in the direction of the fibres finding that muscle knot or trigger point and looking for that twitch response, um so it depends on how bad the trigger point is sometimes I will fan and I will take it out, take the needle out after about five seconds and then if it's not relieving at all and if especially if the needle is stiffening the muscle I'll let it rest in there for a while, maybe up to a minute, depending on how bad the trigger point is.

T: okay, but other than what, other than the way you practice dry needling, are there any other techniques of dry needling that you've heard about or read about?

P3: not really

T: Okay. Thank you so much for your time, I really appreciate it.

P3: Thank you