# The effectiveness of Leander traction versus Static linear traction on chronic facet syndrome patients – a randomised clinical trial.

**BY:**

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A dissertation presented to the Faculty of Health Sciences at the Durban University of Technology in partial compliance with requirements for the Master's Degree in Technology: Chiropractic

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## DEDICATION

**This dissertation is dedicated to wonderful family, friends and the love of my life. Thank you for your undying support through the hard times and for giving me inspiration and guidance. You have been my strength when my steps have failed. You have always seen hope through my despair. Thank you for always believing in me and allowing me the opportunity to follow my dreams. I love you.**

**ACKNOWLEDGEMENTS**

A big thank you to my parents, you have given me the foundation and opportunity to make a success of my life and your unfailing love and support have carried me through. I cannot thank you enough for this opportunity.

To Christelle, the love of my life, for your love and support during the years and for all the good times we have shared thus far. I cannot wait to start our life together and a better companion I could not have wished for.

To my very special friends and colleagues in Durban. Thank you for all the special times and wonderful memories. These will always remain with me and will always bring a smile to my face.

To Dr Heidi Kretzmann, thank you for your time, hard work and encouragement throughout my research study.

To Dr Charmaine Korporaal, your tireless dedication to both the students and the profession will always be remembered. Thank you for your help and guidance.

To Dr Louis Brugman, thank you for your support, guidance and belief in me..

To the staff in the Chiropractic Day Clinic as well as the department of Chiropractic, thank you for all the support and patience.

To Mrs Ireland, thank you for making all the administrative aspects of my research run smoothly. I wish you all the happiness in your retirement.

To Tonya Esterhuizen, thank you for all the help with my statistical analysis.

To all my patients that participated in this study, without you this project would never have been possible. Thank you for your time and support. It was a pleasure to have met each of you.

## ABSTRACT

**The effectiveness of Leander traction versus Static linear traction on chronic facet syndrome patients – A randomised clinical trial.**

**Objective:** The aim of this study was establish if Leander versus Static traction was useful for the treatment of facet syndrome, a common type of mechanical lower back pain seen by chiropractors. Two groups of fifteen participants were chosen on the basis of the inclusion and exclusion criteria.

The first objective was to determine if Static linear traction was effective for the treatment of lumbar facet syndrome in terms of subjective and objective findings. The second objective was to determine if Leander traction was effective for the treatment of lumbar facet syndrome in terms of subjective and objective clinical findings. Lastly the third objective was to compare the subjective and objective clinical findings for both groups.

**Design:** A randomised, two group parallel controlled clinical trial was carried out between the two sample groups. Participants had to have had chronic lower back pain (> 3months). Thirty symptomatic volunteer participants between 25 and 55 were randomly divided into two equal groups – group A (Leander traction) received 5 treatments over a 2 week period. Similarly, group B (Static linear traction) also received 5 treatments over a 2 week period. Algometer readings, Numerical Pain Rating Scale (NRS101), Pain Severity Scale (PSS) and Oswestery Disabilty Index (ODI) were used as

assessment tools. Subjective and objective clinical findings were taken on the first and second visits (i.e. 48 hours) prior to treatment and immediately after treatment. Another set of subjective and objective readings were taken one week after the fifth treatment in order to gauge the long term effects of both treatments. No treatment was given on the sixth visit. Pressure tolerance measurements using an algometer were taken at the end ranges of motion in Kemp's test and spinal extension.

**Outcome measures:** SPSS version 15 (SPSS Inc., Chicago, Illinois, USA) was used for statistical analysis of data. A p value of $<0.05$ was considered as statistically significant. The two groups were compared at baseline in terms of demographics variables and location using Pearson's chi square tests and t-tests as appropriate. Intra-group comparisons were made between all time points. A significant time effect indicated successful treatment intervention. Inter-group comparisons were achieved using repeated measures ANOVA tests for each outcome measured separately. A significant time group interaction effect indicated a significant treatment effect. Profile plots were used to assess the trend and direction of the treatment effect.

**Results:** The results of the study showed that Leander traction and Static linear traction were both effective for treating chronic lumbar facet syndrome and no statistically significant difference was found between subjective and objective clinical findings between the two groups.

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# CHAPTER ONE - INTRODUCTION

## 1.1 INTRODUCTION

Woolf and Phleger (2003) and Reiso, Nygard, Jorgensen, Holanger, Soldal and Bruusgaard (2003) have suggested that worldwide, low back pain is the most prevalent of all musculoskeletal conditions, affecting nearly everyone at some time in his/her life. They have also postulated that lower back syndromes are the most important disorders associated with absence from work in industrialised countries.

"Low back pain (LBP) is a major international problem and there are epidemiological and statistical studies that have documented the high incidence and prevalence of LBP" (Manga et al.,1993). Surveys in America suggest that the life time prevalence of LBP ranges from 60-90% (Kirkaldy-Willis and Burton, 1992) with a 25% to 60% annual incidence (Boswell et al., 2007). Similarly, according to Docrat, (1999) and Van der Meulen, (1997), the lifetime incidence of LBP in Indian and Coloured communities in Durban, Kwa- Zulu Natal (KZN), South Africa, was found to be 78.2% and 76.6% respectively (Docrat, 1999). In black South Africans residing in Chesterville, it was found to be 57.6% (Van der Meulen, 1997).

Kirkaldy-Willis (1988) has suggested that once lumbar facet syndrome reaches a chronic level, it results in constant LBP, which is almost always bilateral. Cox (1999) believes that at least 26% of patients suffering from LBP have lumbar facet syndrome and that flexion distraction is the treatment of choice for this disorder. Historically lumbar traction has been used since 2000 BC for spinal disorders (Kumar, 1996). Gay and Brault (2008) have suggested that static linear traction, a form of sustained traction where the traction load is dispersed across the lumbar spine using a split table, is effective. According to Krause et al., (2000) the mechanism by which traction relieves pain is believed to be the separation of vertebrae, thereby removing the pressure or contact forces from injured tissues, and in so doing increasing peripheral circulation by a massage effect as well as reducing muscle spasm. According to Gay and Brault (2008), various non-surgical therapies exist that mechanically unload the spine, which include traction, Leander and Cox techniques of flexion distraction (mobilization), or motorized spinal traction (decompression) devices such as the DRX9000 nonsurgical spinal decompression device.

Chiropractic management coupled with adjunctive procedures such as manipulation, traction, massage, cryotherapy, heat and exercise therapy, can provide relief for many patients suffering from disorders of the lumbar spine (Gatterman, 1990:173).

Leander traction, classified as a type of intermittent traction where the traction force is focused on a particular area of the lumbar spine which is then subjected to flexion distraction can also help (Cox, 2005 and Gay and Brault, 2008). According to Gudvalli et al., (2006), flexion distraction (FD) and traction differ from high-velocity manipulation in that it is a slow manual traction and mobilization rather than a higher load and speed technique. According to Gay and Brault, (2008) flexion distraction therapies attempt to concentrate forces within a specific segmental level or area, whereas Static linear traction allows dispersion of forces throughout the lumbar spine (although the vector of the forces might vary).

Schneider (1991) has also stated that lumbar traction and Leander traction is indicated for a wide spectrum of painful conditions, based on the physiological effects of vertebral separation, widening of the intervertebral foramina, and possibly multifidus muscle relaxation. It has also been stated by Haldeman (1993) that any restoration of movement to the hypo-mobile spinal segments using traction can only be beneficial to the facet joints. This proposed research will try and establish if lumbar traction therapy, such as Static linear traction and flexion distraction, is effective in treating chronic lumbar facet syndrome. As well as how Static linear traction compares to flexion distraction in the treatment of chronic lumbar facet syndrome.

## 1.2 AIMS AND OBJECTIVES OF THE STUDY

The aim was to compare the effectiveness of Leander traction versus Static linear traction on chronic lumbar facet syndrome a type of mechanical lower back pain.

### 1.2.1 Objectives

#### *1.2.1.1 Objective one*

The first objective was to determine the effectiveness of Leander traction in the treatment of lumbar facet syndrome in terms of subjective and objective clinical findings which included specific outcomes such as pain and disability.

Hypothesis 1

It was hypothesized that Leander traction would cause an overall improvement of symptoms experienced from chronic lumbar facet syndrome (CLFS) Bulbulian, Burke and Dishman (2002), Cox (1999), Gay and Brault (2007), Gudavalli (2006) and Schneider (1991).

#### *1.2.1.2 Objective two*

The second objective was to determine the effectiveness of Static linear traction in the treatment of lumbar spine facet syndrome in terms of subjective and objective clinical findings which included specific outcomes such as pain and disability.

Hypothesis 2

It was hypothesized that Static linear traction would have an overall effect on the improvement of symptoms experienced by patients experiencing lumbar facet syndrome, a type of mechanical lower back pain.

This is supported by Borman (2003), Cox (1999), Gay And Brault (2007), Krause et al., (2000), Lee and Evans (2001) and Revel (2000) who suggest that static linear traction stimulates mechanoreceptors, reduces disc prolapses and increases foraminal volume.

#### *1.2.1.3 Objective three*

The third objective was to compare the subjective and objective clinical findings as well as between group differences for specific outcomes for pain and disability in both groups.

Hypothesis 3

It was hypothesized that when comparing the data between both groups that there would be no difference between the groups with regards to subjective and objective clinical findings.

## 1.3 RATIONALE AND BENEFITS

1.3.1 Leander traction is used by chiropractors to treat mechanical lower back problems and is a form of intermittent traction. Static linear traction has primarily been used by physiotherapists and surgeons to treat disc injuries. No clinical trials exist to assess the efficacy of traction for the treatment of lumbar facet syndrome. This research will establish the efficacy of static versus Leander traction in the treatment of lumbar facet syndrome.

1.3.2 According to Beurskens (1995) and Lee and Evans (2001) the clinical effectiveness of static lumbar traction is not certain. This is mainly due to methodological flaws in previous studies pertaining to the lumbar spine. These flaws include poor prognostic comparability at baseline, lack of information about the randomisation procedure and poor operationalization of treatment effect measurements and incomparability of the co-interventions. This research will attempt to overcome earlier shortcomings.

1.3.3 The available literature suggests that lumbar traction could be effective as the flexion moment stimulates mechanoreceptors, reduces disc prolapse and increases the foraminal surface area (Lee and Evans, 2001). Until now, the proposed mechanisms by which traction could be effective have not been supported by sufficient research, and traction trials have only been done on lumbar disc herniations and not facet syndrome. This study will try and establish the effectiveness of traction on lumbar facet syndrome.

1.3.4 Leander traction is a type of intermittent traction and flexion distraction (FD) where the traction force is focused over a specific area of the spine, however it differs from the Cox method of FD in that distraction of the lumbar spine occurs in extension and the Cox method in flexion. It can be standardized satisfactorily and the duration and amplitude of pull exerted during motorized lumbar traction can be varied (Eckard, 2007). Studies conducted by Lee and Evans (2001) suggest that there is a lack of consensus on the choice of traction to be used in a given clinical situation. This research will try and establish a clearer understanding of the efficacy of these different mechanisms and try and help clinicians decide on the relative appropriateness of the two techniques. No studies have been done on the effects of static versus Leander traction in the treatment of lumbar facet syndrome.

## 1.4 CONCLUSION

In the remaining chapters, the researcher will outline pertinent literature around the topic that will be presented in chapter 2. Chapter 3 will describe the methodology of the study in detail and chapter 4 will present the statistics, results and subsequent conclusions drawn. Chapter 5 will present the final analysis and recommendations.

## CHAPTER TWO - LITERARY REVIEW

### 2.1 INTRODUCTION

In this chapter, the researcher will provide an overview of the current literature that is relevant to this study. The current epidemiological data related to lower back pain (LBP) will be discussed, as well as appropriate anatomy and biomechanics of structures related to lower back pain (LBP). Treatment options will also be outlined. Finally the basic concepts and theories related to the two forms of traction and their applications for LBP will be discussed.

### 2.2 INCIDENCE AND PREVELENCE OF LOW BACK PAIN

Chronic low back pain is a common complaint. Over the last few decades it has become an important cause of disability in the western world (Manga, et al., 1993 and Hills, 2005). Cassidy (1998) also states that back pain in the United States of America (USA), has a incidence rate of 80 % and a prevalence rate of 30% at any given time in the population.

Similarly, in a recent review by Tong, Leslie and Pergolizzi (2007) on LBP, current evidence has shown that 25% to 60% of patients will experience another episode of LBP at one year or longer after the initial episode (Boswell et al., 2007). Chou et al., (2007) and Diamond and Borenstein, (2006) have reported that 1 in 5 patients in America who are working age adults, suffer from chronic LBP and have substantial limitations to their

daily activities. In a recent study conducted by Hagen et al., (2006) on the comorbid conditions related to LBP it was found that patients suffering from LBP had significantly more neck pain, upper back pain, foot pain during exercise, headaches, migraine, sleep problems, heat sensations, anxiety and sadness and depression. While there is no mortality associated with mechanical LBP, morbidity in terms of lost productivity, use of medical services and cost to society can be staggering (Hills, 2005).

Chou et al., (2007) has also stated that more than 85% of patients who initially consult a primary health care physician for back pain have non-specific LBP or pain that cannot be easily attributed to a specific disease or spinal abnormality. Tong, Leslie and Pergolozzi (2007) have stated that the intervertebral discs, facet joints, ligaments, fascia, muscles and nerve root dura have been identified as pain producing structures in the lower back. Bogduk (1995) and Coderre et al., (1993) have also stated that the intervertebral disc, posterior facet joints, and the sacroiliac joints have been reported to be responsible for approximately 70% of all low back pain episodes. It can then be assumed that an accurate diagnosis and treatment protocol is essential in determining the most optimal path of treatment a LBP patient should receive.

It is therefore essential for the clinician to understand the basic anatomy and pathomechanics of the lower back region, in order to understand the mechanical syndromes. For the purpose of this research study a detailed description of the lumbar spine will now be presented.

## 2.3 ANATOMY

The lumbosacral spine consists of five lumbar vertebrae, the sacrum and the coccyx. It is a complex structure comprising of bony elements that are linked by ligaments and joint capsules which are controlled by layers of overlying muscles (Kirkaldy-Willis and Burton, 1992).

### 2.3.1 BONY ANATOMY

#### 2.3.1.1 The lumbar spine

There are five lumbar vertebrae which are identified by their large kidney shaped vertebral bodies, sturdy laminae and absent costal facets. These vertebrae, increase in size from L1 to L5 as the load that they support increases towards the inferior end of the vertebral column (Moore and Dalley, 1999).

The vertebral arch is a horseshoe-shaped structure that is formed by the laminae and pedicles.

There are seven processes that project from this arch, which include the paired superior and inferior articular processes, the spinous process and two transverse processes (Kirkaldy-Willis and Burton, 1992). The spinous processes are thick and broad and point posteriorly. The transverse processes, which originate from the laminae-pedicle junction, are slender, long and flattened on their anterior and posterior surfaces (Moore and Dalley, 1999). The transverse process together with the spinous process are sites for muscles and ligaments to attach (Kirkaldy-Willis and Burton, 1992). The articular processes facilitate flexion, extension and lateral bending of the spine. However they prohibit rotation (Moore and Dalley, 1999).

### 2.3.2 THE LUMBAR ZYGOPOPHYSEAL JOINT (lumbar facet joint)

#### *2.3.2.1 Anatomy*

The lumbar zygopophyseal (facet) joint is a typical synovial joint. This joint is formed by the articulation between the superior articular process of the vertebral body below and the inferior articular process of the vertebral body above, and is classified as a synovial (diarthordial) joint (Moore and Dalley, 1999). The lumbar facet joints are biplanar, with the major posterior parts approximated to the sagittal plane.

The exception is the lower lumbar facet joints that rotate toward the coronal plane at the lumbosacral junction (Giles and Singer, 1997).

Each facet joint is surrounded by an articular capsule posterolaterally and this capsule is thick and fibrous and covers the posterior aspect of the joint. The anterior and medial aspects of the joint are covered by the ligamentum flavum.

The synovial membrane lines the articular capsule and ligamentum flavum. The synovial joint folds supply the joint surface with synovial fluid and are also considered to be pain sensitive structures (Giles and Singer, 1997).

The accessory ligaments help to stabilize the joint by uniting the laminae, transverse process and spinous process (Moore and Dalley, 1999).

#### *2.3.2.2 Function of lumbar facet joints*

The lumbar facet joints control patterns of motion between the lumbar vertebrae. They also protect the discs from shear forces, excessive flexion and axial rotation, as well as providing support to the spinal column (Giles and Singer, 1997).

#### *2.3.2.3 Innervation*

The lumbar facet joints are innervated by the medial branch of the dorsal primary rami of the spinal nerves. Each branch supplies two adjacent joints, thereby supplying each joint with two nerves (Moore and Dalley, 1999). The median branch supplies the level of exit and the level below (Giles and Singer, 1997). According to Hilton's law, the related connective tissue, muscles, skin and ligaments over a joint are supplied by the nerves to that joint.

Therefore, it can be assumed that the neurological input and output of the joint will affect the surrounding structures and visa versa (Moore and Dalley, 1999).

There are four types of sensory receptors within the lumbar facet joint (Leach, 1994; Gatterman, 1995, Cox, 1999):

Type: I Globular corpuscles are found in the layers of the fibrous joint capsule. These are very sensitive, static and dynamic mechanoreceptors that continually fire even when the joint is not moving.

Type: II Conical corpuscles are found within the deeper layers of the fibrous joint capsule. These are less sensitive mechanoreceptors that fire only during movement.

Type: III Larger corpuscles are found on the surface of the joint ligaments. These are thinly encapsulated mechanoreceptors.

Type: IV Unmyelinated nerve fibres that weave throughout the facet joint capsule. These fibres are slow conducting nocioceptive mechanoreceptors.

Stimulation of these receptors by noxious stimuli often causes LBP and may result in the patterns of presentation of LBP seen in patients.

This presentation will now be discussed in terms of the facet joint, a condition known as lumbar (posterior) facet joint syndrome (Kirkaldy-Willis and Burton, 1992).

## 2.4 LUMBAR (POSTERIOR) FACET SYNDROME (facet syndrome)

### 2.4.1 Presentation

With lumbar facet syndrome, the pain is often localized and unilateral at the site of the facet joint involved (Kirkaldy-Willis and Burton, 1992). However, the classic presentation is generally LBP which may be referred to the groin, hip, buttock and posterior thigh to above the knee – mimicking radicular pain (Gatterman, 1990).

In addition, pain of scleratogenous origin may account for a non-diffuse deep pain, where radicular pain is very specific allowing the patient to accurately trace the precise route of the involved nerve root (Giles and Singer, 1997).

This presentation is thought to be secondary to the level of innervation (that is noxiously stimulated) of the facet joint involved together with the facet joint below (as these receive innervation from the same lumbar nerve root segment that is involved) (Sandoz, 1978).

### 2.4.2 Associated clinical signs

The classic signs of facet syndrome are: palpable muscle spasm with focal tenderness over the affected facet joint(s), with hyperextension movements of the back increasing the pain, whereas flexion decreases the pain (Gatterman, 1990 and Kirkaldy-Willis and Burton, 1992).

Aetiological factors which may produce lumbar facet syndrome include trauma (hyperextension of the lumbar spine) e.g. a fall on the buttocks, degeneration and faulty posture. Traumatic injuries to the facet joint produce inflammation of the vertebral joint capsule which raises intra-articular joint pressure and subsequently leads to acute pain (Gatterman, 1990: 161).

Gatterman (1990) also noted that the patient may experience pain but no demonstrable radiographic evidence of malalignment immediately following trauma.

If damage to the articular cartilage has occurred, subsequent degenerative changes may also occur to the facet joint (Gatterman, 1990:161). This can be in conjunction with degeneration and thinning of the intervertebral disc space, which permits approximation of the articulating surfaces of the posterior facet joints and results in the posterior joints becoming roughened and sclerosed (eburnation) (Gatterman, 1990:161).

Oblique and lateral radiographs show degenerative changes consistent with facet joint overriding as well as an increase in the lumbar intervertebral disc angle along with an increased lumbar lordosis, which shifts the weight bearing posteriorly on to the lumbar facet joints (Yochum and Rowe, 1996). Cox (1999) stated that Macnab's line will be positive and that work done by Van Akerveeken was important for determining the stability of the facet syndrome ( Cox, 1999:599-601).Van Akerveeken has determined a measurement for stability or instability of the lumbar spine by using lateral lumbar radiographs to determine damage to the posterior longitudinal ligament and the annulus fibrosis.

Gatterman (1990) has stated that changes in posture where there is an increase in the angulation of the sacral base, will lead to an increased lumbar lordosis which will in turn lead to posterior displacement of the centre of gravity which will ultimately place more strain on the facet joints.

Yang and King (1984) have found that arthritic facet joints have an increase in weight bearing load of 47% and hypothesized that excessive loads on facet joints could stretch the joint capsule and cause back pain as well as narrowing of the intervertebral foramina (Hadley, 1961).

Activities that may increase the pain are: sleeping on the abdomen, sitting in an upright position, rising from the seated position, lifting a load in front of the body at (or above) the waistline, and working with the hands above the head. When symptoms become acute, sneezing and coughing may increase the pain (Gatterman, 1990).

It has been found that pain occasionally radiates into the groin and anterior thigh. Gatterman (1990) also points out that minor sensory changes can occur along with subjective muscle weakness which can be attributed to the pain and not true muscle weakness. It is noted by Shealy (1976) that any muscle weakness, progressive sensory loss, and bladder or bowel dysfunction must be immediately referred to a neurologist.

Gatterman (1990: 162) further states that a common complaint attributed towards lumbar facet syndrome is low back stiffness, especially in the mornings and that pain may be relieved by having the patient assume the 90/90 position, i.e. ( patient draws both knees to the chest and locks hands around the knees) or the Cox method of flexion distraction which will ‘open’ the posterior facet joints (Cox, 1999). According to Cox and Shreiner (1984) and Kirkaldy- Willis and Burton (1992) manipulation has proven to be highly effective in treating lumbar facet syndrome. It was also stated by Gatterman (1990) that postural corrective exercises, which include exercises that strengthen the abdominal core muscles, were essential in a long term recovery as this would decrease the anterior pelvic tilt which will in turn decrease the compressive forces on the posterior facet joints. Obese patients should also be encouraged to lose weight.

## 2.5 CLASSIFICATION AND FURTHER PATHOMECHANICS OF MECHANICAL LOW BACK PAIN

According to Kirkaldy-Willis and Burton (1992) the classification examples of mechanical low back pain syndromes include posterior facet syndrome; sacro-iliac syndrome; Maigne’s syndrome; disc herniation; facet and disc degeneration; central and lateral canal stenosis and myofascial pain dysfunction syndrome.

The above authors have stated that facet joint syndromes and some muscle syndromes are common but are frequently overlooked because they do not demonstrate any abnormalities radiographically. The lumbar (posterior) facet syndrome is most commonly present due to changes in the biomechanics of the lumbo-sacral spine.

However, in order to understand this, one needs to know that the lumbar and sacral spines link the lower extremities and the torso, as well as co-ordinating the transfer of power through the body in most movements e.g. sports, via the kinetic chain (Drezner and Herring, 2001).

Bogduk (1997) and Revel et al., (2000) pointed out that the basic anatomical and functional unit of the vertebral column is the articular triad consisting of the fibrocartilagenous intervertebral disc joints and the two synovial facet joints. The function of the posterior facet joints is to guide and restrain movement between vertebrae and to protect discs from shear forces, excessive flexion and axial rotation. The mechanical properties of the disc allow for load transmission and shock absorption.

According to Cox (1996) each lumbar vertebrae is capable of 5 basic movements, which include, flexion, extension, lateral bending, rotation, and circumduction. This normal anatomical range of mechanical movements of the lumbar facet joints is a pre-requisite to efficient pain-free movement.

He further stated that a lumbar facet joint capable of producing these movements in a pain-free manner was a healthy articulation. The main movements of the lumbar spine include flexion, extension, lateral flexion and rotation. At the lower two lumbar vertebrae, flexion and extension predominantly occur. Rotation at each lumbar vertebra is limited to a few degrees due to the vertical orientation of the facet joints. Combined flexion and rotation carry the highest injury potential (Kirkaldy-Willis and Burton, 1992).

However, certain biomechanical conditions that underlie common forms of low back pain and which involve only minor structural abnormalities occur frequently and are referred to as mechanical low back pain. These disorders involve altered biomechanics of the spine and result in minor aberrations of structure or injury of the lumbar spine motion segments. Although these are usually due to minor injuries they can have quite major short and long term consequences (Bogduk, 1995).

Despite the apparent difficulty in determining the exact aetiology of back pain in a single individual, there has been substantial biomechanical, physiological and psychosocial research which has produced information concerning the risks predisposing to back pain and disability in the population. There appear to be 9 factors important in the pathogenesis of back pain:

1. Increasing age
2. Increase in manual labour

3. Lack of fitness
4. Poor health
5. Degeneration
6. Exposure to vibration
7. Smoking
8. Psychosocial factors ( Haldeman, 1993)
9. Posture

According to Morris (2006) the ability of a physician to resolve the actual cause of the problem from within such a multiplicity of pain-producing structures requires highly developed clinical and diagnostic skills as well as valid clinical instrumentation.

Four main mechanisms by which pain may arise from facet joints are:

1. Mechanical pinching of synovial fold tissue, which may result in traction on the pain sensitive tissues resulting in tissue damage and cell rupture.

   The subsequent release of pain producing substances, results in noxious nerve impulses arising from the nocioceptors. This accounts for the low back pain sensation and discomfort felt by the patient (Giles, 1989:159).
2. Traumatic capsular synovitis which results in ischeamic changes within the surrounding tissues, which in turn leads to ischaemic pain (Giles, 1989:159). Capsular tissue is well supplied with capillaries and neural elements, at all spinal levels.

Small bundles of myelinated and unmyelinated nerve fibres have been consistently found in the posterior joint capsule, in the adjacent part of the subintimal layer and in the adipose synovial plica. The capsule has been found to have a substantial innervation by sensory (nocioceptive and mechanoreceptive) and autonomic nerve fibres as well as having a structural basis for pain perception (Vandenabeele et al., 1997 and Mclain, 1998).

3. Ligamentum flavum. Ashton et al. (1992) and Vandenabeele et al., (1995) have shown that neural structures are present in the ligamentum flavum, which forms the medial part of the capsule. In addition, the ligamentum flavum is closely related with a number of potentially important pain sources. The fibres of the ligamentum flavum have been found to merge with the capsular structures of the facet joints (Grifka et al., 1997). It has also been found that some erector spinae muscle fibres attach close to the attachment point of the ligamentum flavum (Viejo-Fuertes et al., 1998).
4. Multifidus muscle myofascial pain syndrome: According to Schneider (1991) the multifidus muscles are a largely neglected source of pain and vertebral joint dysfunction and believes that after acute trauma to structures of the vertebral motion segment such as the disc or facet, reflex multifidus muscle spasm can develop and cause segmental fixations.

Schneider (1991) further states that it is possible for multifidus muscle spasm to linger after the initial inflammatory response of chemical irritation by extruded disc material or facet syndrome has subsided. This might be an attempt by the central nervous system to continue to “guard” the motion segment by muscular splinting until complete healing has taken place. If multifidus hypertonicity continues long enough the muscle might be predisposed to develop myofascial trigger points (Travell and Simons, 1983).

According to Kirkaldy-Willis and Burton, (1992) reflex multifidus muscle spasm may occur after any trauma to the lumbar facet joints, even without associated disc damage. The facet joint capsules which surround the articular processes are richly innervated with free sensory nerve endings (nocioceptors). During facet trauma, and the ensuing synovitis, these nocioceptors are sensitised and send pain impulses to the dorsal horn of the gray matter of the spinal cord, where they synapse in the internuncial pool.

Spinal interneurons then convey the pain impulses to the thalamus, but also “spillover” to the segment’s motor neurons, which causes a reflex “protective” muscle spasm in the muscles overlying the affected lumbar facet joint.

Guyton and Hall, (1996) have stated that this is similar to the withdrawal reflex, where a painful stimulus causes reflex muscle contraction in order to move the body part away from the source of pain.

Schneider (1991) further states that it can be assumed that the multifidus muscle may perhaps be the best suited muscle to protect the facet joints, due to its unique ability to prevent movements at specific spinal motion segments. However, it can then be theorized that hypertonic multifidus muscles might lead to fixations and any lack of functional mobility within a joint can lead to chronic mechanical pain syndromes such as chronic lumbar facet syndrome (Schneider, 1991). Schneider (1991) believes that mechanical stretching of the multifidi muscles during traction would relax hypertonic muscle fibres and thereby remove the restraining force on the facet joints.

There is an emerging body of literature demonstrating decreased function, atrophy and fatty infiltration in the multifidus muscle structure which appears to be important with regards to segmental stability of the lumbar spine. CT imaging of trunk muscles in chronic low back pain patients has shown atrophy and increased fatty deposits within multifidus muscles (Danneels et al., 2000 and Kamaz et al., 2007). An aetiological relationship between atrophy of the multifidus muscle and the occurrence of LBP can not be ruled out as a possible explanation. Alternatively, atrophy may be the consequence of LBP. A possible reason for this is that after the onset of pain and possible inhibition of the multifidus has occurred, a combination of reflex inhibition and substitution patterns of the trunk muscles, e.g. Psoas, may occur and may ultimately work together and cause selective atrophy of the multifidus.

Since this muscle is considered important for lumbar segmental stability, it can be assumed that atrophy of this muscle may be a reason for the high recurrence rate of LBP.

## 2.6 THE TREATMENT OF LOWER BACK PAIN (LBP)

Tong, Leslie and Pergolizzi (2007) state that the majority of episodes of LBP are mechanical or musculoskeletal in origin and respond well to exercise and conservative pharmacological treatment (NSAIDs). Furthermore, non-surgical and non-invasive therapies are frequently prescribed. Conservative treatments vary widely and are generally individualized to the patient.

If LBP is unresponsive to conservative treatment, such as, exercise, NSAIDs, skeletal muscle relaxants, superficial heat therapy and cryotherapy as well as patient education, then other treatment options include more aggressive pharmacological alternatives, spinal manipulation, traction and more recently developed therapies such as transcutaneous electrical nerve stimulation (TENS), interferential current (IFC) and ultrasound (Chou et al., 2007). Chou et al., (2007) state that additional non-invasive modalities exist for treating chronic LBP which include exercise regimens such as Pilates and yoga, spinal traction (manual, mechanized and motorized), back schools and cognitive behavioural therapy (CBT).

Borman et al. (2002) have suggested that many modalities used in physical therapy for LBP are questionable and that the optimal treatment still remains uncertain. Van Tulder et al., (1997), Rastanen (2001) and Tong, Leslie and Pergollizi (2007) have suggested that the effectiveness of a treatment often varies and therefore the evaluation thereof is difficult. Traction is a therapeutic option that is often combined with other treatment modalities (Hansen et al., 1993, Beurskens et al., 1995 and Revel, 2000).

## 2.7 THE ROLE OF TRACTION IN CHRONIC LOW BACK PAIN

Physicians have used traction since ancient times as a means of correcting spinal deformities Revel, (2000).

But since the advent of bracing techniques and orthopedic surgery, indications for using traction therapy have fallen out of favour (Gay and Brault, 2008). However, recent studies conducted by Sari et al., (2005) have shown conclusively using computed tomographic evaluation, that lumbar spinal traction does indeed reduce prolapsed intervertebral disc material from the disc space along with reducing any compression effects of prolapsed disc material on the neural foramina, as well as increasing the neural foraminal diameter and the spinal canal diameter.

It has been reported by various other studies (Beurskens et al., 1995., Caillet, 1981., Guvenol, Tuzun, Peker, and Goktay, 2000., Lechumann and Brunner, 1958., Kekosz, Hilbert and Tepperman, 1986., Letchuman and Deusinger, 1993., Mathews, 1972., Neuwirth, Hilde, and Champbell, 1952 and Revel, 2000) that traction diminishes the compressive loads on intervertebral discs, and facet joints as well as causing a flattening of the lumbar lordosis which stretches lumbar spinal musculature and ligaments. As a result, the stretching effect of traction on muscles and ligaments may lead to a reduction in muscle spasm and a widening of the intervertebral foramina and facet joint spaces which may in turn lead to a reduction in low back pain.

Borman et al., (2002) have stated that the literature is conflicting with regards to the efficacy of lumbar Static linear traction in the treatment of acute LBP (Rastanen, 2001 and Revel, 2000) although it has long been the preferred treatment for treating lumbar disc problems.

Beurskens et al., (1995) and Revel, (2000) have conducted comprehensive trials indicating that traction therapy was ineffective in the treatment of non-specific LBP. Revel (2000) did note that when traction was applied in conjunction with other forms of treatment, such as, manipulation, exercise therapy, NSAIDs and modaitiies such as IFC, it was beneficial in patients with LBP. However there is no compelling evidence to show that lumbar traction is clinically ineffective.

### 2.7.1 Types of traction:

In their recent review on the management of chronic low back pain with traction therapy, Gay and Brault (2008) have suggested that sustained traction (20-60 minutes) and intermittent traction (alternating traction and relaxation with cycles of a few minutes or less), as supported by (Cyriax, 1964; Cox,1996; Hinterbuchner, 1985; Ljunggren, Weber and Larsen, 1984 and Pellechia, 1994) are the two most important parameters to consider when looking at the type of traction applied, as well as whether the traction force was applied by motorised or manual means (Macario and Pergollizi, 2006).

In addition to an intermittent and sustained traction force application, it is also important to note whether the forces applied are dispersed throughout the lumbar spine, such as in sustained Static linear traction, or if there is a logical effort to focus the force, as is the case with intermittent flexion distraction (Leander traction). Gay and Brault, (2008) recommend that a traction force of 30%-50% of body weight is thought to be most effective in causing maximal vertebral separation without being uncomfortable to the patient ( Beurskens et al., 1997; Borman et al., 2003; Konrad et al., 1992 and Van der Heijden et al., 1995). Traction can be applied with the patient in most positions including supine, prone, side-lying or suspended upright or inverted.

### 2.7.2 The effects of traction therapy:

Several theories have been proposed to explain the possible clinical benefit of traction therapy for CLBP. According to Pellechia (1994), Cox (1996) and Gudavalli (1998), distracting the motion segment is thought to change the position of the nucleus pulposus relative to the posterior annulus fibrosis or change the disc-nerve interface (Knutsson, et al., 1988). These effects seem plausible based on studies examining the kinematics of the lumbar spine during traction therapies (Gay and Brault, 2008).

In addition to separating the vertebrae, traction has been shown to reduce nucleus pulposus pressure (Ramos and Martin, 1994 and Gudavalli, et al., 1997), as well as increase foraminal area (Gudavalli, et al., 1997).

Gay and Brault (2008) however noted that it is unlikely that mechanical changes observed in a prone position will be sustained after a patient resumes an upright, weight-bearing posture and go on to say that any lasting clinical response to traction therapy would more likely be because of the effect of traction on the mechanophysiology of the motion segment or neural tissues. A further consideration is that not all traction therapies exert the same force on the spine.

Animal studies performed by Maclean, et al., (2005) have shown the mechanophysiology of the disc to be sensitive to the amount, frequency and duration of loading. It has been shown that controlled dynamic disc distraction may stimulate disc and joint repair (Kroeber, et al., 2005), whereas tensile loading on the intervertebral annulus fibrosis promotes tissue degradation (Iatridis, et al., 2005).

Cox (1993) has stated that besides the mechanical effect on the disc and posterior spinal ligaments, traction therapy may also achieve pain reduction through mechanoreceptor stimulation, due to mobilization of the facet joints during the traction procedure. Kirkaldy-Willis and Burton (1992) and Revel (2000) also state that the mechanoreceptors are located within the joint capsule of the facet joints, and communicate joint position/velocity information to the central nervous system.

They are large diameter, myelinated fibres of the A type, and are known to have a strong inhibitory effect on the transmission of pain impulses at the spinal cord level (Melzack and Wall, 1983). Lee et al., 2004 have examined the brain circuitry involved in emotional experiences using functional magnetic resonance imaging and have determined that the cerebral hemispheres are specialized for positive and negative emotional experiences.

The above authors have determined that positive-approach related emotions are associated with the left cerebral hemisphere region and negative withdrawl-related emotions are more aligned with the right hemisphere. It was concluded that it was important for proper linking of circuitry of subcortical structures with mesial temporal, anterior cingulated and frontal lobe regions in emotion and that that the valence model of emotion was essential in lateralized cerebral specialization for positive and negative emotional experiences. In essence, mechanoreceptor impulses travel to the spinal cord faster than pain impulses, where they close the pain “gate” in the dorsal horn of the spinal cord. Mechanoreceptor stimulation is also known to inhibit motorneuron activity, which could reduce the tonus of segmentally innervated muscles groups and so reduce muscle tone.

Schneider (1991) has suggested that traction therapy, particularly flexion distraction, stretches the joint capsules in an oscillatory fashion, and probably stimulates mechanoreceptors during each phase of traction, resulting in both analgesia and decreased muscle tone. Schneider (1991) stated that while the posterior spinal elements are undergoing traction, the multifidus muscles are also being vigorously stretched and if the sarcomeres of a muscle are in a state of contracture (unable to separate), traction may force separation of the myofibrils and promote relaxation by lengthening the fibres.

It has also been noted that a strong stretch of muscle tissue will also cause stimulation of the proprioceptors, the golgi tendon organs, and the muscle spindles, which will cause reflex inhibition of motor neuron activity and reduce muscle tone (Schneider, 1991).

According to Schneider (1991) this would have an immediate effect on restoring facet joint mobility', and when using a Leander traction table, the doctor can concentrate the traction force at specific vertebral levels by placing a contact hand over a spinous process, and applying head ward (cephalad) pressure while the caudal section of the table moves down.

This motion would allow the multifidi muscles to be stretched and since the multifidi muscles originate at the spinous processes and insert onto the mammillary process of a vertebrae one or two levels below, it will receive a very specific stretch when traction is applied with added manual spinous pressure.

However, Eckard, (2007) believes that any downward force applied over facet joints during Leander traction may be potentially harmful to that joint.

For the purpose of this study the researcher applied no downward force over the affected lumbar facet joint during Leander traction, but instead, applied a gentle stabilizing force with the contact hand over the affected lumbar facet joint during Leander traction. Schneider (1991) suggests that vigorous and continual stretching of the multifidi during Leander traction may eliminate associated trigger points in a manner similar to spray and stretch or postisometric relaxation techniques, due to the reflex inhibition of motorneurons in the spinal cord (Travell and Simons, 1983).

It was noted earlier by Schneider (1991) that a slight PA mobilization force should be applied by the doctors contact hand which was placed over the spinous process of the affected lumbar facet joint. However, Eckard (2007) states that this could be potentially harmful to the facet joints and for this reason a stabilization force was applied by the researcher in this study. This was done by placing the contact hand over the interspinous space above the affected lumbar vertebrae and stabilizing the joint at each end range of motion of the Leander traction table. It was assumed that by doing this, it would prevent any proposed adverse effects of PA mobilization in FD (Eckard, 2007) whilst maintaining the desired mechanical affects of FD as proposed by Lee and Evans (2001) table 1.

**Table 1.** A comparison of the mechanical effects of Static linear traction and PA mobilization with flexion-distraction (Lee and Evans, 2001)

| | **Static Linear traction** | **PA mobilization and FD (Leander traction)** |
|---|---|---|
| **Loading pattern** | Flexion moment and distraction of the lumbar spine. Segments are subjected to anterior shear. | 1. PA mobilization causes a three point bending of the lumbar spine which leads to an extension moment.<br>2. Segments above the mobilized vertebra are subjected to posterior shear, and those below to anterior shear. |
| **Intervertebral foramen (IVF)** | Increase in foraminal volume | 1. PA mobilization causes a decrease in foraminal volume.<br>2. Leander traction type FD causes further possible decrease in IVF size due to extension-distraction effect (Cox, 1999:276) |
| **Posterior annulus and other posterior soft tissues.** | Stretches the posterior tissues. | 1. PA mobilization relaxes the posterior tissues (Lee and Evans, 2001).<br>2. Leander traction causes a decrease in height of the posterior disc space which in turn causes anterior migration of the nucleus pulposis (Cox, 1999:275-276 and Ekard, 2007).<br>3. FD moblizes fixated facet joints and restores physiologic motion to the posterior elements of the vertebral motion segment (Cox, 1999). |

The basic concepts and theories of Static linear traction and FD will now be discussed in terms of the exact application and the efficacy of both treatments in the treatment of chronic LBP.

### 2.7.3 Static (sustained) linear traction:

Static linear traction can be classified as a form of sustained traction with a split table design where the traction force is dispersed over a wide area of the spine, specifically in this case the lumbar spine. According to Onel et al., (1989) Static linear traction is achieved by attaching a harness around the pelvis (to deliver a caudal pull) and the upper body is stabilized by a chest harness (for cephalad pull), 70-150lb (30%-50% body weight) off pull is generally needed to distract lumbar vertebrae. It is generally considered in the literature that a minimum of 35% of total body must be applied before effective linear traction of lumbar spine is possible (Borman et al., 2003; Gay and Brault, 2008; Krause et al., 2000 and Revel, 2000).

Static linear traction has been shown to separate vertebrae (Panjabi, 1983), decrease intradiscal pressure, (Ramos and Martin, 1994 and Sari,2005), reduce electromyographic paraspinal activity, (Letchuman and Deusinger, 1993), and retract herniated disc material (Onel, et al., 1989 and Sari, 2005).

It is therefore assumed that Static linear traction may cause a reduction in the size of disc herniations as well as causeing decompression of the nerve roots. However, Anderson et al., (1983) believes that any sustained or intermittent traction force will affect myoelectric activity within paraspinal muscles by causing an increase in contraction of these muscle groups which may in turn cause an in increase in IVD pressures rather than a decrease in IVD pressures.

This form of traction can be beneficial in the treatment in chronic mechanically related lumbar spine conditions such as lateral spinal nerve root compression which is directly related to lateral spinal canal stenosis. It has been shown by Letchuman and Deusinger (1993) that static and intermittent traction on the lumbar spine had no real significant difference in magnitude of myoelectric EMG activity of lumbar sacrospinalis muscle groups. However, more than 50% of patients in both traction groups experienced decreased pain after traction. This may be attributed to a decrease in myoelectric EMG activity of hypertonic multifidus muscles, which have been theorized (Kirkaldy-Willis and Burton, 1992) to play a major role in the maintenance of dysfunction and pain associated with disc and facet injury. However, no studies have looked at EMG activity of multifidus muscles during sustained or intermittent traction of the spine.

Lee and Evans (2001) have stated that Static linear traction causes a flattening of the lumbar lordosis through the flexion moment produced by traction. This is achieved by having the patient assume the Fowler's position, for example: the patient lies supine with a cushion placed under both knees causing flexion of both knees and hips. Lee and Evans (2001) suggest that the Fowler's position would take up the initial slack of posterior soft tissues of the lumbar spine and when traction is applied to posterior soft tissues this extra stretch caused by the traction force would produce various therapeutic effects. Therefore, the Fowler's position is clinically important in that it reduces the traction force required to stretch posterior tissues. Humphreys et al., (1998) have shown that the flexion moment had a more significant affect on increasing foraminal volume than the axial traction force. Lateral radiographs of Lumbar facet syndrome often show the spine in hyperlordosis, which in turn places extra stress on the lumbar facet joints (Gatterman, 1990 and Cox, 1999). This disruption of the normal spinal curvature of the lumbar spine can result in several deteriorative processes starting at that affected area. According to Abrams (1999) one of these deteriorative processes that occurs as a result of an increased spinal curvature is the inflammatory reaction that occurs on and around the IVD, facet joints and spinal nerves.

Static linear traction has been shown to produce a statistically significant increase in the bony foraminal surface area, though no significant change in the central canal area was found (Schlegel, et al., 1994 and Sari, 2005). It has been shown that when Static linear traction is applied intermittently, while the patient is in the Fowler's position, that this would have no significant change in the size of the lateral spinal canals due to the lack of a 'sustained' traction force administered (Saunders, 1983). Revel (2000) has stated that entrapped synovial folds, which are highly pain sensitive structures within a facet joint, could be released due to the distracting affects of traction. Therefore, based on the above literature, it is plausible that Static linear traction can have an effect on the lumbar facet joints. No studies have been done on the effects of Static linear traction on lumbar facet syndrome. Thus the aim of this study was to examine the efficacy of Static linear traction and FD therapy for patients with chronic lumbar facet syndrome.

### 2.7.4 Flexion Distraction (Leander traction):

Chiropractic practice has employed many methods and techniques to manipulate/mobilize the vertebral motion segments in an effort to relieve pain, restore joint mobility, and achieve normal neural function. Various forms of traction therapy have been used by chiropractors to apply sustained and intermittent traction forces throughout the spine so as to mobilize/ stretch the spinal joints (Cox, 1999, Eckard, 2007 and Gay and Brault, 2008).

Chiropractors James Cox and Leander Eckard have defined FD as a logical effort to concentrate forces into the lumbar spine motion segments while linear traction forces are intermittently varied (Cox, 1999, Eckard, 2007 and Schneider, 1991).

In FD the doctor decides the direction and extent of off-axis force (most often flexion, lateral flexion, or extension) that can be used based on the patient's symptoms and tolerance for treatment (Cox, 1999). The specialized treatment tables designed by chiropractors James Cox and Leander Eckard presently appear to be the most popular FD traction tables in chiropractic use. Motorized FD tables are innovative manipulation/ PA mobilization devices and are also known as Leander or Cox traction tables which provide a constant up and down movement that is used by the clinician to facilitate PA mobilization of the lumbar spine and pelvis. Flexion creates 'Y' axis decompression; therefore motion segments within the entire spine benefit and the chiropractor can assist in this attempt and make specific PA mobilizations and adjustments to the spine (Eckard, 2007). For the purpose of this study the examiner stabilized the motion segment by pressure over the spinous process as opposed to exerting PA mobilization forces whilst performing the FD.

Leander Eckard, D.C., has developed a mechanized flexion distraction table that is similar to the one developed by Cox, but it differs in one major way in that it is used to apply axial traction and PA mobilization with the spine in slight extension, or in a lordotic (neutral) position. Eckard (2007) states that the doctor can apply a manipulative thrust or slight cephelad PA mobilization with the doctors contact hand while the table is mechanically separating the facet joints during traction. Eckard (2007) also emphasizes that manipulative thrusts require much less force than conventional manipulation. Eckard (2007) however believes that manipulative thrusts along with PA mobilization of spinal segments may be improper and potentially traumatic because it places too greater force on the posterior elements of the annulus fibrosis, facet joint capsule, and posterior ligaments. Therefore, for the purpose of this study the examiner stabilized the motion segment by a gentle pressure over the spinous process.

Leander traction is different from traditional Static linear traction in that rather than allowing the forces to be dispersed throughout the lumbar spine it attempts to concentrate the traction force on a smaller area of the lumbar spine. This is achieved by the chiropractor's contact hand, which is placed cephalad over the spinous processes of the affected vertebrae (Schneider, 1991).

Leander traction is seen as type of FD as shown by Cox (1999) except that Leander traction tables differ with a drop abdominal section. Both authors however promote FD but have one fundamental difference in their respective techniques and that is that Leander traction promotes FD when the spine is in extension (extension-distraction) and Cox from flexion. Eckard, (2007) however believes that the lumbar spine should be in a neutral (normal lordotic) position during traction because the nucleus pulposis moves more anterior in such a position, as apposed to the nucleus pulposis moving more posterior when the spine is in flexion as is the case with the Cox method of FD. For the purpose of this study the abdominal section was lowered as applied by Eckard, (2007).

In a review of the literature of flexion distraction of the lumbar spine Gay, Bronfort and Evans, (2005) together with Cox, (1999) have suggested that studies that have evaluated the theories of effect of FD (such as, increased height of IVD, reduction of disc protrusions, relief of stenosis, reduction of intradiscal pressure, reduction of segmental muscle hypertonicity, improved posture and locomotion and the clinical effects of FD on low back pain and leg pain have shown that FD could be a reliable form of treatment for LBP. But the exact mechanisms by which FD may influence spinal disorders are unknown (Schneider, 1991).

Cox (1999) believes that FD stimulates Group 3 afferent nerve fibres, opioid production and along with decreasing the intra-articular pressure within the lumbar facet joints by passively moving these joints, there will be a decrease in pain. Due to the mobilization effects of Leander traction it can be assumed that motion also occurs in the facet joints which may improve symptoms shown by facet syndrome. Gay, Bronfort and Evans (2005) have suggested that FD might release entrapped synovial folds between lumbar facet joint surfaces as well as stretching or possibly disrupting periarticular adhesions, depending on their orientation to the stress vectors induced by the treatment. It was stated by the above authors that it was unclear whether mechanoreceptive stimulation induced by FD was sufficient enough to reduce pain.

Gay, Bronfort and Evans (2005) in their review of FD on the lumbar spine have suggested that FD may also benefit disorders other than disc herniation, such as, facet syndrome. They suggest that FD and Static linear traction have been shown to increase the thickness of articular cartilage which can be beneficial in chronic lumbar facet syndrome (Salter, 1996). The above authors suggest that traction may also counteract the detrimental effects of segmental hypomobility and immobility by mobilizing muscles (multifidus) and segmental levels where muscle spasm has rendered the joint immobile or hypomobile.

This is especially evident with FD where there is a continuous passive stretch on the affected motion segment. It was also postulated by the above authors that traction and particularly FD may improve segmental instability by improving the biomechanics and motion control of a facet joint, as well as improving reflex activation, improved proprioceptive acuity through the stimulation of low-threshold receptors, may ultimately reduce pain. Panjabi (1992) has stated that instability results from changes in the neutral zone of a motion segment and may occur as a result of trauma, degenerative changes or loss of motion control.

Gay and Brault (2008) in their review of management of chronic LBP with traction therapy have stated that although (FD) has been used by chiropractors since the early 1970's, the first clinical trial examining its efficacy for LBP was only recently published. A recent randomised clinical trial and subgroup analysis conducted by Gudavalli, Cambron and McGregor (2006) which compared active trunk exercises with FD, showed that patients with moderate or severe LBP benefited most from FD and those who had recurrent pain benefited most from trunk exercises. Patients in this study were 18 years and above and had to have had LBP for 3 months or longer. The sample size was 235 where 50 patients were diagnosed with radiculopathy.

Patients who received FD had treatments 2-4 times per week for 4 weeks and follow-ups were done after 4 weeks, 3, 6 and 12 months. The FD was performed on specially constructed table with a moveable headpiece and a movable lower piece. With the patient lying prone the clinician placed one hand over the affected area of the lumbar spine and used the other hand to flex, laterally flex and rotate the lower section of the table.

Two treatment components were used in this study. Firstly traction was directed at the affected level using the flexion component of FD and then secondly, mobilizations were used with a combination of ranges of motion which were targeted at the affected level. Most patients moved from the traction component to the mobilization component within 4 weeks of care. A single FD treatment lasted between 3 and 6 minutes. For patients who had radiculopathy, the FD procedure in flexion was used. The number of repetitions was determined by symptom severity and only three sets of repetitions were given at each visit. Each repetition was held for 4 seconds and a maximum of five repetitions were allowed for each set. Patients who had radiculopathy only had mobilizations applied to the affected are. It was also noted that all clinically relevant levels from the lower thoracic spine through L5/S1 level were treated. These were determined through motion palpation and static palpation of the lower thoracic spine and lumbar spine and through other signs and symptoms associated with each case.

It was noted that the FD group received modalities such as ultrasound and cryotherapy and that treatment protocols were assessed for consistency between providers. The active trunk exercise program (ATEP) was administered by licensed physical therapists and consisted of flexion or extension exercises, weight training, flexibility exercises and cardiovascular exercises dependent on patient symptoms and were aimed at strengthening the muscles surrounding the spine and increasing flexibility. Both groups improved after 4 weeks but there was a statistically significant improvement for the FD group ($p=0.1$). However, chronic patients seemed to benefit more from the exercise protocol. Cambron, et al., (2006) did a one year follow up study and showed that the patients who received FD where still pain free after 12 months. This clinical trial showed a slight difference in visual analogue pain scale (VAS) favouring FD at 5 weeks ($p=0.1$) in both intention to treat and completed treatment groups. Furthermore, patients with moderate or severe sustained pain benefited most from FD and that those who had recurrent episodes of pain benefited more from ATEP.

In a further randomised clinical trial conducted by Beyerman et al., (2006) which compared FD with trigger- point therapy and Sham manipulation and effleurage, it showed that both groups improved at an equal rate and that there was no difference in Pain disability indexes and Roland- Morris pain questionnaires. Patients had to be 18 years and above and had to have had LBP for 4-12 weeks. The mean age of patients in this study was 51 years and 8 treatments of FD were applied over 3 weeks with a 3 week post treatment follow-up.

In this study two-hundred and fifty two patients with low back pain associated with osteoarthritis were randomly assigned to the treatment group (moist hot pack and FD) or the moist heat group. Each group attended 20 treatments over several weeks. At sessions 1, 5, 10, 15 and 20 subjective and objective measurements were taken using a visual analogue pain scale, Oswestery Low Back Pain Questionnaire and range of motion was measured using a J-Tech dual inclinometer.

Based on their review of the literature on FD on the lumbar spine Gay, Bronfort and Evans (2005) have stated that FD and traction result in a reduction of intradiscal pressure and decompression of the foramina but the clinical effectiveness of these forms of treatment have been not been adequately addressed.

In a Trial conducted by Beira and Peers (1998) which outlined the effects of FD on the diameter of the spinal canal in patients with low back pain and radiculopathy. It was revealed through an MRI axial view of levels L4/L5, that FD had reduced the amount of the spinal canal that was occupied by the disc herniation, however the sample size of the study was to small (n=30).This is supported by Gudavalli (1998) who suggests that FD will reduce disc material within the spinal canal due to the distracting affect of FD on the posterior longitudinal ligament.

Hawk, et al., (2005) and Beyerman, et al., (2006) have all compared the affects of FD and spinal maniplation and have shown that both groups improved equally and that there was no difference in Numerical Rating Scale (NRS-101) and Oswestry Low Back Pain Disability index (ODI) between the groups. However, the effects of FD and manipulation could not be isolated in the above trials, but it appeared that when FD was coupled with other treatment modalities, such as, manipulation, there was a statistically significant reduction in pain experienced by the patients. Hawk, et al., (2005) conducted a randomized controlled clinical trial on one hundred and eleven individuals older than 18 who were suffering from sub-acute or chronic low back pain.

The application for prescribed ranges of biomechanical forces for each treatment was standardized using specialized computer equipment. Interpersonal interactions were provided by a primary clinician who was blinded to the treatment assignment and treating clinicians delivered treatments with minimum interaction. The primary outcome measures for this study were the accuracy of the patient's perceptions of group assignment, which was done on the $4^{th}$ visit as well the mean changes in the pain disability index. The results of this trial showed that patients in the control group were more likely to perceive their treatment assignment accurately than those in the active group (78% versus 54% respectively).

Patients in both groups improved at the same rate. Age, gender, prior chiropractic experience and expectations of treatment at baseline had no effect on the outcome. Patients in the control group were however not successfully blinded. It was concluded from this study that therapeutic factors other than biomechanical force, which were common to both groups, showed a clinically significant reduction in pain for both groups.

Therefore the aim of this study was to compare the efficacy of Static linear traction and Leander traction (flexion distraction) in the treatment of chronic lumbar facet syndrome.

By looking at the evidence stated above it can be assumed that traction can be used as a means of treating lumbar facet syndrome. Revel, (2000) and Schneider, (1991) believe that the biomechanical effects of traction could aid patients with entrapped synovial folds within the facet joints as well as creating a rhythmic stretch on hypertonic multifidus which could be major causative factors in facet syndrome as well as the mechanism by which pain is relieved by blocking the pain gate. This research will endeavour to evaluate the efficacy of Static linear traction and Leander traction in the treatment of facet syndrome, a common mechanical type of lower back pain.

# CHAPTER THREE – METHODOLOGY

## 3.1 INTRODUCTION

This chapter deals with the main methodological factors that were used in order to substantiate the basis for the data collection process and the statistical methods used to interpret the data.

## 3.2 STUDY DESIGN

This was a randomised 2 group parallel controlled clinical trial, utilizing convenience sampling. A sample group of 30 symptomatic participants was used. This study received approval from the Institutional Review Board (FRC) of DUT and was compliant with the ethical standards of the Helsinki Declaration of 1975, in the format that it was executed and is presented here.

## 3.3 SUBJECT RECRUITMENT

Participants were selected from those who responded to advertisements (Appendix A) placed in public places, pamphlet distribution and newspaper advertisements. This study was conducted using symptomatic participants only and all volunteers were screened prior to their acceptance into the study based on the inclusion and exclusion criteria.

## 3.4 SAMPLE SIZE AND GROUP ALLOCATION

A priori calculation was used to determine the sample size before this study was conducted. To do a priori you need to know the difference in terms of means and standard deviations you are expecting between the groups so you can determine how large a sample you need. According to the priori calculation in this study, the fewest number of participants required to obtain a significantly significant result was thirty participants.

Formal sample size calculations were not possible since accurate statistics on which to base the sample size calculations were not available. Trends in the observed differences and relationships between variables will be emphasised rather than statistical significance sinne this study will be considered as an exploratory study. The reason for this is that these techniques have never formally been assessed for this particular condition and it is necessary to initially assess the existence of a treatment effect. (Esterhuizen, 2008).

Thirty participants were divided into two groups (A and B). This was done by placing 15 A's and 15 B's in an envelope and through convenience sampling. The participants were asked to remove a piece of paper from the envelope and without looking at it, hand it to the researcher.

The paper removed from the envelope therefore determined which group the participant was allocated to. Group A participants received Leander traction and Group B participants received Static linear traction. Each group of fifteen participants had chronic lumbar facet syndrome.

## 3.5 CLINICAL PROCEDURE

### 3.5.1 Patient procedure

Potential candidates had to undergo a telephonic interview where the following questions were asked to determine if they fell within the inclusion criteria of this study before an appointment was scheduled:

1) Are they experiencing LBP with or without pain radiating into the groin, hip, buttock, and often the leg, in most cases above the knee (Gatterman, 1990).
2) Does bending backwards increase the pain (Gatterman, 1990).
3) Do any activities, such as, sleeping on the abdomen, sitting in an upright position, lifting a load in front of the body at or above the waistline, working with the hands and arms above the head, and arising from sitting, increase the pain.
4) Participants were also asked if their age range fell within the specified range of 25 to 55 years of age and what length of time they had been experiencing low back pain.

If candidates answered yes to two of the first three questions asked in the telephonic interview they were considered for this study as per the inclusion and exclusion criteria.

Appointments were scheduled where the study was explained to the patient. Participants were then given an informed consent form to sign and a letter of information. Participants were then evaluated at the initial consultation. During that consultation, a diagnosis was made based on a case history (Appendix B), physical examination (Appendix C), relevant lumbar spine regional examination (Appendix D) and SOAPE note (Appendix E). In order to establish whether they were eligible for this study, they had to meet the following inclusion and exclusion criteria:

### 3.5.2 Inclusion Criteria

1. Participants had to be between the ages of 25 and 55 years to decrease the chance of sacroiliac and / or spinal ankylosis (Kirkaldy-Willis and Burton, 1992:418).
2. The participants pain rating scale on the NRS had to be greater than 3 and less than 7, (Jensen, et al., 2005), to improve the sample homogeneity (Mouton, 1996:132).

3. All participants had to have intermittent chronic mechanical low back pain (lumbar facet syndrome) with duration of 6 weeks or longer .This is because most individuals suffering from low back pain improve within 6 weeks (Liebenson, 1996:3). This will improve sample homogeneity.
4. Orthopaedic tests are considered part of the diagnostic criteria for confirming a posterior facet syndrome; however, it is possible that they can be used to assist in the confirmation of diagnosis. In order to be included in this study, participants must have had a minimum of three out of the five orthopaedic tests listed below being positive.
    a) Kemp's test (Gatterman, 1982: 141 and Magee, 1992: 399).
    b) Facet joint challenge (Bergman, 1993: 95).
    c) Palpatory tenderness (Magee, 1992).
    d) Spinous percussion (Bergman, 1993: 103).
    e) Pain on extension over the affected lumbar facet joint (Gatterman, 1990).
5. Participants were required to sign an informed consent form to ensure that they undertook participation in this study in full awareness of all that it entailed. They were given the option to ask any questions pertaining to the research, and they understood that they were free to withdraw from the research at any time.

### 3.5.3 Exclusion criteria

1. Participants who presented with signs and symptoms of posterior facet syndrome in combination with any of the following (Kirkaldy-Willis and Burton, 1992:291) were excluded:
    a) Presence of paresthesias.
    b) Presence of neurological deficit.
    c) Presence of root tension signs.
    d) Presence of hip, buttock, or back pain on straight leg raising (Magee, 1997).
2. Contraindications to manual therapy, (Bergman et al., 2002; Gudavalli et al., 2006 Kirkaldy- Willis and Burton, 1992:291).
    a) Severe osteoporosis that was previously diagnosed.
    b) Lumbar fracture.
    c) Evidence of central nervous system disease.
    d) Systemic disease potentially affecting the musculoskeletal system.
    e) Failed fusion surgery.
    f) Inability to undergo physical therapy or flexion distraction therapy for any other reason.
    g) Psychiatric illnesses or lack of cognitive abilities that would potentially modify true responses on primary outcomes.
    h) Current and known substance abuse.
    i) Large Abdominal Aneurysm.

j) Visceral referred pain.

k) Morbidly obese.

l) Pregnancy.

m) The presence of fever, tumours, tuberculosis or any infectious disease.

n) Local inflammation, thrombosis, metal implants or a hip prosthesis.

3. Participants who were receiving manual or medicinal intervention including NSAIDS within 48 hours prior to the onset of the study had to comply with a 3-day washout period as proposed by (Poul, et al., 1993).
4. Participants with a history of lower back surgery were excluded from the study as the source of their pain may have been related to the surgery.
5. Participants who required further clinical testing to confirm their diagnosis were excluded from the study.
6. Participants were also excluded from the study if there was any suspicion of substance abuse.
7. Patients with psychiatric illness or lack of cognitive abilities that would potentially modify true responses on primary outcomes were also excluded from the study.
8. Participants who were morbidly obese (40% over ideal body weight) were also excluded from the study (Gudavalli, 2006).

According to Magee (1992), the following must also be considered and for the purpose of this study were excluded.

a) Spinal malignancy.
b) Severe cardiovascular disease (angina, atherosclerosis, vascular insufficiency of the lower extremity).
c) Rheumatoid arthritis.
d) Spondylitis which includes ankylosing spondylitis, psoriatic arthritis and reiter's syndrome.
e) Severe osteoporosis.
f) Spinal infection.
g) Large central disc protrusion and/or cord compression.
h) Pregnancy
i) Involuntary head and neck movements.
j) Uncooperative subjects.

### 3.5.4 Intervention

The researcher was the only examiner used in this study. This helped ensure consistency throughout the clinical trial

Once the participant had undergone the full medical case history, revised physical, lumbar regional examinations and had read and signed the informed consent form they were asked to complete a NRS(101) and a PSS(Pain Severity Scale), as adapted from Hsieh et al., (1992) as well as an ODI (Oswestery Disabilty Index) questionnaire.

Each group received five treatments over a 3 week period. There was a 48 hour (two day) interval between each the five treatments as recommended by Kirkaldy-Willis and Burton, 1992 and Morris, 2006 in accordance with theMckenzie protocol for treatment of Chronic LBP. Subjective and objective measurements were taken pre and post intervention on the first and second visits. Participants were required to come for three treatments in the first week (7 days) and two treatments in the second week. Participants were required to wait 7 days after the last treatment ($5^{th}$ treatment) before returning for their final set of readings. On the sixth visit subjective and objective clinical findings were taken in order to gauge the long term effects of the treatment. No treatment was given on the sixth visit.

NRS(101) values were recorded prior to treatment on the $1^{st}$ and $2^{nd}$ visits and then at the $6^{th}$ visit. PSS values however were recorded prior to treatment on each of the six visits. This was done in order to ascertain if there was any statistical significance with each individual treatment. The Participant was then asked to put his/her hand into a hat and pick a piece of paper from the hat. This procedure determined to which group the participant was allocated (i.e. group A or B).

Once the group had been determined by the participant they were asked to be seated on the examination table (i.e. Leander 900 'Z' flexion distraction table) with their backs exposed.

**Leander "900" series table specifications:**

- Electrical Configuration: Available in both 110v and 220v
- Table height:: With Uplift/Variable Height (select): 22"-30" or 24"-32". Fixed height (select): 22", 24", 26" 28", 30" or 32"
- Table Length (fully retracted): 68"
- Table Length (fully extended): 88"
- Flexion Speed: 0-30 strokes per minute
- Uplift Speed: 14 seconds
- Depth of flexion distraction: 16 degrees or 8 ¼" is standard (measured at end of retracted ankle cushion); variable to 7 degrees or 3 ¾".
- Lateral Flexion Travel: 25 degrees either side.
- Weight: 165lbs. (standard)/190lbs. (all options)
- Foam: Regular and optional extra firm.
- Vinyl Colours: Select from 25 Grand Sierra Commercial Grade Vinyl Colours.

Algometer readings were then taken in the seated position, 2cm from to the midline at the interspace above the spinous process (Kirk, Lawrence and Valvo, 1985) of the affected lumbar vertebrae.

The algometer pressure sensitive head was placed horizontally over the area and a horizontal downward pressure force in the horizontal plane was exerted by the examiner over the affected lumbar facet joint and paravertebral muscles (Fischer, 1986). Algometer readings were only taken at the end ranges of motion for Kemp's test (Cipriano, 1985 and Magee, 1992) and spinal extension (Gatterman, 1990) positions before the treatment they had chosen was administered. Algometer readings were also taken immediately post intervention on the 1st and 2nd treatments and also on the last visit (6th visit). However no treatment was given on the final visit and only one set of algometer readings were taken.

For the purpose of this study pressure tolerance was measured by an algometer. Pressure tolerance is defined as the highest pressure (force) which can be tolerated under clinical conditions and is typically measured over normal bone or muscle in order to ascertain any underlying pathological tenderness (Fischer, 1986 and Fischer, 1987). Merskey and Spear have shown that pressure measurements are an effective means of gauging the effectiveness of many treatment modalities and the long term effectiveness of treatment.

Algometer readings for Kemp's test and spinal extension were taken 5 times over the treatment period. Pre treatment and post treatment readings were taken on the 1st and 2nd visits.

Algometer readings were also taken on the 6th visit but no treatment was given. Only one set of algometer readings were taken on the 6th visit. The participant was placed in the Kemp's test (Cipriano, 1985) position (participant was seated on the examination table and the examiner first passively and laterally flexed the participant towards the affected side. Once the participant was in a comfortable position while laterally flexed, the examiner then rotated the person's body towards the affected side while simultaneously passively extending the persons spine at the affected area).

According to Magee (1992) and Cipriano (1985) this position causes maximum narrowing of the intervertebral foramen and stress on the facet joint to the side on which rotation occurs.

Once this position of end range of motion was reached, and if symptoms were reproduced or not reproduced, the examiner then placed the algometer 2cm from the midline at the interspace above the spinous process of the affected lumbar facet joint and paravertebral muscles and exerted a vertical downward pressure with the force dial. The procedure was explained to the participant and they were told to verbally indicate when the pain became too great by saying "Stop" (Fischer, 1986) and the reading was then recorded by the examiner.

Fischer (1986) suggests that the applicator tip should be applied perpendicular to the skins surface at a gradually increasing rate of 2 pounds per second. Fischer (1986) also stated that pressure tolerance measurements vary widely over diverse cultural groups and stated that the average PTM (Pressure Tolerance Measurement) for L4 paraspinals (2 cm from to the midline) were 17.6 lb/cm2 for males and 12.6lb/cm2 for females.

Similarly, algometer readings for spinal extension were taken when the participant was seated on the table. The participant was placed into a position of maximum spinal extension by the examiner where end range of motion was established or until symptoms were or were not reproduced (Magee, 1992 and Gatterman, 1990). Once this position was established the algometer was then placed 2cm from the midline at the interspace above the spinous process of the affected lumbar facet joint and a horizontal downward pressure in the horizontal plane was exerted by the examiner until pain was felt by the participant. The participant was told to say “stop” when pain was felt and the reading was then taken by the examiner. Once the first set of algometer readings were taken, treatment was administered. Immediately after the treatment was administered another set of algometer readings, which included Kemp’s test and a spinal extension, were taken over the affected facet joint area.

**Group A (Leander traction)**

Group A participants received Leander traction in which 10 repetitions of intermittent mobilization of Leander traction took place at a velocity of 1 repetition every 2 seconds for an estimated period of 20 seconds over the affected area of the lumbar spine (Eckard, 2007).

#### 3.5.4.1 Patient positioning for Leander traction: Leander 900 "Z" flexion distraction table

1. The patient was placed in the prone position with their face in the headroll paper.
2. The patient was then positioned so that the top of the iliac crest was even with the front edge of the caudal (pelvic) cushion.
3. The abdominal cushion was then released to allow the patient's lumbar spine to attain its normal lordosis.
4. The ankle cushion was then adjusted so that it touched the top of the instep of the foot. Patients may have been able to increase the amount of distraction force applied to their spine by pulling against the ankle cushion with their toes. The ankle straps may also be used to secure the patient's legs and in certain cases may have increased patient traction (Eckard, 2007).

5. The doctors contact hand (thenar) was placed over the affected lumbar spine segments' spinous process (Cox, 1998 and Eckard, 2007) and a gentle stabilizing force was applied over the affected lumbar facet joint. Eckard (2007) believes that any downward force applied over the lumbar facet joint during Leander traction may be potentially harmful to that joint.
6. The depth of flexion distraction travel was set to –12,2 degrees from the horizontal, on the 900 "Z" Leander flexion distraction table.
7. Only at a maximum depth of flexion distraction (-12,2 degrees), was the stabilizing force applied by the doctors contact hand, which was placed over the affected facet joint of the lumbar spine.
8. The flexion speed of the table was set to 10 repetitions at a velocity of 1 repetition every 2 seconds. Each patient received 10 mobilizations over the affected lumbar spinal segment at a velocity of 1 repetition every 2 seconds for approximately 20 seconds.
9. Leander traction was stopped immediately if any pain or discomfort was experienced by the patient. Cox (1999) has stated that pain can be felt during flexion distraction and that treatment should be stopped immediately.

10. If any pain or discomfort was felt by the patient during Leander traction or immediately after the treatment was applied that patient would' have immediately been excluded from the study, and would also have received a DUT chiropractic clinic voucher for 1 free treatment.

**Group B (Static linear traction):**

Group B participants received static linear traction for a period of 10 minutes at a traction ratio no greater than 35% (55 pounds of pull in a 75 kilogram patient) of the patients total body weight (Mathews, 1972 and Onel et al., 1989).

### 3.5.4.2 Patient positioning for Static linear traction: Saunders lumbar, hand pump hometraction unit.

**Model no. D415.354: Serial# LHT 0732**

**Saunders Group, 4250 Novex Drive, Alaska, MN 55318**

1. All patients were treated with the same apparatus and were told they had to feel a distinct but tolerable pulling in the lumbar region during the 10 minute session. Traction was held for a period of 10 minutes.
2. The patient was asked to lie in the supine position with a cushion under their knees in order for the lumbar spine to assume its normal curvature.

This form of patient positioning is also known as the Fowler's position and is clinically important in that it reduces the traction force required to stretch posterior tissues (Lee and Evans, 2001).

3. Two canvas braces were attached to the patient once they were comfortable lying on the traction unit.
4. One brace was placed around the iliac crest and the other brace was placed around the lower thoracic cage.
5. After unlocking the sliding table top, the traction force was slowly increased by the pump, starting from zero to 20% of total body weight, until the patient indicated that a pulling was felt. According to Beurskens et al., (1995) the participant will feel the pulling force before 20% percent is reached and that this is usually used as a gauge to determine the participants level of comfort. If any pain is felt during this stage traction must immediately cease.
6. The traction was then increased to 35% of total body weight.

7. Once this force was reached and if the patient complained of no pain or discomfort , the traction force was held at 35% for a period of 10 minutes (Mathews, 1972, Onel et al., 1989 and Beurskens et al., 1995).

8. The patient was free to release the hand held pump at any time during the procedure if any pain or discomfort was felt. The hand held pump would then immediately release the traction force placed on the lumbar spine. In the event of this happening the participant was excluded from the study. During this study no participants had to use the pump release system and thirty seven participants were seen during the study with a drop out rate of seven participants.

Participants in this study were warned that they may experience mild muscle stiffness and pain as a result of the traction. If stiffness and pain was still evident after the third treatment (within 7 days of the initial treatment) no further traction was administered and any further participation in the study was ceased. The participant was offered 1 free treatment at the chiropractic day clinic at Durban University of Technology (DUT).

During this study no participants reported any discomfort during Leander traction or Static linear traction. No participants receiving Static linear traction had exacerbated symptoms during the course of treatments. However, over half the participants receiving Leander traction had an initial exacerbation. This occurred between treatments one and two (48 hours) where the participants reported increased low back stiffness but not increased LBP.

During this study there were seven drop-outs and all of these were participants who received Leander traction. It was unclear whether an exacerbation of these participants symptoms could have been the main reason for their failure to complete the study.

### 3.6 Outcome measures: Interpretation of the raw data:

All outcome measures were quantitative in nature and relatively normally distributed. Therefore they were all treated parametrically, and group means and standard deviations were calculated for each time point (6 time points for PSS, 3 time points for NRS(101) and ODI scores, and 5 time points for algometer readings). Algometer readings had 5 measurement points. Note that there were 4 measurement points taken ( i.e. before and after treatment 1 and treatment 2 respectively) and the 5$^{th}$ measurement point was taken on the last consultation (6$^{th}$ visit) where no treatment was given. The group means were compared over time (intra-group) and over time between groups (inter-group) as described in section 3.6.

Intention to treat analysis was not applicable in this situation since there were no protocol/treatment violations or group changes and no missing data. Thus participants were analysed according to the original group they were randomised to, which was also the group they completed the treatment in. Thus ‘per protocol’ analysis was used.

### 3.6.1 Subjective data

#### *3.6.1.1 Numerical Pain Rating Scale (NRS 101)*

The Numerical Pain Rating Scale (Appendix F) is an effective and reliable tool to evaluate if pain is reduced with treatment and to what degree (Bolton and Wilkinson, 1998:1-7). For the purpose of this study NRS (101) evaluations were used. NRS (101) scores were measured over 3 time points. Two NRS (101) scores were taken prior to treatment on the 1st and 2nd visits. Another set of NRS(101) scores were taken on 6th visit in order to gauge the long term effects of the treatment. No treatment was given on the 6th visit. No post treatment NRS(101) scores were taken. Participants were asked to score the NRS (101) pain scale when it was at its worst with a number between 0 (No pain) and 100 (excruciating pain) as well as a number between 0 (No pain) and 100 (Excruciating pain) for when their pain was at its least. Thus the NRS(101) was out of a total of 100 points. Statistical analysis was done by taking the averages of pain when it was at its least and when it was at its worst at each of the three time points. Inter and intra Group means and standard deviations were calculated over three time points in order to determine if there was a statistically significant decrease in LBP pain experienced by the participants.

### *3.6.1.2. Pain Severity Scale (PSS)*

PSS scores (Appendiix G), as adapted from Hsieh et al., (1992), were taken 6 times prior to treatment on each of the 6 visits. No treatment was given on the 6$^{th}$ visit. PSS scores were taken in order to gauge the effectiveness of the treatment after each visit. PSS scores were evaluated by asking the participants to score a number between 0 (No pain) and 10 (Excruciating pain). Thus the PSS scale was out of a total of 11 points.

Both NRS (101) and PSS pain were used in this study. Bolton and Wilkinson (1998) suggest that NRS (101) scores are more readily used to measure changing intensities of pain experienced by the patient.

However, Jensen et al., (1986) have stated the PSS scales are easier to use and understand for the patient and also suggest that the utility and validity of the of the 11 point rating scale yields similar results in terms of the number of subjects who respond correctly to them and the validity when compared to other methods of measurement of pain intensity. Statistical analysis was done over 6 time points.

The averages of the scores were analysed after the 6 time points in order to see if any statistically significant reduction in pain was experienced by both groups. Inter and intra group means and standard deviations were compared over time in order to ascertain the efficacy of each treatment.

#### *3.6.1.3 Revised Oswestery Low Back Pain and Disability questionnaire (ODI)*

The Revised Oswestry Low back pain and Disability (ODI), Questionnaire (Appendix G), is a sensitive measure of pain and disability in LBP (Morris, 1983 and Fairbank and Pynsort, 2000). Oswestry Disabilty Index (ODI) scores were used in this study in order to evaluate the short and long term effects of the treatments for both groups with regards to low back pain and disability.
These scores ranged from 0 (No pain) to 50 (Excruciating pain) and participants were asked to mark each block with the view on how they felt at that exact moment in time.

Participants were asked to answer each question by choosing the best ‘answer’ to describe their typical pain and/or limitations felt. If any limitations fell between two questions the participant was asked to choose the higher point value question.

Percentage disability was worked out by adding up the points of the questionnaire and then dividing the total by 50 and then multiplying the answer by 100 (Fairbank et al., 1980). ODI scores were taken 3 times prior to treatment on the 1st and 2nd visits. Another set of ODI scores were taken on 6th visit in order to gauge the long term effects of the treatment. Statistical analysis was done over 3 time points. ODI averages were taken after each of the 3 time points and mean and standard deviations were calculated. Inter and intra group means were compared in order to ascertain if there was any statistically significant reduction in pain and disability between the two groups.

### 3.6.2 Objective data:

#### 3.6.2.1 Pressure Threshold Algometry (Wagner force dial FDK 20)

An algometer (the force dial algometer to assess the tenderness of the affected joints) was used in this study. The algometer can be used to quantify response to treatment such as manipulation and provides an objective means of measuring the patient's response to treatment (Fischer, 1986:836).

Pressure tolerance measurements were taken 5 times, 2 centimetres lateral to the midline at the interspace above the spinous process of the affected facet joint and surrounding paravertebral musculature. As mentioned previously, algometer readings were taken for Kemp's test and spinal extension and were taken pre and post treatment (2 sets of readings) over the affected lumbar facet joint for the first two treatments and then again on the 6$^{th}$ visit. No treatment was given on the 6$^{th}$ visit and only one set of algometer readings were taken.

Participants were passively placed by the examiner into spinal extension and Kemp's test until the end range of motion was reached or symptoms were or were not reproduced, and then the algometer force dial was placed over the affected facet joint and a steady horizontal downward force in the horizontal plane was exerted by the examiner until pain was felt by the participant. The participant was then requested to indicate the point of pain or discomfort by saying 'Stop', and the reading was then taken at that point (Appendix H). Each measurement was noted for later statistical analysis.

Statistical analysis was done over 5 measurement points. Mean and standard deviation averages were calculated over the first 4 measurement time points to gauge if there was any statistically significant decrease in pain between the first 2 treatments. Inter and intra group comparisons were also done over these 4 measurement points in order to gauge the efficacy of both treatments in both groups.

Algometer measurements were also taken on the 6$^{th}$ visit which was represented by measurement point 5. Averages of measurement point 5 were taken and mean and standard deviations were calculated in order to see if there was any statistically significant reduction of pain in the long term and the long term affects of the treatment (3 weeks).

## 3.7 Statistical analysis:

SPSS version 15 (SPSS Inc., Chicago, Illinois, USA) was used for statistical analysis of data. A p value of $<0.05$ was considered as statistically significant. The two groups were compared at baseline in terms of demographics variables and location using Pearson's chi square tests and t-tests as appropriate. Intra-group comparisons were made between all time points. A significant time effect indicated successful treatment intervention. Inter-group comparisons were achieved using repeated measures ANOVA tests for each outcome measured separately.

A significant time group interaction effect indicated a significant treatment effect. Profile plots were used to assess the trend and direction of the treatment effect. The statistician the researcher consulted recommended this method in order to confirm that randomisation was complete (Esterhuizen, 2009).

## CHAPTER FOUR-STATISTICAL METHODOLOGY AND RESULTS

### 4.1 INTRODUCTION

Thirty participants were divided into two groups of 15 respectively (group A and group B). Group A received Leander traction and Group B received Static linear traction. Each participant for this study suffered from chronic lumbar facet syndrome. Demographic data consisting of race, age, gender, affected side and location were analysed. To ensure complete randomisation had taken place demographic and baseline outcome measures were compared between the treatment groups. This was achieved using the independent t-tests for normally distributed quantitative variables.

Each group received five treatments over a three week period. Subjective and objective measurements were taken pre and post intervention on the 1st , 2nd and 6th visits. The same subjective and objective measurements were taken on the 6th but no treatment was given. Participants were required to come for three treatments in the first week (7 days), two treatments in the second week and then wait another week (7days) before returning for the last consultation (6th).

NRS(101) scores (figures 6, 13 and 20) were taken 3 times and were documented on the 1st and 2nd visit prior to treatment and at the 6th visit. Participants were asked to indicate a number between 0 (No pain) and 100 (Excruciating pain) when the pain was at its worst, as well as a figure

between 0 and a hundred (100) when the pain was at its least. ODI scores between (0 and 50) were also taken at these above mentioned intervals (figures 7, 14 and 21) and participants were asked to complete the questionnaire, at the same time, in order to determine the level of improvement in disability and pain. Algometer readings were also taken at the above mentioned intervals. However, algometer readings were taken 5 times over six visits on the participants affected side while they were in Kemp's test and spinal extension position. Figure 2 shows the first 4 measurements points which were taken pre and post treatment on the 1st and 2nd visits to help gauge any statistically significant decrease in pain between the first two treatments. The 5th measurement point was taken on the sixth visit (3 weeks after first consultation). This was done in order to gauge the long term effects of the treatment for both groups.

The Pain Severity Scale (PSS) was used to try and asses how effective the treatments were after each individual visit with regards to pain reduction (Hsieh et al., 1992). These were documented on the DUT clinic SOAPE note after each of the six visits by the participants. The participants were asked to indicate a number between 0 (No pain) and 10 (Excruciating pain). PSS scores were taken six times over three weeks before each of the 5 treatments and on the sixth visit (Figures 1, 8 and 15). This was done in order to gauge if there was any statistically significant decrease in pain after each visit (first 5 time points) as well as the long term affects of the treatment (6TH time point).

## 4.2 RESULTS- DEMOGRAPHICS OF THE SAMPLE

Thirty participants were randomised to two equal groups. Their mean age was 37.5 years with a standard deviation of 9.5 years and a range from 25 to 54 years. There were 15 males and 15 females in the sample which were predominantly Indian and White with only 3 coloured and 3 Black participants (Table 1).

**Table 1:** Representation of race groups

| | | Frequency | Percent |
|---|---|---|---|
| **Valid** | Black | 3 | 10.0 |
| | Coloured | 3 | 10.0 |
| | Indian | 12 | 40.0 |
| | White | 12 | 40.0 |
| | Total | 30 | 100.0 |

## 4.3 RESULTS- DEMOGRAPHICS BY TREATMENT GROUPS

### 4.3.1 Demographics by age

**Table 2:** Comparison of mean age between the treatment groups.

| | Group | N | Mean | Std. Deviation | Std. Error Mean | P value |
|---|---|---|---|---|---|---|
| **Age in years** | Static linear traction | 15 | 39.67 | 9.484 | 2.449 | 0.211 |
| | Leander traction | 15 | 35.27 | 9.354 | 2.415 | |

Table 2 shows there was no significant difference in mean age between the treatment groups (p=0.211).

### 4.3.2 Demographics by gender

**Table 3:** Comparison of gender between the treatment groups.

| | | | Group | |
|---|---|---|---|---|
| | | | **Static linear traction** | **Leander traction** |
| **Gender** | **Male** | Count | 6 | 9 |
| | | % Within gender | 40.0% | 60.0% |
| | **Female** | Count | 9 | 6 |
| | | % Within gender | 60.0% | 40.0% |

Pearson chi square p=0.273

$X^2$ = 1,2

Degrees of freedom= 1

Table 3 shows that the percentage distribution of females and males between the two groups was similar. Gender was not significantly different between the treatment groups (p=0.273).

### 4.3.3 Demographics by race

**Table 4:** Comparison of race between the treatment groups

| | | | Group | | Total |
|---|---|---|---|---|---|
| | | | Static linear traction | Leander traction | |
| **Race** | **Black** | Count | 2 | 1 | 3 |
| | | % Within race | 66.7% | 33.3% | 100.0% |
| | **Coloured** | Count | 1 | 2 | 3 |
| | | % Within race | 33.3% | 66.7% | 100.0% |
| | **Indian** | Count | 8 | 4 | 12 |
| | | % Within race | 66.7% | 33.3% | 100.0% |
| | **White** | Count | 4 | 8 | 12 |
| | | % Within race | 33.3% | 66.7% | 100.0% |
| **Total** | | Count | 15 | 15 | 30 |
| | | % Within race | 50.0% | 50.0% | 100.0% |

Pearson chi square p=0.343

$X^2$ =3,33

Degrees of freedom= 3

Table 4 showed that race was not statistically different between the treatment groups (p=0.343).

### 4.3.4 Demographics for affected side between treatment groups

**Table 5:** Comparison of affected side between the treatment groups

| | | | Group | | Total |
|---|---|---|---|---|---|
| | | | Static linear traction | Leander traction | |
| **Side** | **Left** | Count | 9 | 5 | 14 |
| | | % Within Location | 64.3% | 35.7% | 100.0% |
| | **Right** | Count | 6 | 10 | 16 |
| | | % Within Location | 37.5% | 62.5% | 100.0% |
| **Total** | | Count | 15 | 15 | 30 |
| | | % Within Location | 50.0% | 50.0% | 100.0% |

Pearson chi square p=0.143

$X^2 = 2,143$

Degrees of Freedom= 1

Table 5 shows that the affected side of the facet lesion was not significantly different statistically between the treatment groups (p=0.143).

### 4.3.5 Demographics of location between treatment groups

**Table 6:** Comparison of location between the treatment groups

| | | | Group | | Total |
|---|---|---|---|---|---|
| | | | Static linear traction | **Leander traction** | |
| **Location** | T12/L1 | Count | 0 | 2 | 2 |
| | | % Within location | 100% | 100% | 100% |
| | L1/L2 | Count | 1 | 0 | 1 |
| | | % Within location | 100.0% | .0% | 100.0% |
| | L2/L3 | Count | 1 | 4 | 5 |
| | | % Within location | 20.0% | 80.0% | 100.0% |
| | L3/L4 | Count | 3 | 0 | 3 |
| | | % Within location | 100.0% | .0% | 100.0% |
| | L4/L5 | Count | 8 | 4 | 12 |
| | | % Within location | 66.7% | 33.3% | 100.0% |
| | L5/S1 | Count | 2 | 5 | 7 |
| | | % Within location | 28.6% | 71.4% | 100.0% |

Pearson chi square p=0.064

$X^2$ =10,419

Degrees of Freedom= 5

To be included in the study, participants had to have had lumbar facet syndrome from T12/L1 to L5/S1 lumbar spinal segments. Table 6 shows that location of the facet lesion was not significantly different statistically between the treatment groups (p=0.064). The majority of the participants who took part in this study had lumbar facet syndrome at L4/L5. Table 6 shows that 12 (40%) of the sample group had facet syndrome at the L4/L5 level of which 8

(26.6%) had Static linear traction as a choice of treatment and 4 (13.3%) had Leander traction.

The second most frequent location was L5/S1 with 7 (23.3%) of the sample group of which only 2 (6.6%) had Static linear traction and 5 (16.6%) had Leander traction. Location for T12/L1 facet syndrome was 2 (6.6%) of the sample group and both participants had Leander traction as treatment. Only 1 (3.3%) participant had facet syndrome at L1/L2 level and they received Static linear traction. Location for L2/L3 showed that 5 (16.6%) of the sample group had Facet syndrome at this level of which 1 (3.3%) had Static linear traction as treatment and 4 (13.3%) had Leander traction. Location for L3/L4 facet syndrome was 3 (10%) of the sample group and all three had Static linear traction as treatment. No Leander traction was given at this level.

However, location of facet syndromes at all levels was not statistically significant enough to demonstrate if any level showed a better rate of improvement than the other. Participants who had facet syndrome at T12/L1 only had Leander traction and the effects of Static linear traction were not established at this area. Similarly, L1/L2 and L3/L4 facet syndrome participants only had Static linear traction and no Leander traction. Only L2/L3; L4/L5 and L5/S1 levels were compared in this study. This could stimulate further research into specific treatment aimed at localized areas of the spine.

## 4.4 Results- Treatment efficacy

### 4.4.1 Objective one:

Objective One was to determine the efficacy of Leander traction (Group A) in the treatment of lumbar facet syndrome in terms of subjective and objective clinical findings.

**Table 7:** Within-subjects effects for PSS in the Leander traction group (Group A)

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.75 | <0.001 |

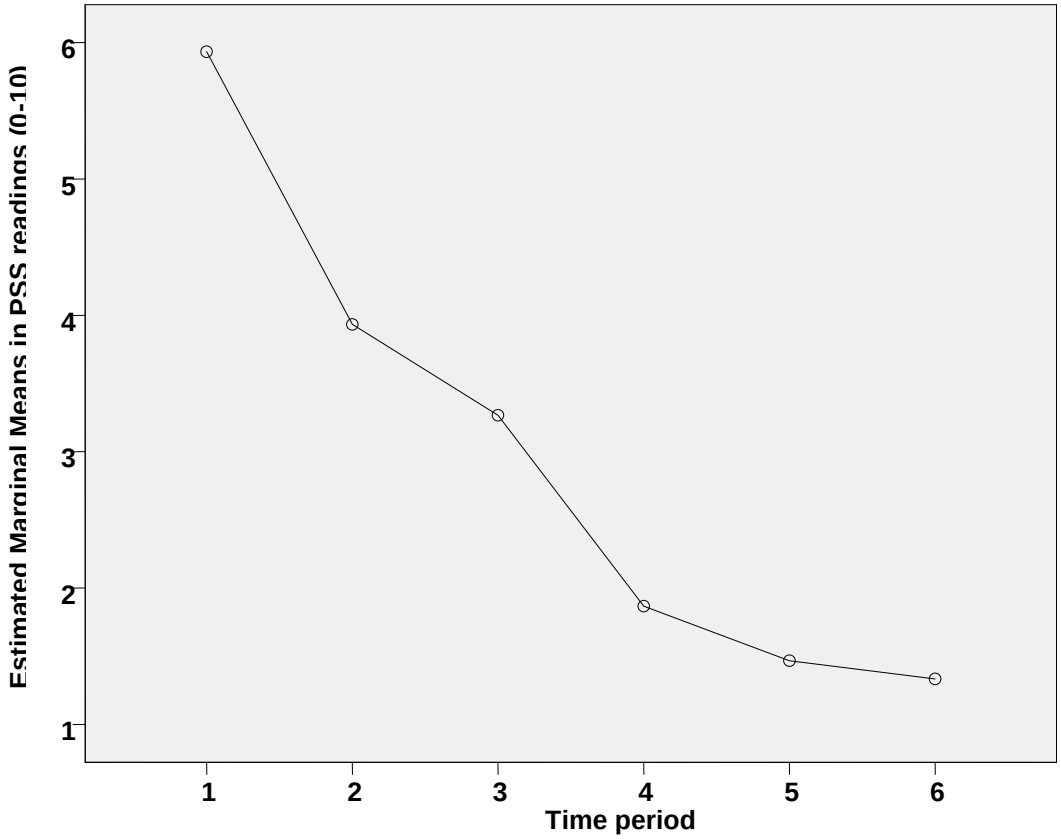


**Figure 1:** Time effect for PSS in the Leander traction group (Group A)

Table 7 shows that there was a highly significant time effect in this group statistically. This can be clearly seen in Figure 1 where a significant drop in Pain Severity Scale (PSS) perception can be seen for Group A (p=0.001). Figure 1 illustrates the marginal means for PSS used for both groups. These readings were taken at six different periods. Time 1 – measurement taken prior to 1$^{st}$ treatment, Time 2 – measurement taken before 2$^{nd}$ treatment, Time 3 – measurement taken before 3$^{rd}$ treatment, Time 4 – measurement taken before 4$^{th}$ treatment, Time 5 – measurement taken before 5$^{th}$ and final treatment and Time 6 – measurement taken on last visit (6$^{th}$).

Figure 1 demonstrates a significant reduction in pain statistically after the 1st treatment, as can be seen between time periods 1 and 2.

Similarly there was a steady reduction in pain after each of the five treatments as can be seen between time points 2 to 5. The long term effect of the treatment was evident with time point 6 where the pain score was very similar to point 5. This suggests that participants still felt relief from the treatment after 1 week had passed since the last treatment.

**Table 8:** Within-subjects effects for Right Kemp's test in the Leander traction group (Group A)

| Effect | **Statistic** | **p value** |
|---|---|---|
| Time | Wilk's lambda=0.377 | 0.021 |

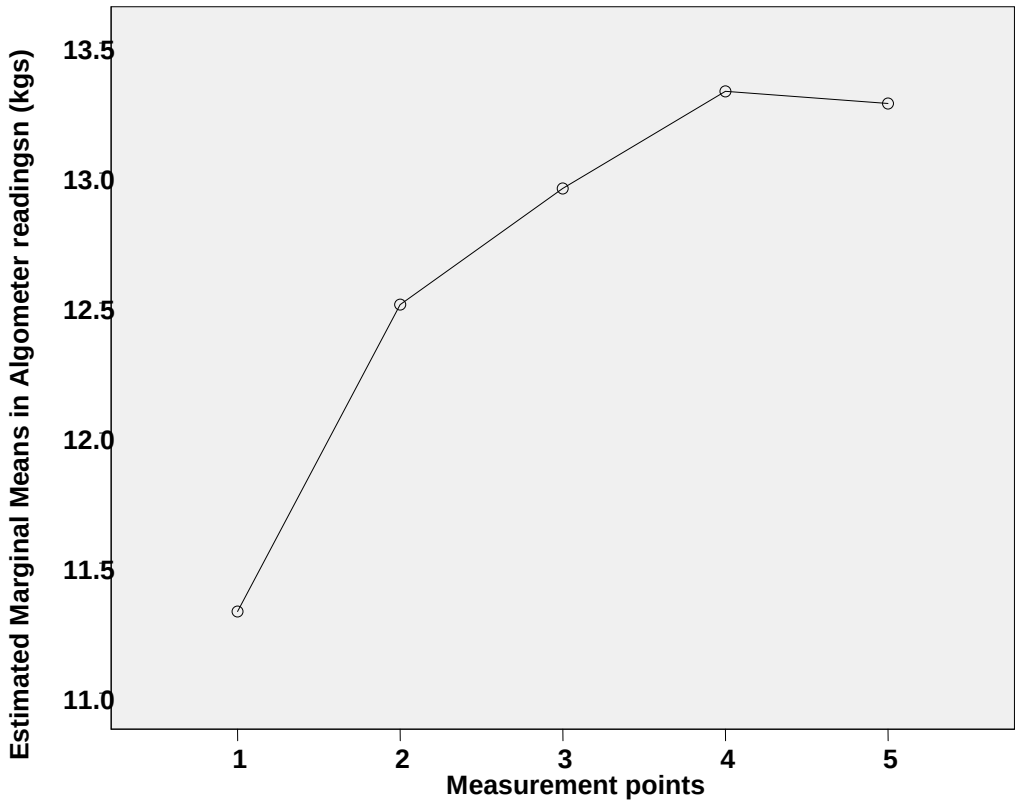


**Figure 2:** Time effect for Right Kemp's test in the Leander traction group

Table 8 shows a significant time effect statistically for Right Kemp's test in Group A (p=0.021). Figure 2 shows there was a steady increase in pain tolerance to Right Kemp's test using the algometer. Therefore there was a reduction in pain experienced by the participants. Figure 2 illustrates the marginal means used for the algometer readings taken for Kemp,s test and spinal extension in both groups. These readings were taken at five different measurement points.

Point 1 – measurement taken prior to 1st treatment, Point 2 – measurement taken immediately after 1st treatment, Point 3 – measurement taken prior to 2nd treatment, Point 4 – measurement

taken immediately after the 2nd treatment and Point 5 – measurement taken 7 days after last treatment (6th visit).

Figure 2 shows that pain tolerance immediately increased after the first treatment (points 1 and 2) and that pain tolerance increased at a linear rate between points 2 and 4. Points 4 and 5 show tolerance to pain remained the same since the last treatment.

**Table 9:** Within-subjects effects for Left Kemp's test in the Leander traction group (Group A)

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.352 | 0.015 |

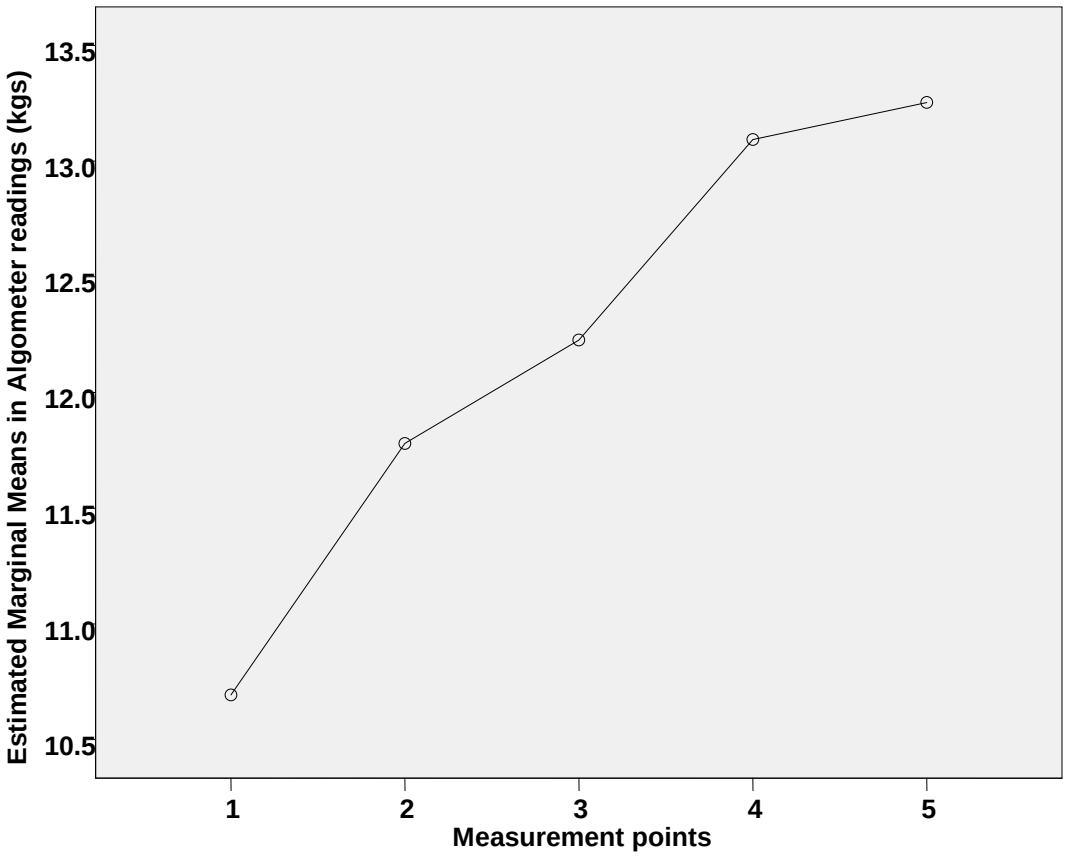

**Figure 3:** Time effect for Left Kemp's test in the Leander traction group (Group A)

There was a significant increase over time statistically for Left Kemp's test measurement in this group (p=0.015). Figure 3 shows a steady increase for pain tolerence in algometer readings for Left kemp's test in Group A. Therefore a reduction in pain was experienced by the participants. Figure 3 shows a very similar trend as figure 2 with regards to pain tolerance experienced by the participants during Left and Right Kemp's test during Leander traction.

This is demonstrated by the linear curve shown between the 5 different measurement points.

**Table 10:** Within-subjects effects for Right Ext. in the Leander traction group (Group A)

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.237 | 0.002 |

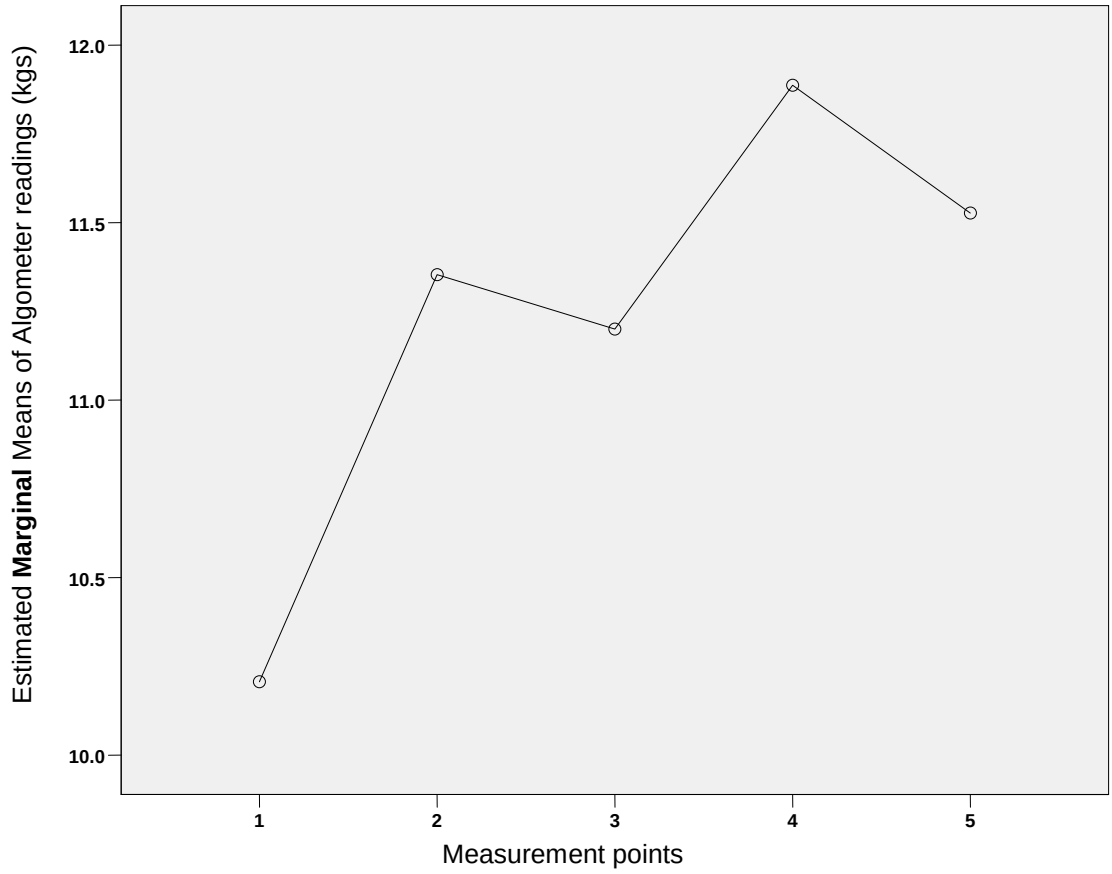


**Figure 4:** Time effect for Right Ext. in the Leander traction group (Group A)

The overall increase over time for Right Ext. was significant in this group statistically (p=0.002). Figure 4 shows an increase for right extension algometer readings which indicates a reduction in pain experienced by the participants.

**Table 11:** Within-subjects effects for Left Ext. in the Leander traction group (Group A)

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.364 | 0.013 |

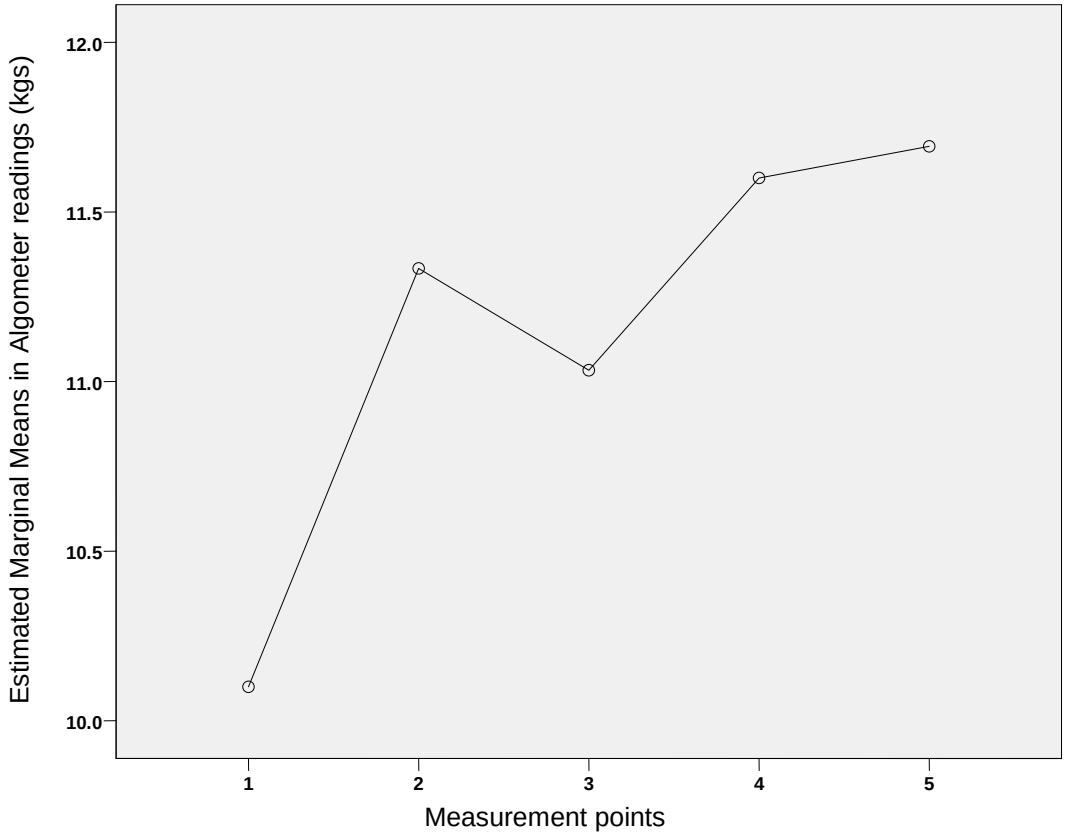


**Figure 5:** Time effect for Left Ext. in the Leander traction group (Group A)

The overall increase over time for Left Ext. was significant in this group statistically (p=0.013). Figure 5 shows an increase for left extension algometer readings which indicates a reduction in pain experienced by the participants. When comparing figures 4 and 5 we see very similar trends with regards to pain reduction for left and right sided extension using Leander traction. This can be seen between measurement points 1 to 4. However, there was a slight decrease in pain tolerance for right extension for Leander traction but this was not statistically significant.

**Table 12:** Within-subjects effects for NRS (101) in Leander traction group (Group A)

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.212 | <0.001 |

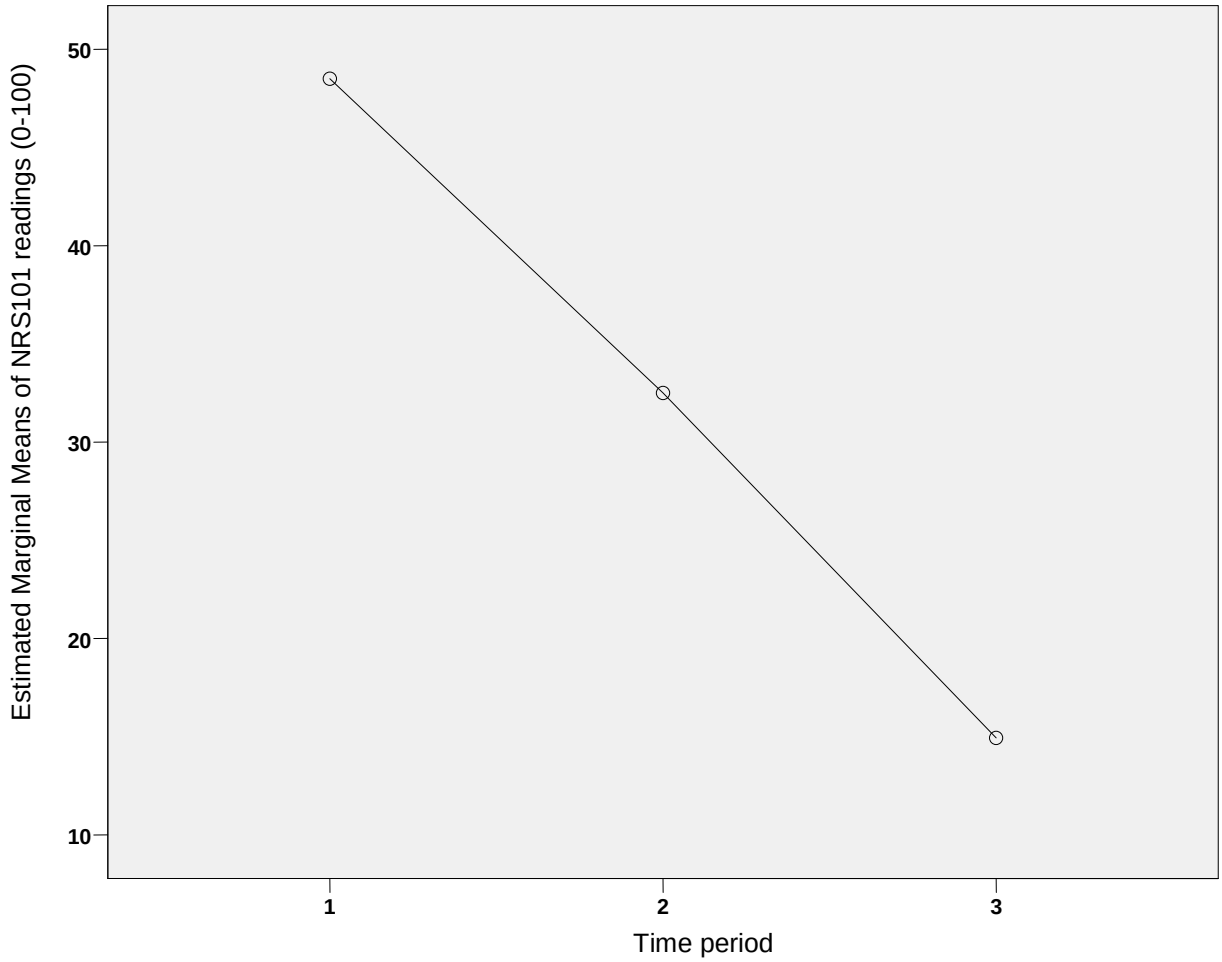


**Figure 6:** Time effect for NRS (101) in Leander traction group (Group A)

Pain measured by NRS (101), was significant statistically and decreased linearly over the 3 time points (p<0.001). Figure 6 illustrates the marginal means for NRS (101) readings used in both groups. These readings were taken at three different periods.

Time 1- measurement taken prior to 1st treatment, Time 2 – measurement taken prior to 2nd treatment and Time 3 – measurement taken on the last consultation (6th). Figure 6 shows a linear reduction in pain between the three time points. Time points 1 and 2 demonstrate when NRS (101) scores were taken prior to treatments 1 and 2.

There was a minimum time period of 48 hours between the first two treatments. Time points 2 and 3 demonstrate the time between the 2nd treatment and the final visit (6th) when NRS (101) scores were taken. This was done in order to gauge the long term effects of the treatment between the 2nd visit and the final visit (6th).

**Table 13**: Within-subjects effects of the Oswestry Disability Index (ODI) in the Leander traction group (Group A)

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.202 | <0.001 |

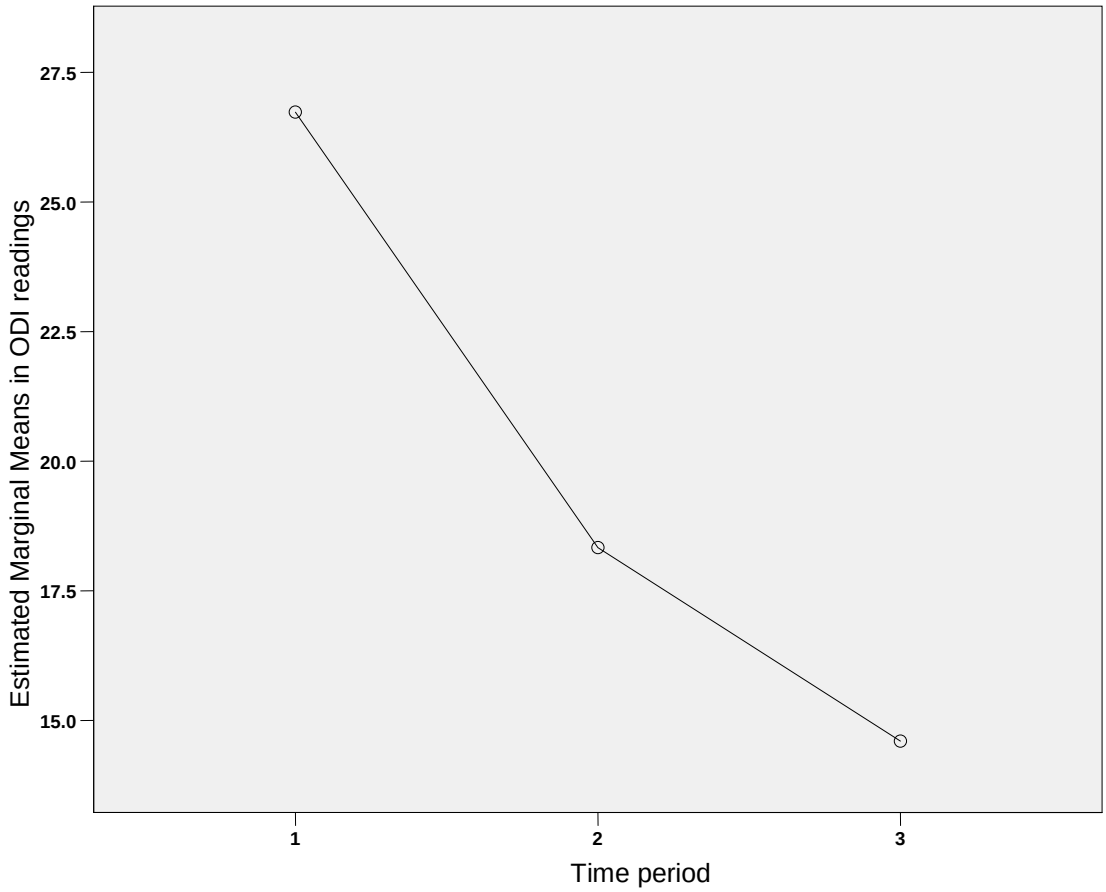


**Figure 7:** Time effect for Oswestry Disability Index (ODI) in the Leander traction group (Group A)

The ODI scores were significant statistically over the 3 time points ($p<0.001$). The ODI scores 0 (No pain) to 50 (Excruciating pain). Figure 7 shows how there was a marked decrease in pain perceived by the participants. The Revised Oswestry Low back pain and Disability Index Questionnaire (ODI) has been designed to give the doctor information on how back pain affects the patients everyday life. Participants were required to complete an ODI form on the 1st, 2nd and 6th visits.

In the 48 hour period between the 1st and the 2nd visits the participant were asked to be as honest as possible when marking the box which best described their pain and problem at that particular time. No treatment was given on the 6th visit, however ODI scores were collected along with other subjective and objective measurements as mentioned earlier. Figure 7 illustrates the marginal means for the ODI readings. These readings were taken at three different time periods. Time 1 – measurements taken prior to 1st treatment, Time 2 – measurements taken prior to 2nd treatment and Time 3 – measurement taken prior to final consultation.

Time points 1 and 2 demonstrate when ODI scores were taken prior to treatments 1 and 2. Time points 2 and 3 demonstrate the time between the 2nd treatment and the final visit (6th) when ODI scores were taken. This was done in order to gauge the efficacy of the treatment between the 2nd visit and the final visit as well as the long term effects of the treatment.

### 4.4.2 Objective Two

Objective two was to determine the efficacy of Static linear traction (Group B) in the treatment of lumbar spine facet syndrome in terms of subjective and objective clinical findings.

**Table 14:** Within-subjects effects for PSS in the Static Linear traction group (Group B)

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.151 | <0.001 |

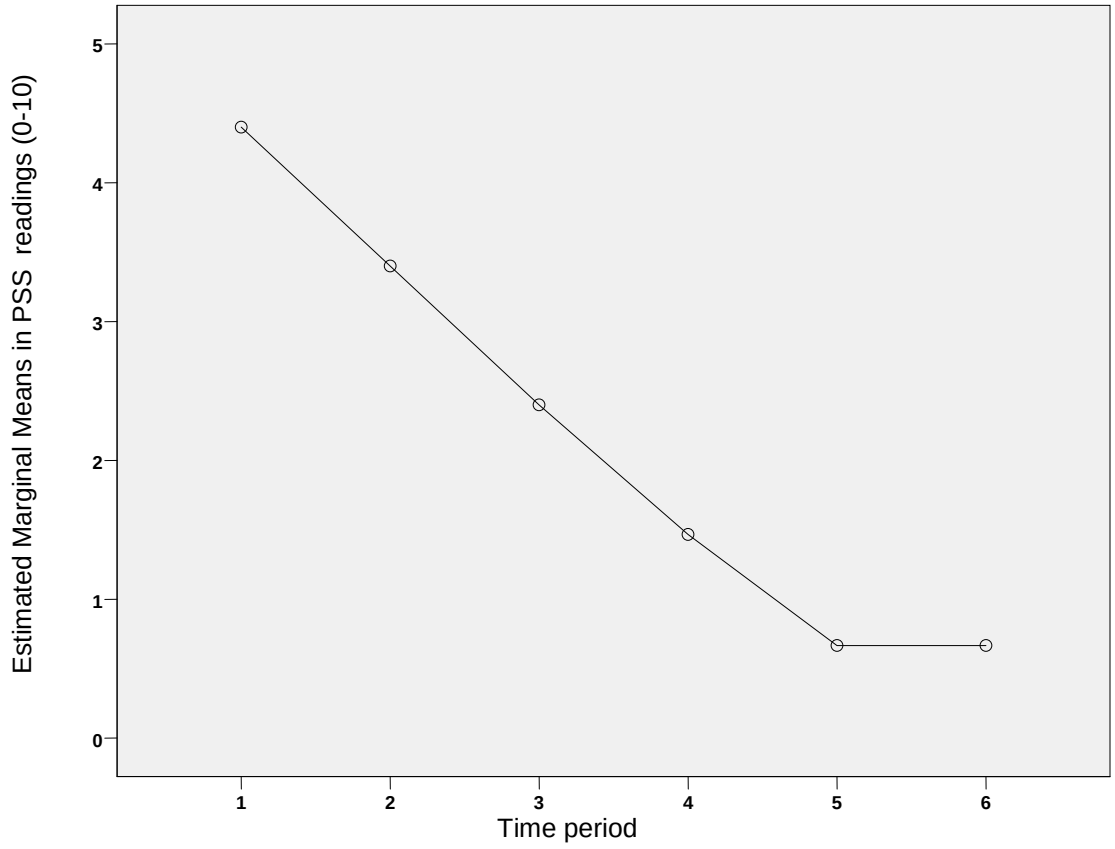


**Figure 8:** Time effect for PSS in the Static Linear traction group (Group B)

Table 14 shows that there was a highly significant time effect in this group statistically ($p<0.001$). This can be clearly seen in Figure 8 where a significant drop in Pain Severity Scale (PSS) perception can be seen for Group B.

**Table 15:** Within-subjects effects for Right Kemp's test in the Static Linear traction group (Group B)

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.226 | 0.001 |

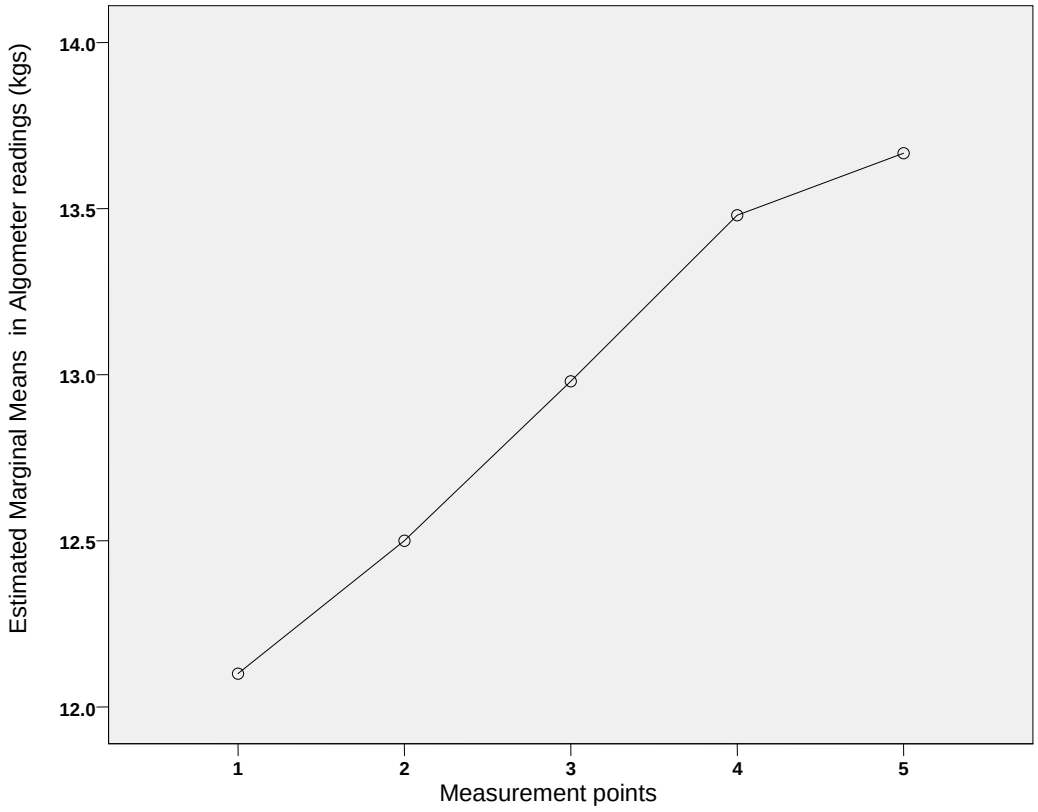


**Figure 9:** Time effect for Right Kemp's test in the Static Linear traction group (Group B)

Table 15 shows a significant time effect for Right Kemp's test in this group statistically (p=0.001). The increase was almost linear as can be seen in Figure 9. It can be assumed then that there was a steady increase in pain tolerance to Right Kemp's test using the algometer. This resulted in the reduction in pain experienced by the participants.

**Table 16:** Within-subjects effects for Left Kemp's test in the Static Linear traction group (Group B)

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.172 | <0.001 |

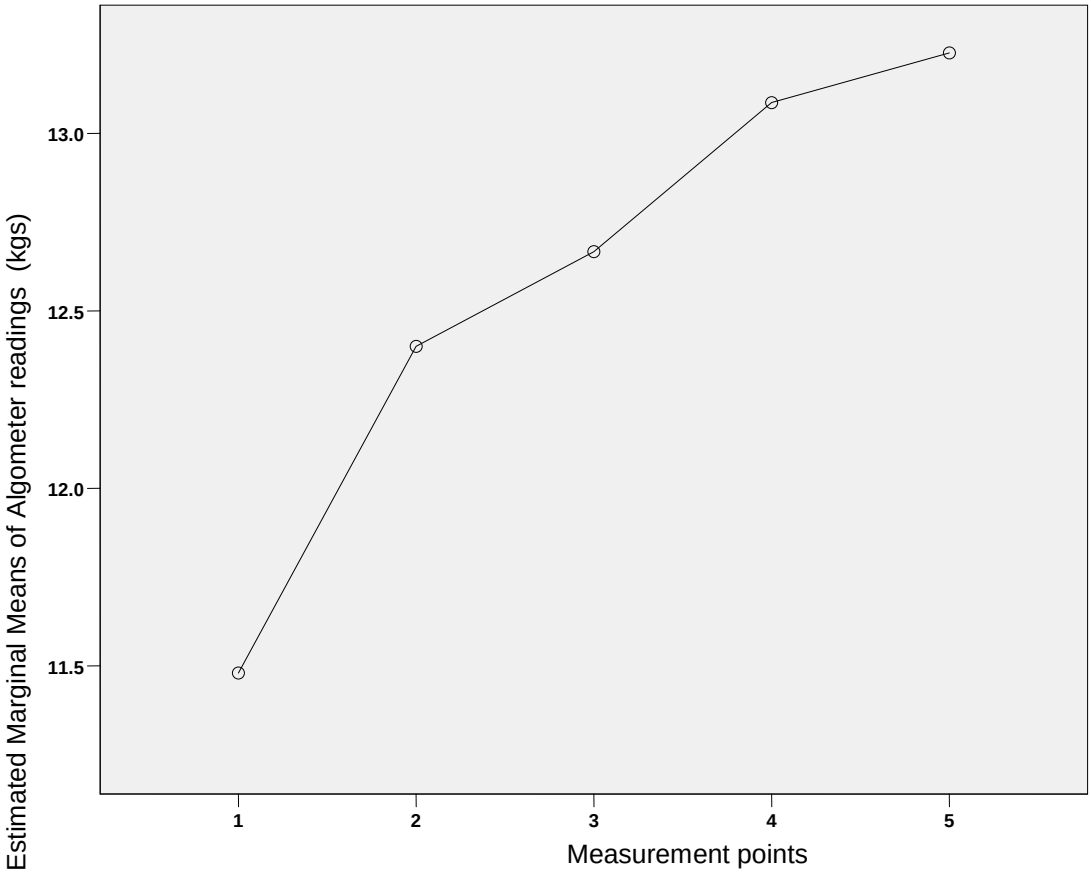

**Figure 10:** Time effect for Left Kemp's test in the Static Linear traction group (Group B)

Table 16 shows that there was a highly significant increase over time for left Kemp's test measurement in this group statistically ($p<0.001$). This can also be seen in Figure 10, which demonstrates a steady increase in pain tolerence to the algometer used. When comparing Figures 9 and 10 we see a similar linear trend between the 5 different measurement points with regards to algometer pain tolerance readings for Left and Right Kemp's test in the Static linear traction group.

**Table 17:** Within-subjects effects for Right Ext. in the Static Linear traction group (Group B)

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.288 | 0.005 |

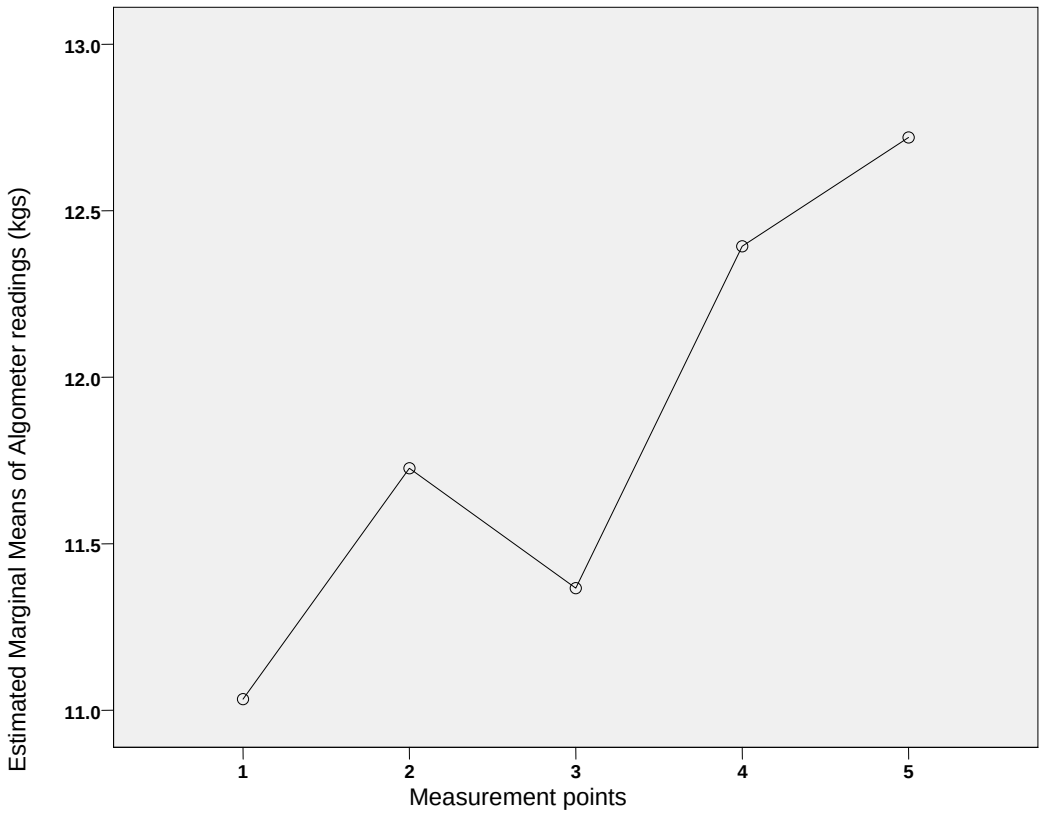


**Figure 11:** Time effect for Right Ext. in the Static Linear traction group (Group B)

Table 17 shows that the increase over time for Right Ext. was significant in this group statistically (p=0.005). This is also demonstrated by Figure 11 which shows a significant decrease in pain experienced by the participants when they were subjected to the algometer.

**Table 18:** Within-subjects effects for Left Ext in the Static Linear traction group (Group B)

| Effect | Statistic | p value |
|---|---|---|

| | | |
|---|---|---|
| **Time** | Wilk's lambda=0.322 | 0.009 |

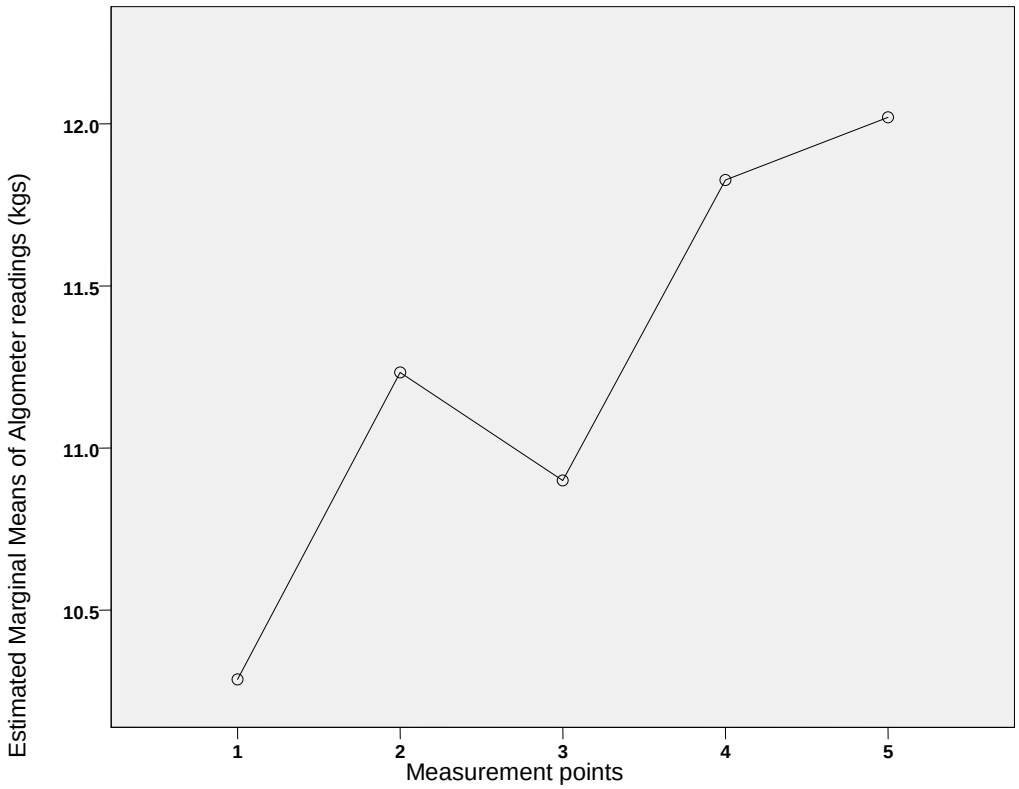


**Figure 12:** Time effect for Left Ext. in the Static Linear traction group (Group B)

Table 18 shows the overall increase over time for Left Ext. was significant in this group statistically (p=0.009). This is also shown in Figure 12 which demonstrates a significant drop in pain felt in lumbar spine extension by Group B participants.

When comparing Figures 11 and 12 we see a similar linear trend between the 5 different measurement points with regards to algometer pain tolerance readings for left and right extension in the Static linear traction group.

**Table 19:** Within-subjects effects for NRS (101) in the Static Linear traction group (Group B)

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.360 | 0.001 |

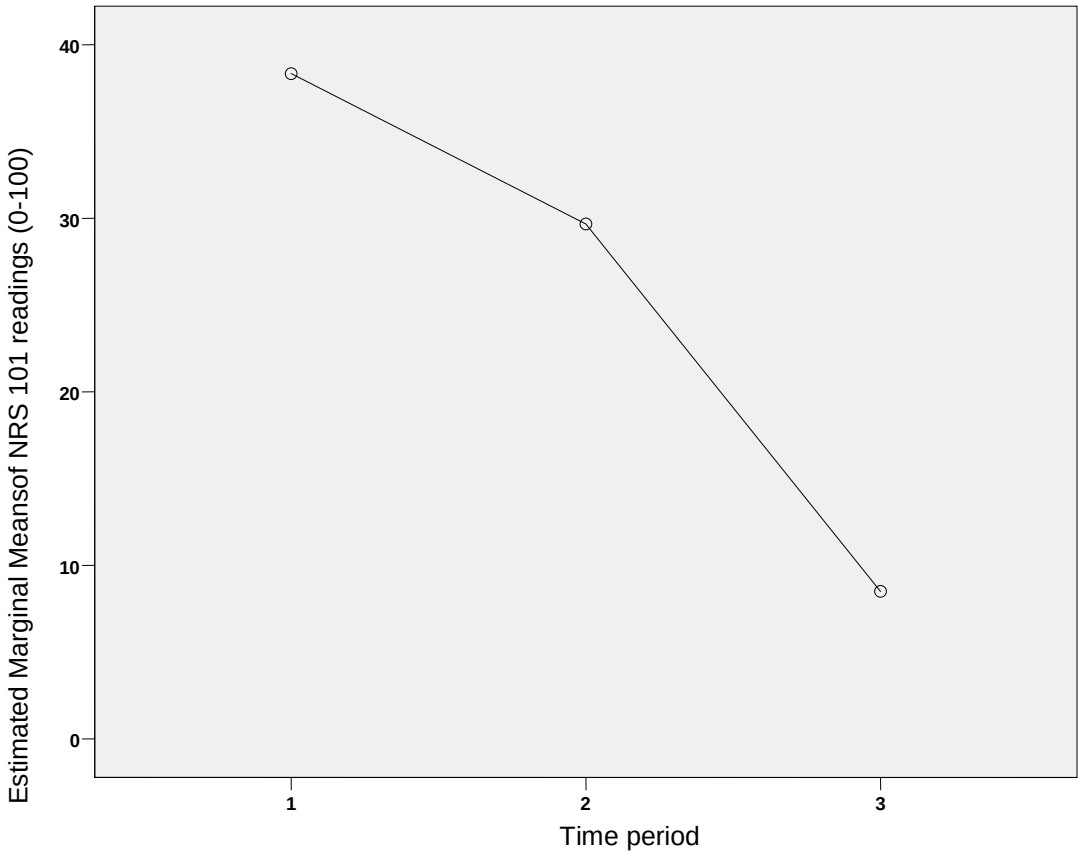


**Figure 13:** Time effect for NRS (101) in the Static Linear traction group(Group B)

Table 19 shows that pain measured by NRS (101) decreased significantly over the 3 time points statistically (p=0.001).

This is also demonstrated in Figure 13 which shows an almost linear decrease in pain scores for the NRS (101) system. Participants were asked to score their pain on the 1st , 2nd and 6th visits.

**Table 20:** Within-subjects effects for Oswestry Disability Index (ODI) in the Static Linear traction group (Group B)

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.279 | <0.001 |

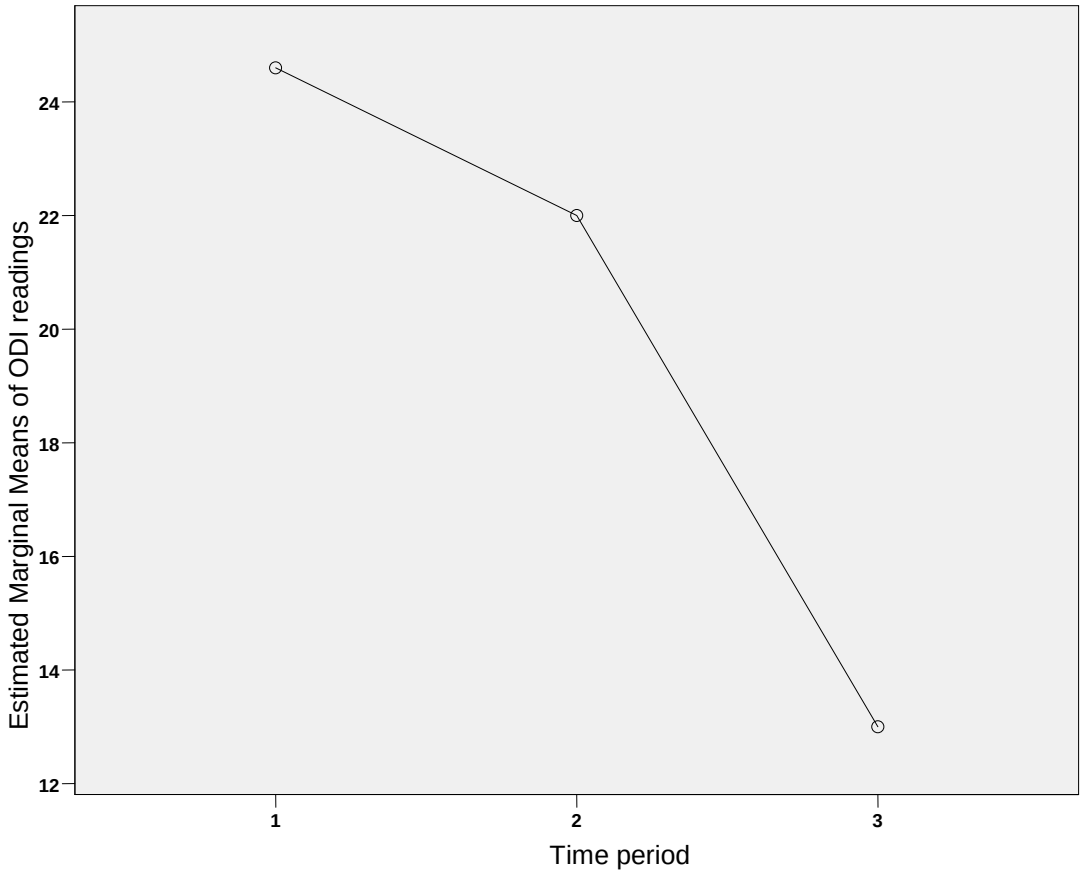


**Figure 14:** Time effect for Oswestry Disability Index(ODI) in the Static Linear traction group(Group B)

Table 20 shows that the ODI score decreased significantly over the 3 time points statistically ($p<0.001$). This is also demonstrated by Figure 14 which illustrates a significant drop in pain and disability experienced by participants in this group.

### 4.4.3 Objective Three

Objective three was to compare subjective and objective clinical findings from both groups.

**Table 21**: Within-and Between-subjects effects for PSS in Group A and Group B

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.146 | <0.001 |
| **Time*group** | Wilk's lambda=0.715 | 0.129 |
| **Group** | F=2.721 | 0.110 |

**Table 22:** Between groups mean differences for PSS in Group B.

Paired Samples Statistics(b)

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **Pair 1** | **PSS1** | 4.40 | 15 | 1.404 | .363 |
| | **pss2** | 3.40 | 15 | 1.724 | .445 |
| **Pair 2** | **PSS1** | 4.40 | 15 | 1.404 | .363 |
| | **pss3** | 2.40 | 15 | 1.639 | .423 |
| **Pair 3** | **PSS1** | 4.40 | 15 | 1.404 | .363 |
| | **pss4** | 1.47 | 15 | 1.846 | .477 |
| **Pair 4** | **PSS1** | 4.40 | 15 | 1.404 | .363 |
| | **pss5** | .67 | 15 | 1.345 | .347 |
| **Pair 5** | **PSS1** | 4.40 | 15 | 1.404 | .363 |
| | **pss6** | .67 | 15 | 1.345 | .347 |
| **Pair 6** | **pss2** | 3.40 | 15 | 1.724 | .445 |
| | **pss3** | 2.40 | 15 | 1.639 | .423 |
| **Pair 7** | **pss2** | 3.40 | 15 | 1.724 | .445 |
| | **pss4** | 1.47 | 15 | 1.846 | .477 |
| **Pair 8** | **pss2** | 3.40 | 15 | 1.724 | .445 |
| | **pss5** | .67 | 15 | 1.345 | .347 |
| **Pair 9** | **pss2** | 3.40 | 15 | 1.724 | .445 |
| | **pss6** | .67 | 15 | 1.345 | .347 |
| **Pair 10** | **pss3** | 2.40 | 15 | 1.639 | .423 |
| | **pss4** | 1.47 | 15 | 1.846 | .477 |
| **Pair 11** | **pss3** | 2.40 | 15 | 1.639 | .423 |
| | **pss5** | .67 | 15 | 1.345 | .347 |
| **Pair 12** | **pss3** | 2.40 | 15 | 1.639 | .423 |
| | **pss6** | .67 | 15 | 1.345 | .347 |
| **Pair 13** | **pss4** | 1.47 | 15 | 1.846 | .477 |
| | **pss5** | .67 | 15 | 1.345 | .347 |
| **Pair 14** | **pss4** | 1.47 | 15 | 1.846 | .477 |
| | **pss6** | .67 | 15 | 1.345 | .347 |
| **Pair 15** | **pss5** | .67(a) | 15 | 1.345 | .347 |
| | **pss6** | .67(a) | 15 | 1.345 | .347 |

a The correlation and t cannot be computed because the standard error of the difference is 0.

b Group B = Static linear traction

**Table 23.** Between groups 95% confidence levels for PSS in Group B

Paired Samples Test(a)

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| **Pair 1** | PSS1 - pss2 | 1.000 | 1.254 | .324 | .306 | 1.694 |
| **Pair 2** | PSS1 - pss3 | 2.000 | 1.512 | .390 | 1.163 | 2.837 |
| **Pair 3** | PSS1 - pss4 | 2.933 | 1.944 | .502 | 1.857 | 4.010 |
| **Pair 4** | PSS1 - pss5 | 3.733 | 1.831 | .473 | 2.719 | 4.747 |
| **Pair 5** | PSS1 - pss6 | 3.733 | 1.831 | .473 | 2.719 | 4.747 |
| **Pair 6** | pss2 - pss3 | 1.000 | .756 | .195 | .581 | 1.419 |
| **Pair 7** | pss2 - pss4 | 1.933 | 1.223 | .316 | 1.256 | 2.610 |
| **Pair 8** | pss2 - pss5 | 2.733 | 1.335 | .345 | 1.994 | 3.472 |
| **Pair 9** | pss2 - pss6 | 2.733 | 1.335 | .345 | 1.994 | 3.472 |
| **Pair 10** | pss3 - pss4 | .933 | .799 | .206 | .491 | 1.376 |
| **Pair 11** | pss3 - pss5 | 1.733 | .884 | .228 | 1.244 | 2.223 |
| **Pair 12** | pss3 - pss6 | 1.733 | .884 | .228 | 1.244 | 2.223 |
| **Pair 13** | pss4 - pss5 | .800 | .775 | .200 | .371 | 1.229 |
| **Pair 14** | pss4 - pss6 | .800 | .775 | .200 | .371 | 1.229 |

Group B = Static linear traction

**Table 24.** Between groups mean differences for PSS in Group A

Paired Samples Statistics(a)

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **Pair 1** | PSS1 | 5.93 | 15 | 1.387 | .358 |
| | pss2 | 3.93 | 15 | 1.335 | .345 |
| **Pair 2** | PSS1 | 5.93 | 15 | 1.387 | .358 |
| | pss3 | 3.27 | 15 | 1.580 | .408 |
| **Pair 3** | PSS1 | 5.93 | 15 | 1.387 | .358 |
| | pss4 | 1.87 | 15 | 1.506 | .389 |
| **Pair 4** | PSS1 | 5.93 | 15 | 1.387 | .358 |
| | pss5 | 1.47 | 15 | 1.685 | .435 |
| **Pair 5** | PSS1 | 5.93 | 15 | 1.387 | .358 |
| | pss6 | 1.33 | 15 | 1.839 | .475 |
| **Pair 6** | pss2 | 3.93 | 15 | 1.335 | .345 |
| | pss3 | 3.27 | 15 | 1.580 | .408 |
| **Pair 7** | pss2 | 3.93 | 15 | 1.335 | .345 |
| | pss4 | 1.87 | 15 | 1.506 | .389 |
| **Pair 8** | pss2 | 3.93 | 15 | 1.335 | .345 |
| | pss5 | 1.47 | 15 | 1.685 | .435 |
| **Pair 9** | pss2 | 3.93 | 15 | 1.335 | .345 |
| | pss6 | 1.33 | 15 | 1.839 | .475 |
| **Pair 10** | pss3 | 3.27 | 15 | 1.580 | .408 |
| | pss4 | 1.87 | 15 | 1.506 | .389 |
| **Pair 11** | pss3 | 3.27 | 15 | 1.58-0 | .408 |
| | pss5 | 1.47 | 15 | 1.685 | .435 |
| **Pair 12** | pss3 | 3.27 | 15 | 1.580 | .408 |
| | pss6 | 1.33 | 15 | 1.839 | .475 |
| **Pair 13** | pss4 | 1.87 | 15 | 1.506 | .389 |
| | pss5 | 1.47 | 15 | 1.685 | .435 |
| **Pair 14** | pss4 | 1.87 | 15 | 1.506 | .389 |
| | pss6 | 1.33 | 15 | 1.839 | .475 |
| **Pair 15** | pss5 | 1.47 | 15 | 1.685 | .435 |
| | pss6 | 1.33 | 15 | 1.839 | .475 |

Group A = Leander traction

**Table 25.** Between groups 95% confidence levels for PSS in Group A

Paired Samples Test(a)

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| **Pair 1** | PSS1 - pss2 | 2.000 | 1.134 | .293 | 1.372 | 2.628 |
| **Pair 2** | PSS1 - pss3 | 2.667 | 1.291 | .333 | 1.952 | 3.382 |
| **Pair 3** | PSS1 - pss4 | 4.067 | 1.387 | .358 | 3.299 | 4.835 |
| **Pair 4** | PSS1 - pss5 | 4.467 | 1.807 | .467 | 3.466 | 5.468 |
| **Pair 5** | PSS1 - pss6 | 4.600 | 2.028 | .524 | 3.477 | 5.723 |
| **Pair 6** | pss2 - pss3 | .667 | .816 | .211 | .215 | 1.119 |
| **Pair 7** | pss2 - pss4 | 2.067 | .961 | .248 | 1.534 | 2.599 |
| **Pair 8** | pss2 - pss5 | 2.467 | 1.457 | .376 | 1.660 | 3.274 |
| **Pair 9** | pss2 - pss6 | 2.600 | 1.805 | .466 | 1.601 | 3.599 |
| **Pair 10** | pss3 - pss4 | 1.400 | .632 | .163 | 1.050 | 1.750 |
| **Pair 11** | pss3 - pss5 | 1.800 | 1.146 | .296 | 1.165 | 2.435 |
| **Pair 12** | pss3 - pss6 | 1.933 | 1.534 | .396 | 1.084 | 2.783 |
| **Pair 13** | pss4 - pss5 | .400 | .737 | .190 | -.008 | .808 |
| **Pair 14** | pss4 - pss6 | .533 | 1.187 | .307 | -.124 | 1.191 |
| **Pair 15** | pss5 - pss6 | .133 | .640 | .165 | -.221 | .488 |

Group A = Leander traction

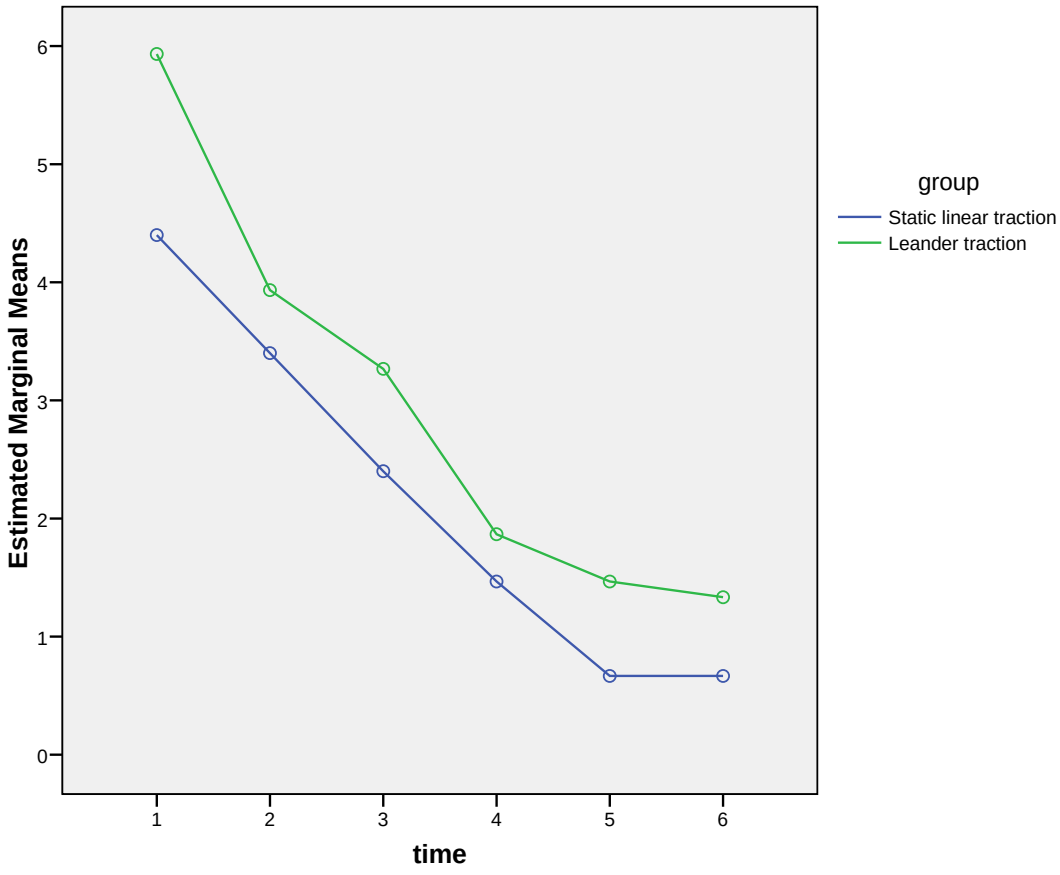


**Figure 15:** Mean PSS over time for Group A and Group B

Table 21 shows that overall there was a significant time effect ($p<0.001$) in both groups statistically, but that there was no significant differential treatment effect ($p=0.129$). Figure 15 shows that the slopes of the two profiles were very similar and almost parallel as can be seen over the six time interval points where PSS scores were taken. However, Leander traction showed a slight increase over time between the first two treatments (Time points 1 and 2), but this was not statistically significant. Thus we cannot conclude that one treatment was better than the other for this outcome.

They both showed a significant decrease over time to the same extent. Tables 22, 23, 24 and 25 show no statistically significant differences between the two groups for mean differences and 95% confidence levels.

**Table 26:** Within-and Between-subjects effects for Right Kemp's test for Group A and Group B

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.436 | <0.001 |
| **Time*group** | Wilk's lambda=0.827 | 0.295 |
| **Group** | F=0.040 | 0.843 |

**Table 27.** Between groups mean differences for Right Kemp's test Group B.

Paired Samples Statistics(a)

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **Pair 1** | rkemp1pre | 12.100 | 15 | 4.5458 | 1.1737 |
| | rkemp1post | 12.500 | 15 | 4.4002 | 1.1361 |
| **Pair 2** | rkemp1post | 12.500 | 15 | 4.4002 | 1.1361 |
| | rkempspre2 | 12.980 | 15 | 4.3183 | 1.1150 |
| **Pair 3** | rkempspre2 | 12.980 | 15 | 4.3183 | 1.1150 |
| | rkemppost2 | 13.480 | 15 | 4.5433 | 1.1731 |
| **Pair 4** | rkemppost2 | 13.480 | 15 | 4.5433 | 1.1731 |
| | rkemppre3 | 13.667 | 15 | 4.1022 | 1.0592 |

Group B = Static linear traction

**Table 28.** Between groups 95% confidence levels for Right Kemp's test in Group B.

Paired Samples Test(a)

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| **Pair 1** | rkemp1pre - rkemp1post | -.4000 | .9885 | .2552 | -.9474 | .1474 |
| **Pair 2** | rkemp1post - rkempspre2 | -.4800 | 1.3950 | .3602 | -1.2525 | .2925 |
| **Pair 3** | rkempspre2 - rkemppost2 | -.5000 | .4598 | .1187 | -.7546 | -.2454 |
| **Pair 4** | rkemppost2 - rkemppre3 | -.1867 | 1.0589 | .2734 | -.7731 | .3997 |

Group B = Static linear traction

**Table 29.** Between groups mean differences for Right Kemp's test in Group A

Paired Samples Statistics(a)

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **Pair 1** | rkemp1pre | 11.313 | 15 | 3.7140 | .9590 |
| | rkemp1post | 12.493 | 15 | 3.8605 | .9968 |
| **Pair 2** | rkemp1post | 12.493 | 15 | 3.8605 | .9968 |
| | rkempspre2 | 12.940 | 15 | 3.6561 | .9440 |
| **Pair 3** | rkempspre2 | 12.940 | 15 | 3.6561 | .9440 |
| | rkemppost2 | 13.313 | 15 | 3.0699 | .7926 |
| **Pair 4** | rkemppost2 | 13.313 | 15 | 3.0699 | .7926 |
| | rkemppre3 | 13.267 | 15 | 3.6603 | .9451 |

Group A = Leander traction

**Table 30.** Between groups 95% confidence levels for Right Kemp's test in Group A

Paired Samples Test(a)

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| **Pair 1** | rkemp1pre - rkemp1post | -1.1800 | 1.3311 | .3437 | -1.9171 | -.4429 |
| **Pair 2** | rkemp1post - rkempspre2 | -.4467 | 3.1117 | .8034 | -2.1699 | 1.2765 |
| **Pair 3** | rkempspre2 - rkemppost2 | -.3733 | 1.4878 | .3841 | -1.1972 | .4506 |
| **Pair 4** | rkemppost2 - rkemppre3 | .0467 | 2.4029 | .6204 | -1.2840 | 1.3774 |

Group A = Leander traction

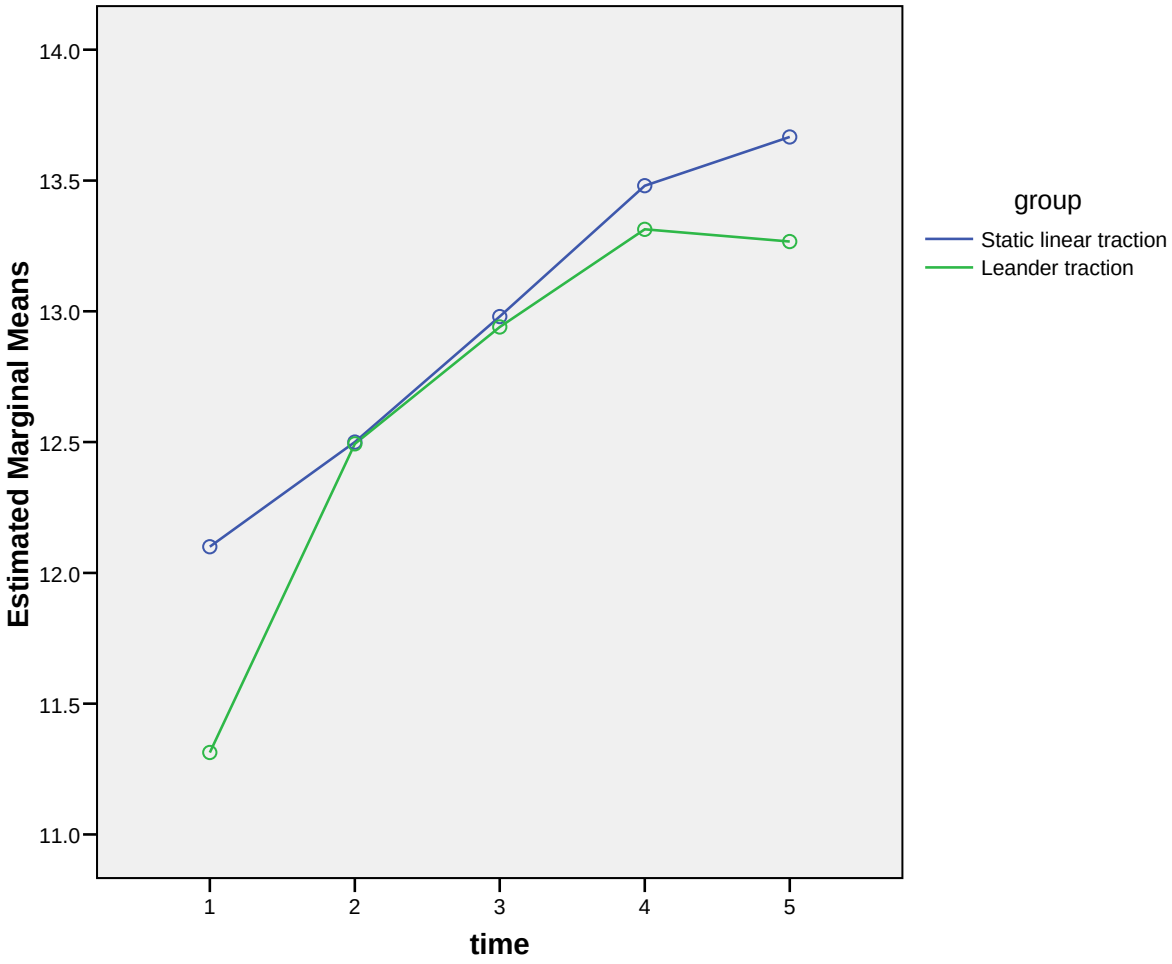


**Figure 16:** Mean Right Kemp's test over time for Group A and Group B

Table 22 shows that overall there was a significant time effect statistically ($p<0.001$) within both groups but that there was no significant differential treatment effect between the groups ($p=0.295$). Figure 16 shows that the slopes of the two profiles were very similar and almost parallel as can be seen over the 5 measurement points for the algometer.

However, Leander traction (Group A) showed a slightly faster rate of increase over time immediately after the 1st treatment when

compared to Static linear traction(Group B), as can be seen between measurement points 1 and 2. However, this was not significant statistically. Thus we cannot conclude that one treatment was better than the other for this outcome. Tables 27, 28, 29 and 30 show that mean differences and 95% confidence levels were not statistically significant for both groups.

**Table 31:** Within-and Between-subjects effects for Left Kemp's test for Group A and Group B

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.369 | <0.001 |
| **Time*group** | Wilk's lambda=0.918 | 0.697 |
| **Group** | F=0.079 | 0.781 |

**Table 32.** Between groups mean differences for Left Kemp's test in Group B

Paired Samples Statistics(a)

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **Pair 1** | lkemp1pre | 11.480 | 15 | 4.6401 | 1.1981 |
| | lkemp1post | 12.400 | 15 | 4.9020 | 1.2657 |
| **Pair 2** | lkemp1post | 12.400 | 15 | 4.9020 | 1.2657 |
| | lkempspre2 | 12.667 | 15 | 4.5975 | 1.1871 |
| **Pair 3** | lkempspre2 | 12.667 | 15 | 4.5975 | 1.1871 |
| | lkempspost2 | 13.087 | 15 | 4.6439 | 1.1990 |
| **Pair 4** | lkempspost2 | 13.087 | 15 | 4.6439 | 1.1990 |
| | lkempspre3 | 13.227 | 15 | 4.3267 | 1.1172 |

Group B- Static linear traction

**Table 33.** Between groups 95% confidence levels for left Kemp's test in Group B

Paired Samples Test(a)

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| **Pair 1** | lkemp1pre - lkemp1post | -.9200 | 1.2996 | .3355 | -1.6397 | -.2003 |
| **Pair 2** | lkemp1post - lkempspre2 | -.2667 | 1.9327 | .4990 | -1.3369 | .8036 |
| **Pair 3** | lkempspre2 - lkempspost2 | -.4200 | .2541 | .0656 | -.5607 | -.2793 |
| **Pair 4** | lkempspost2 - lkempspre3 | -.1400 | .8043 | .2077 | -.5854 | .3054 |

Group B-Static linear traction

**Table 34.** Between groups mean differences for Left Kemp's test in Group A

Paired Samples Statistics(a)

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **Pair 1** | lkemp1pre | 10.693 | 15 | 2.2861 | .5903 |
| | lkemp1post | 11.780 | 15 | 2.3118 | .5969 |
| **Pair 2** | lkemp1post | 11.780 | 15 | 2.3118 | .5969 |
| | lkempspre2 | 12.227 | 15 | 1.8572 | .4795 |
| **Pair 3** | lkempspre2 | 12.227 | 15 | 1.8572 | .4795 |
| | lkempspost2 | 13.093 | 15 | 2.8080 | .7250 |
| **Pair 4** | lkempspost2 | 13.093 | 15 | 2.8080 | .7250 |
| | lkempspre3 | 13.253 | 15 | 2.6978 | .6966 |

Group A = Leander traction

**Table 35.** Between groups 95% confidence levels for Left Kemp's test in Group A.

Paired Samples Test(a)

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| **Pair 1** | lkemp1pre - lkemp1post | -1.0867 | 1.3799 | .3563 | -1.8508 | -.3225 |
| **Pair 2** | lkemp1post - lkempspre2 | -.4467 | 1.3974 | .3608 | -1.2205 | .3272 |
| **Pair 3** | lkempspre2 - lkempspost2 | -.8667 | 1.3683 | .3533 | -1.6244 | -.1089 |
| **Pair 4** | lkempspost2 - lkempspre3 | -.1600 | 1.2727 | .3286 | -.8648 | .5448 |

Group A = Leander traction

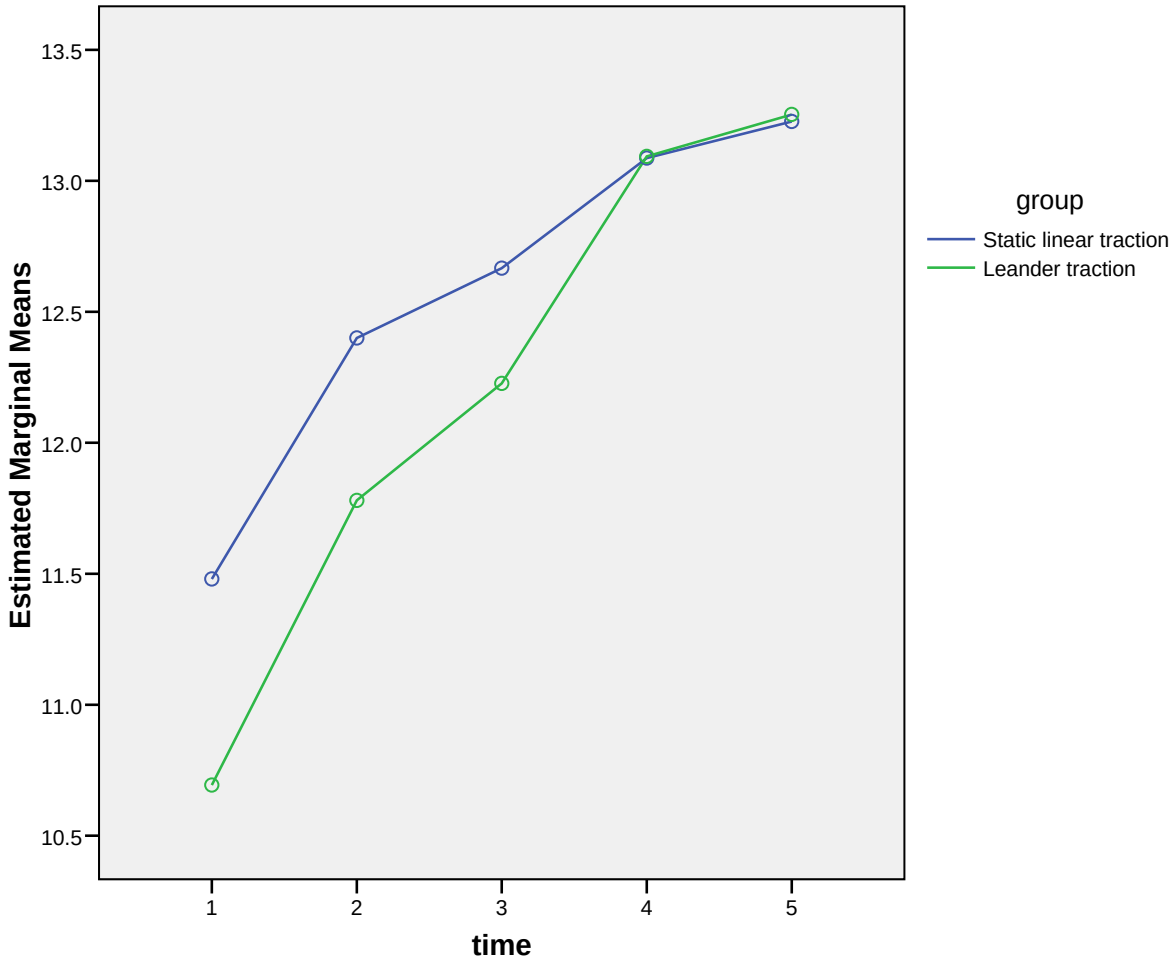


**Figure 17:** Mean Left Kemp's test over time for Group A and Group B

Table 31 shows that overall there was a significant time effect statistically ($p < 0.001$) within both groups, but that there was no significant differential treatment effect between the groups ($p=0.697$). Figure 17 shows that the slopes of the two profiles were very similar but there was perhaps a trend towards Leander traction treatment (Group A) showing a faster rate of increase over time than the Static linear traction treatment group. However, we cannot conclude that one treatment was better than the other for this outcome.

They both showed a significant increase over time. Tables 32, 33, 34 and 35 show that mean differences and 95% confidence levels were not statistically significant for both groups.

**Table 36.** Within-and Between-subjects effects for Right Ext. for Group A and Group B

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.369 | <0.001 |
| **Time*group** | Wilk's lambda=0.918 | 0.697 |
| **Group** | F=0.079 | 0.781 |

**Table 37.** Between groups mean differences for Right Ext. in Group B.

Paired Samples Statistics(a)

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **Pair 1** | rext1pre | 11.033 | 15 | 3.8360 | .9905 |
| | rext1post | 11.727 | 15 | 3.8113 | .9841 |
| **Pair 2** | rext1post | 11.727 | 15 | 3.8113 | .9841 |
| | rext2pre | 11.37 | 15 | 3.392 | .876 |
| **Pair 3** | rext2pre | 11.37 | 15 | 3.392 | .876 |
| | rext2post | 12.393 | 15 | 3.3803 | .8728 |
| **Pair 4** | rext2post | 12.393 | 15 | 3.3803 | .8728 |
| | rext3pre | 12.720 | 15 | 3.4549 | .8920 |

Group B = Static linear traction

**Table 38.** Between groups 95% confidence levels for Right Ext. in Group B.

Paired Samples Test(a)

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| **Pair 1** | rext1pre - rext1post | -.6933 | .6756 | .1744 | -1.0674 | -.3192 |
| **Pair 2** | rext1post - rext2pre | .3600 | 1.6439 | .4245 | -.5504 | 1.2704 |
| **Pair 3** | rext2pre - rext2post | -1.0267 | 1.1646 | .3007 | -1.6716 | -.3817 |
| **Pair 4** | rext2post - rext3pre | -.3267 | 1.0613 | .2740 | -.9144 | .2611 |

Group B = Static linear traction

**Table 39**. Between groups mean differences for Right Ext. in Group A.

Paired Samples Statistics(a)

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **Pair 1** | rext1pre | 10.207 | 15 | 3.1696 | .8184 |
| | rext1post | 11.353 | 15 | 3.5589 | .9189 |
| **Pair 2** | rext1post | 11.353 | 15 | 3.5589 | .9189 |
| | rext2pre | 11.20 | 15 | 2.815 | .727 |
| **Pair 3** | rext2pre | 11.20 | 15 | 2.815 | .727 |
| | rext2post | 11.887 | 15 | 3.0081 | .7767 |
| **Pair 4** | rext2post | 11.887 | 15 | 3.0081 | .7767 |
| | rext3pre | 11.527 | 15 | 2.9183 | .7535 |

Group A = Leander traction

**Table 40.** Between groups 95% confidence levels for Right Ext. in Group A

Paired Samples Test(a)

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| **Pair 1** | rext1pre - rext1post | -1.1467 | 1.4584 | .3766 | -1.9543 | -.3390 |
| **Pair 2** | rext1post - rext2pre | .1533 | 2.0781 | .5366 | -.9975 | 1.3041 |
| **Pair 3** | rext2pre - rext2post | -.6867 | .6556 | .1693 | -1.0497 | -.3236 |
| **Pair 4** | rext2post - rext3pre | .3600 | 2.3439 | .6052 | -.9380 | 1.6580 |

Group A = Leander traction

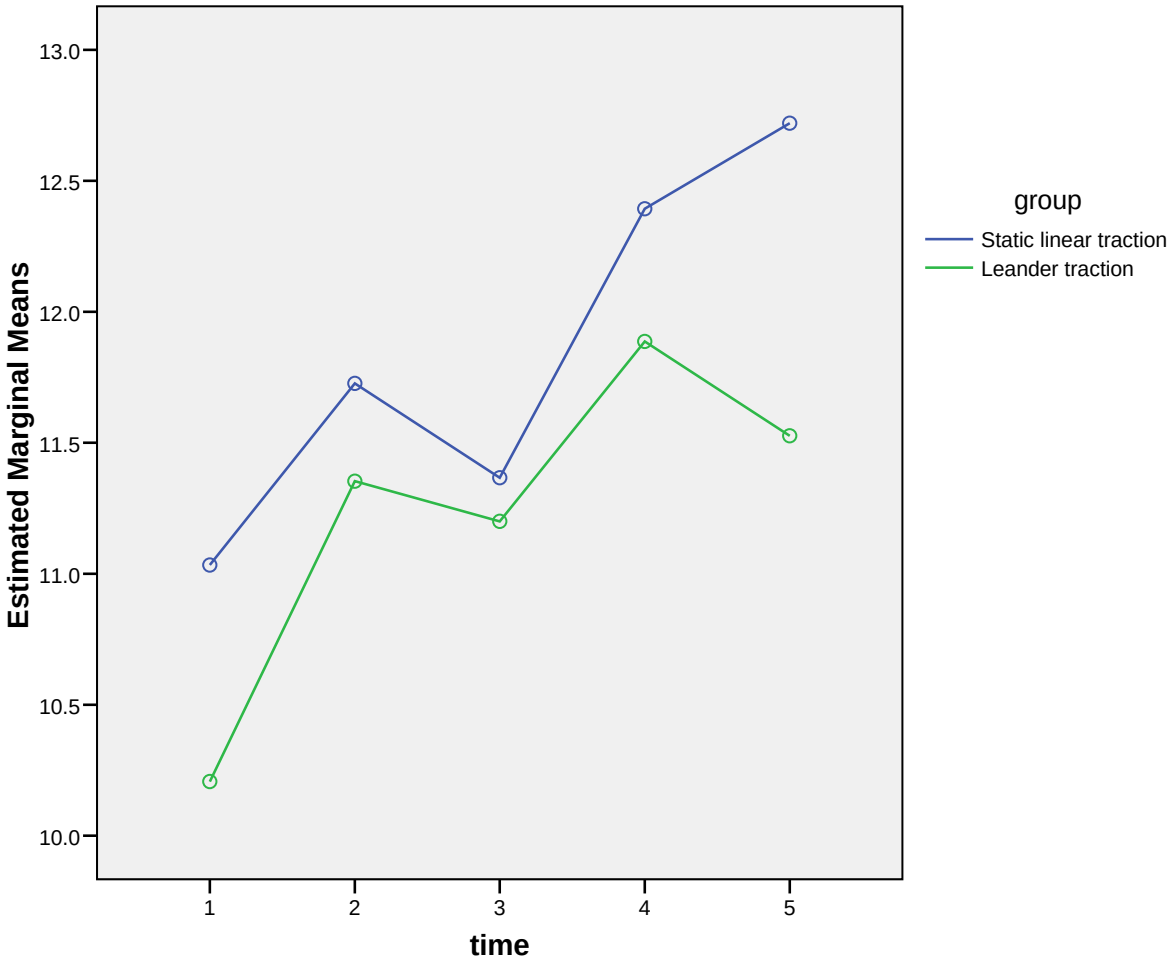


**Figure 18:** Mean Right Ext. over time for Group A and Group B

Table 36 shows that overall there was a significant time effect statistically ($p<0.001$) within both groups but that there was no significant differential treatment effect between the groups ($p=0.384$). Figure 18 shows that the slopes of the two profiles were very similar. The exception was where the trend suggested that Static linear traction (Group B) produced a higher decrease of pain over time, between the second last and the last measurement (time 4 and 5).

However, we cannot conclude that one treatment was better than the other for this outcome. They both showed a significant increase over time. Tables 37, 38, 39 and 40 show no statistically significant differences between both groups for mean differences and 95% confidence levels.

**Table 41:** Within-and Between-subjects effects for Left Ext. in Group A and Group B

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.377 | <0.001 |
| **Time*group** | Wilk's lambda=0.917 | 0.691 |
| **Group** | F=0.012 | 0.915 |

**Table 42.** Between groups mean differences for Left Ext. in Group B

Paired Samples Statistics(a)

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **Pair 1** | lext1pre | 10.287 | 15 | 3.4904 | .9012 |
| | lext1post | 11.233 | 15 | 3.2206 | .8316 |
| **Pair 2** | lext1post | 11.233 | 15 | 3.2206 | .8316 |
| | lext2pre | 10.90 | 15 | 2.821 | .728 |
| **Pair 3** | lext2pre | 10.90 | 15 | 2.821 | .728 |
| | lext2post | 11.827 | 15 | 3.1572 | .8152 |
| **Pair 4** | lext2post | 11.827 | 15 | 3.1572 | .8152 |
| | lext3pre | 12.020 | 15 | 3.4030 | .8786 |

Group B = Static linear traction

**Table 43.** Between groups 95% confidence levels for Left Ext. in Group B

Paired Samples Test(a)

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| **Pair 1** | lext1pre - lext1post | -.9467 | .9862 | .2546 | -1.4928 | -.4005 |
| **Pair 2** | lext1post - lext2pre | .3333 | 1.5559 | .4017 | -.5283 | 1.1950 |
| **Pair 3** | lext2pre - lext2post | -.9267 | 1.0740 | .2773 | -1.5214 | -.3319 |
| **Pair 4** | lext2post - lext3pre | -.1933 | .9177 | .2369 | -.7015 | .3148 |

Group B = Static linear traction

**Table 44.** Between groups mean differences for Left Ext. in Group A

Paired Samples Statistics(a)

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **Pair 1** | lext1pre | 10.100 | 15 | 1.9867 | .5130 |
| | lext1post | 11.333 | 15 | 2.6999 | .6971 |
| **Pair 2** | lext1post | 11.333 | 15 | 2.6999 | .6971 |
| | lext2pre | 11.03 | 15 | 1.624 | .419 |
| **Pair 3** | lext2pre | 11.03 | 15 | 1.624 | .419 |
| | lext2post | 11.600 | 15 | 2.0064 | .5181 |
| **Pair 4** | lext2post | 11.600 | 15 | 2.0064 | .5181 |
| | lext3pre | 11.693 | 15 | 2.7613 | .7130 |

Group A = Leander traction

**Table 45.** Between groups 95% confidence levels for Left Ext. in Group A

Paired Samples Test(a)

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| **Pair 1** | lext1pre - lext1post | -1.2333 | 1.2720 | .3284 | -1.9378 | -.5289 |
| **Pair 2** | lext1post - lext2pre | .3000 | 1.6716 | .4316 | -.6257 | 1.2257 |
| **Pair 3** | lext2pre - lext2post | -.5667 | .7556 | .1951 | -.9851 | -.1482 |
| **Pair 4** | lext2post - lext3pre | -.0933 | 2.5027 | .6462 | -1.4793 | 1.2926 |

Group A = Leander traction

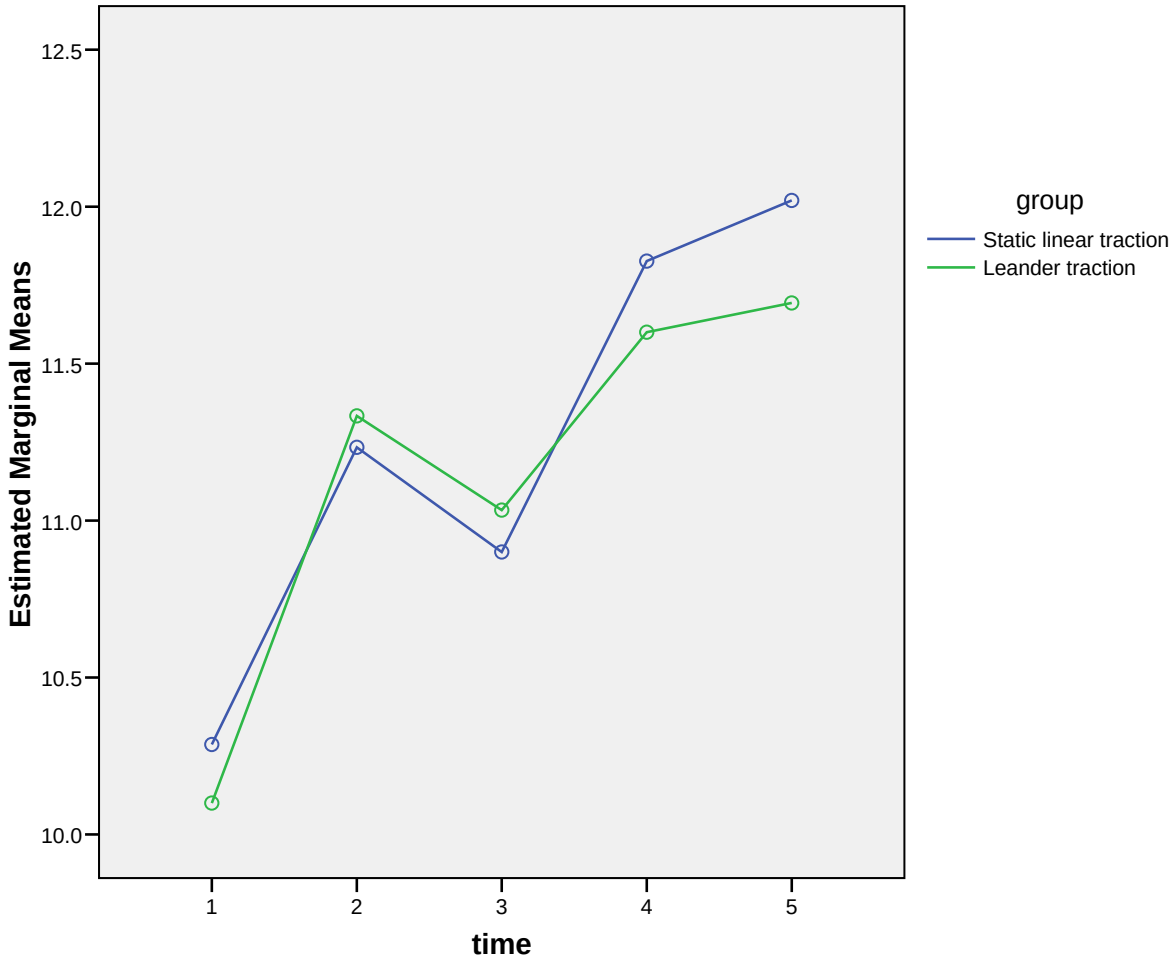


**Figure 19:** Mean Left Ext. over time for Group A and Group B

Table 41 shows that overall there was a significant time effect statistically ($p<0.001$) within both groups but that there was no significant differential treatment effect between the groups ($p=0.691$). Figure 19 shows that the slopes of the two profiles were very similar and almost parallel as can be seen over the five measurement points. Thus, we cannot conclude that one treatment was better than the other for this outcome.

They both showed a statistically significant decrease in pain over time. Tables 42, 43, 44 and 45 show that mean differences and 95% confidence levels between both groups was not statistically significant.

**Table 46:** Within-and Between-subjects effects for NRS (101) in Group A and Group B

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.279 | <0.001 |
| **Time*group** | Wilk's lambda=0.875 | 0.165 |
| **Group** | F=2.175 | 0.151 |

**Table 47.** Between groups mean differences for NRS(101) in Group B

Paired Samples Statistics(a)

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **Pair 1** | NRS1 | 38.3333 | 15 | 21.24825 | 5.48627 |
| | NRS2 | 29.6667 | 15 | 18.96582 | 4.89695 |
| **Pair 2** | NRS1 | 38.3333 | 15 | 21.24825 | 5.48627 |
| | NRS3 | 8.5000 | 15 | 8.95425 | 2.31198 |
| **Pair 3** | NRS2 | 29.6667 | 15 | 18.96582 | 4.89695 |
| | NRS3 | 8.5000 | 15 | 8.95425 | 2.31198 |

Group B = Static linear traction

**Table 48.** Between groups 95% confidence levels for NRS(101) in Group B

Paired Samples Test(a)

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| **Pair 1** | NRS1 - NRS2 | 8.66667 | 9.44281 | 2.43812 | 3.43741 | 13.89592 |
| **Pair 2** | NRS1 - NRS3 | 29.83333 | 23.51798 | 6.07232 | 16.80951 | 42.85715 |
| **Pair 3** | NRS2 - NRS3 | 21.16667 | 19.59106 | 5.05839 | 10.31750 | 32.01583 |

Group B = Static linear traction

**Table 49**. Between groups mean differences for NRS(101) in Group A

Paired Samples Statistics(a)

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| **Pair 1** | NRS1 | 48.5000 | 15 | 9.58049 | 2.47367 |
| | NRS2 | 32.5000 | 15 | 11.29949 | 2.91752 |
| **Pair 2** | NRS1 | 48.5000 | 15 | 9.58049 | 2.47367 |
| | NRS3 | 14.9333 | 15 | 18.87446 | 4.87336 |
| **Pair 3** | NRS2 | 32.5000 | 15 | 11.29949 | 2.91752 |
| | NRS3 | 14.9333 | 15 | 18.87446 | 4.87336 |

Group A = Leander traction

**Table 50.** Between groups 95% confidence levels for NRS(101) in Group A

Paired Samples Test(a)

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| **Pair 1** | NRS1 - NRS2 | 16.00000 | 11.56503 | 2.98608 | 9.59550 | 22.40450 |
| **Pair 2** | NRS1 - NRS3 | 33.56667 | 18.96507 | 4.89676 | 23.06416 | 44.06917 |
| **Pair 3** | NRS2 - NRS3 | 17.56667 | 16.63674 | 4.29559 | 8.35355 | 26.77978 |

Group A = Leander traction

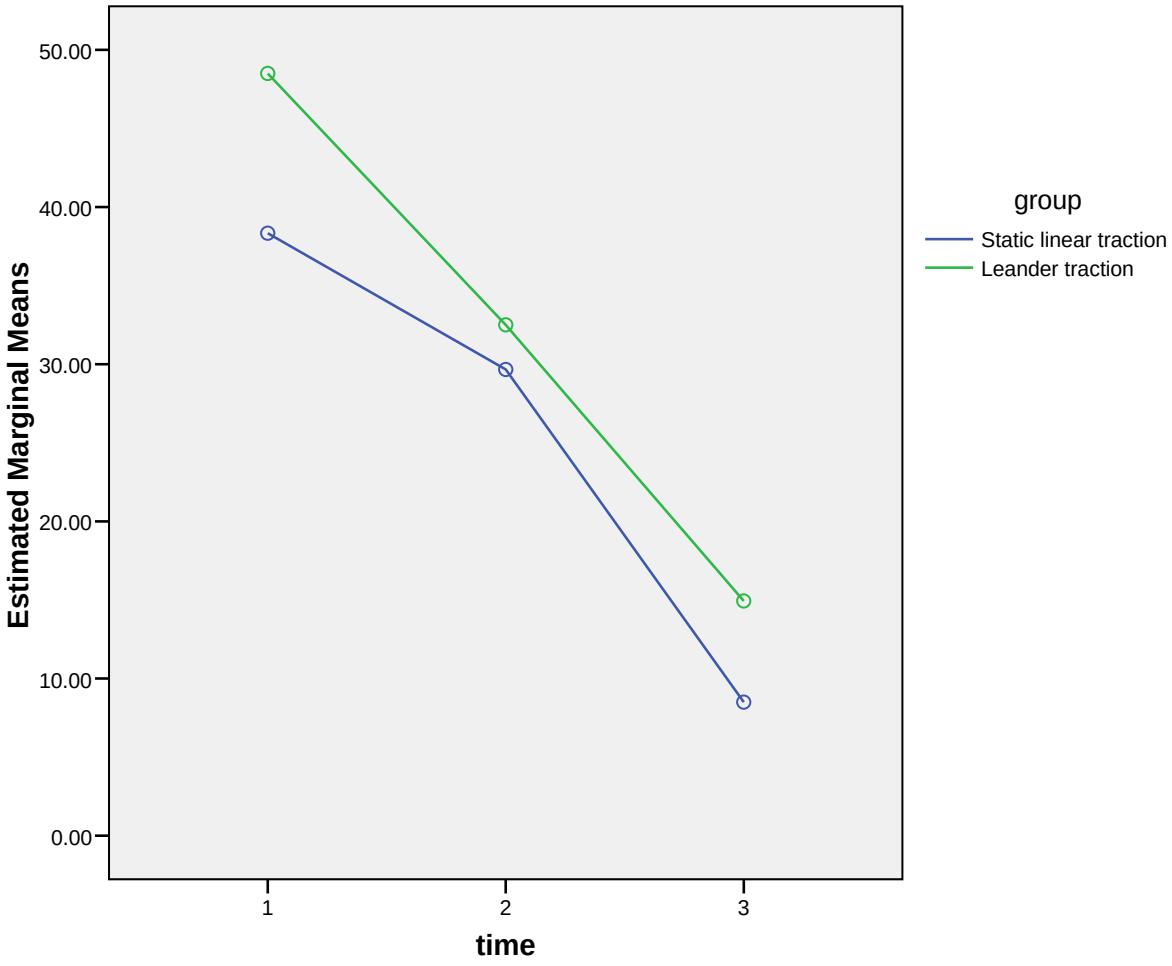


**Figure 20:** Mean NRS (101) over time for Group A and Group B

Table 47 shows that overall there was a significant time effect statistically ($p<0.001$) within both groups but that there was no significant differential treatment effect between the groups ($p=0.165$). Figure 20 shows that the slopes of the two profiles were very similar and almost parallel as can be seen over the 3 time points. Thus, we cannot conclude that one treatment was better than the other for this outcome.

They both showed a statistically significant decrease of pain over time. Tables 48, 49, 50 and 51 show that mean differences and 95% confidence levels between the two groups was not statistically significant.

**Table 51:** Within-and Between-subjects effects for Oswestry Disability Index (ODI) in Group A and Group B

| Effect | Statistic | p value |
|---|---|---|
| **Time** | Wilk's lambda=0.234 | <0.001 |
| **Time*group overall** | Wilk's lambda=0.625 | 0.002 |
| **Time*group early phase** | Wilk's lambda=0.649 | 0.001 |
| **Time*group late phase** | Wilk's lambda=0.880 | 0.061 |
| **Group** | F=0.00 | 0.991 |

**Table 52:**Between groups mean differences for Oswestry Disability Index (ODI) in Group B .

Paired Samples Statistics(a)

| | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| **oswestry1** | 24.60 | 15 | 8.270 | 2.135 |
| **oswestry2** | 22.00 | 15 | 8.767 | 2.264 |
| **oswestry1** | 24.60 | 15 | 8.270 | 2.135 |
| **oswestry3** | 13.00 | 15 | 4.567 | 1.179 |
| **oswestry2** | 22.00 | 15 | 8.767 | 2.264 |
| **oswestry3** | 13.00 | 15 | 4.567 | 1.179 |

Group B = Static linear traction

**Table 53.** Between groups 95% confidence intervals for Oswestry Disability Index (ODI) in Group B.

Paired Samples Test(a)

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| Pair 1 | oswestry1 - oswestry2 | 2.600 | 3.066 | .792 | .902 | 4.298 |
| Pair 2 | oswestry1 - oswestry3 | 11.600 | 8.416 | 2.173 | 6.939 | 16.261 |
| Pair 3 | oswestry2 - oswestry3 | 9.000 | 8.677 | 2.240 | 4.195 | 13.805 |

Group B = Static linear traction

**Table 54.** Between groups mean differences for Oswestry Disability Index (ODI) in Group A.

Paired Samples Statistics

| | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| **oswestry1** | 26.73 | 15 | 5.994 | 1.548 |
| **oswestry2** | 18.33 | 15 | 4.515 | 1.166 |
| **oswestry1** | 26.73 | 15 | 5.994 | 1.548 |
| **oswestry3** | 14.60 | 15 | 6.738 | 1.740 |
| **oswestry2** | 18.33 | 15 | 4.515 | 1.166 |
| **oswestry3** | 14.60 | 15 | 6.738 | 1.740 |

Group A = Leander traction

**Table 55.** Between groups 95% confidence intervals for Oswestry Disability Index (ODI) in Group A.

Paired Samples Test

| | | Paired Differences | | | | |
|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | |
| **Pair 1** | oswestry1 - oswestry2 | 8.400 | 4.896 | 1.264 | 5.689 | 11.111 |
| **Pair 2** | oswestry1 - oswestry3 | 12.133 | 7.130 | 1.841 | 8.185 | 16.082 |
| **Pair 3** | oswestry2 - oswestry3 | 3.733 | 5.824 | 1.504 | .508 | 6.959 |

Group A = Leander traction

Table 52 shows that overall there was a significant time effect statistically ($p<0.001$) within both groups and that there was also a significant differential treatment effect between both groups ($p=0.002$). Figure 21 shows that the slopes of the two profiles intersected at two points over time. This is better interpreted separately as early effects and late effects. Thus, we conclude that Leander traction (Group A) was significantly more effective in the early phase ($p=0.001$) and that both treatments were equivalent in the late phase ($p=0.061$) but the non statistically significant trend suggested that static linear traction (Group B) was more effective in the late phase for this outcome. This is also demonstrated by tables 53, 54, 55 and 56 which show the mean differences and 95% confidence levels between the two groups.

Hsieh et al., (1992) suggests that the ODI index is only statistically significant if there is a MCID difference of 30%. However, these differences fell marginally short of the 30% mark and was not statistically significant.

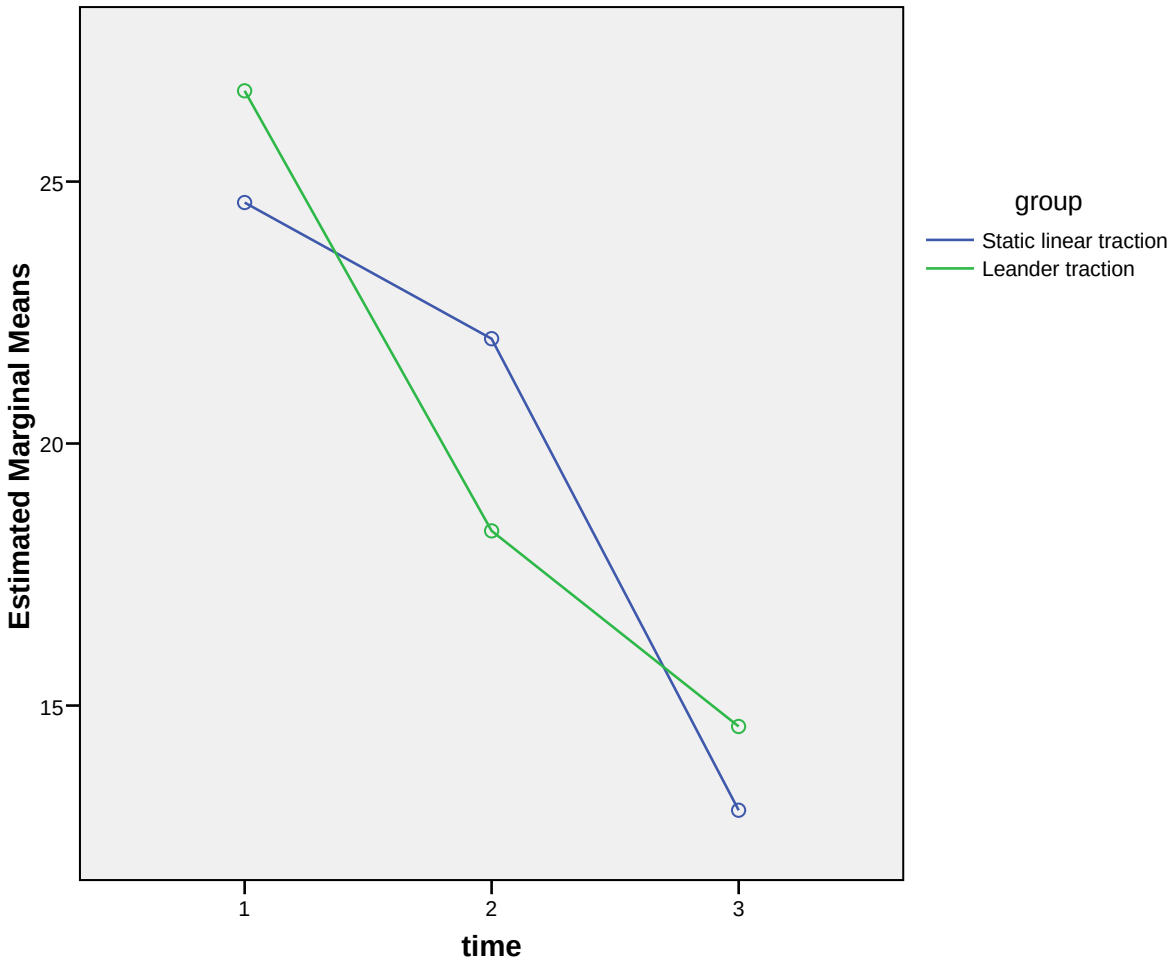


**Figure 21:** Mean Oswestry Disability Index (ODI) score over time for Group A and Group B

# CHAPTER FIVE – DISCUSSION OF RESULTS

## 5.1 Introduction

This chapter will discuss the results obtained from the statistical analysis of the subjective (NRS (101), Pain Severity Scale (PSS) and Oswestry Disability Index questionnaire (ODI)) and objective (Algometer readings for Kemp's test and spinal extension) data.

There were 3 objectives introduced in this study and these will now be discussed in terms of subjective and objective findings.

## 5.2 Subjective data

### 5.2.1 Leander traction (Group A)

Results obtained from the NRS (101) for Group A (Leander traction) participants showed a significant reduction in pain over the 3 time points statistically (p=0.001) [Figure 6]. Similar trends were seen for both PSS (p=0.001) and ODI (o=0.001) scores as seen in figures 1 and 7. This reduction in pain and disability experienced by the participants could be, in part, due to a decrease in multifidus muscle spasm, which is a common finding in chronic lumbar facet syndrome (Cox, 1999.; Kirkaldy- Willis and Burton, 1992 and Schneider, 1991).

Schneider (1991) has suggested that Leander traction stretches the facet joint capsules in an ‘oscillatory’ fashion which stimulates mechanoreceptors within the facet joint during each phase of traction. This could then result in both analgesic affects as well as decreased multifidus muscle spasms. During Leander traction multifidus muscle fibres are vigorously stretched and if sarcomeres within the muscle are in a state of contracture (unable to separate) then this type of traction may force separation of myofibrils and promote relaxation by lengthening of the fibres. It must also be noted that any strong stretch of muscle tissue will cause stimulation of proprioceptors, golgi tendon organs, and muscle spindle fibres, which will in turn cause inhibition of motor neuron activity and reduce muscle spasm.

The improvement of participants in the Leander traction group may also be due to the postero-anterior (PA) moblization effect on the facet joints and the flexion distraction effect on the posterior soft tissues i.e. multifidus muscle that this particular form of traction does stretch (Cox 1999 and Schneider 1991). For reasons pertaining to this study a slight PA mobilization force was applied over the affected lumbar facet joint with each maximum downward flexion motion (-12.5 degrees) of the table and was given for 10 repetitions at a velocity of one PA mobilization every two seconds (Cox, 1999).

Due to the application of a  (PA) force along with the downward flexion distraction force in Leander traction the affected facet joint might experience slight extension bending along with anterior shear (Lee and Evans, 2000).

These above mentioned affects of PA mobilization along with stretching of the posterior soft tissues i.e. multifidus muscle, might have a therapeutic effect on the lumbar facet joints and surrounding structures. (Cox, 1999 and Schneider , 1991). To be more specific we see posterior shear induced at the motion segments above the vertebra being mobilised along with anterior shear at the segments below. Thus the effects of Leander traction can be both useful for stretching posterior soft tissues as well as mobilizing facet joints and surrounding soft tissues.

There are fundamental differences between Postero-Anterior (PA) mobilization and linear traction. An understanding of the mechanical effects of these two types will help clinicians decide the relative appropriateness of the two techniques (Lee and Evans, 2001). It could then be argued that linear traction could be more helpful in regaining flexion movement of the spine and PA mobilization extension movement of the spine.

The flexion and extension movements induced by these two types of traction, should then have a direct effect on the lumbar facet joints and surrounding soft tissues. Lee and Evans (2001) stated that the flexion movement produced by linear traction stretched the posterior soft tissues, and that the extension movement produced by PA mobilization tended to reduce any tension in these tissues. However, linear traction may be more painful and less tolerable in acute LBP patients with injuries to the posterior tissues whereas PA mobilization may be more tolerable and less painful.

The differences in direction and magnitude of intervertebral shear forces for PA mobilization in Leander traction and Static linear traction are evident when it comes to any translational instability, such as spondylolisthesis and spondylosis within the lumbar spine (Lee and Evans, 2001). Linear traction should be avoided due to the fact that the motion segments are subjected to anterior shear forces during linear traction. However it was also noted by Lee and Evans (2001) that PA mobilization only caused anterior shear of the motion segments below the mobilized vertebra and if the unstable segment was above the mobilized vertebra then posterior shear would be induced in that segment which could possibly reduce tissue strains and help relieve pain. Thus, in the case of L5/S1 spondylolisthesis or spondylosis, mobilization of the sacrum is not a contraindication and may actually relieve symptoms, but mobilization of L5 should be avoided.

According to Schneider (1991) Leander Eckard, D.C. has stated that mechanised Leander traction tables can be used in adjunctive ways to help the doctor to mobilize or manipulate facet joints while the table is mechanically separating the facet joints during flexion distraction. This requires much less force than conventional manipulation. Eckard (2007) has also pointed out that the lumbar spine should be in a lordotic (neutral) position during traction because the nucleus pulposis moves anterior in such a position.

Schneider (1991) also believes that when mechanised Leander tables are used to mobilize facet joints and when a manual PA pressure is applied to the facet joints over the spinous processes of the affected area, then this form of traction would immediately apply stretch to the surrounding tissues and facet joint capsules which would then cause the desired therapeutic results. Eckard (2007) however believes flexion distraction may be improper and potentially traumatic because it may place too great a force on the posterior elements of the annulus fibrosis, facet joint capsules and the posterior ligaments.

### 5.2.2 Static linear traction (Group B)

Group B (Static linear traction) participants showed a similar significant trend statistically for reduction in LBP and disability scores for NRS (101) (figure 13), PSS (figure 8) and ODI (figure 14) as Group A (Leander traction) participants. This reduction in pain can be due to stretching of the facet joint capsule as stated by ( Cox, 1999., Gudavalli et al., 1997 and 2000.; Kekosz, 1986., Letchuman and Deusinger, 1993 and Lee and Evans, 2001).

It must be noted that traction does not just affect the facet joint but also surrounding structures such as the Intervertebral Disc (IVD) and surrounding musculature and ligaments. The above affects have been shown through Computed Tomographic (CT) studies done by Sari et al. (2005), that during traction individuals who were suffering from acute Lumbar Disc Herniation (LDH) had a reduction in the size of the herniation, and had an increased spinal canal size along with widening of the neural foramina as well as a decrease in the thickness of the psoas muscle.

It can be assumed that all these above effects can lead to a reduction in pain. Onel (1989) used CT scans to show that Static linear traction caused a marked reduction in the size of some herniations, particularly those in the midline or posterolateral position. However it is not certain if these effects persisted after traction had stopped.

It is speculative whether after 5 treatments of continuous Static linear traction, that vertebral body separation and facet joint distraction could have had therapeutic effects. This could be a promotion of cartilage repair by a reduction in compressive loads on the facet joint and IVD (Revel, 2000 and Krause et al., 2000). However, a synovial fold might get stuck in a facet joint which could be released through the distracting affects of traction. Revel (2000) and Krause et al., 2000 also stated that intervertebral joint distraction may cause stimulation of the numerous mechanoreceptors present within the joint capsules, ligaments and annulus fibrosis and that afferent impulses from these mechanoreceptors may contribute to blocking nocioceptive impulses as stated by Knutsson, Skogland and Natchev. (1998).

Studies done on electromyogram (EMG) effects of Static linear traction on lumbar paraspinal musculature have shown that traction has very little effect on paraspinal muscle contractility (Revel, 2000). However, studies have shown that paraspinal muscle activity during intermittent traction and sustained traction are associated with myoelectric activity consistent with muscle contraction opposing the traction force. Letchuman and Deusinger, (1993) have suggested this effect can be counteracted by applying a prolonged traction force gradually and regularly over the affected area.

This was the case with Group B participants, where a traction force of 33% of total body weight was given over a period of ten minutes. Beurskens et al., (1997); Van der Heijden et al., (1995); Borman et al., (2003) and Gay and Brault, (2008) have suggested that Static linear traction of 30% to 50% of total body weight at a minimum time period of ten minutes will be sufficient enough to have an affect on the three joint complex (Kirkaldy-Willis and Burton, 1992), and that this form of traction was similar in pain reduction to low-dose traction, mineral baths, underwater massage, or traditional physical therapy for LBP of longer than four weeks duration.

It is also possible that participants in this study were also suffering from discogenic pain as well as facet joint pain. However, no radiographic, CT or Magnetic Resonance Imaging (MRI) studies were done in order to assess IVD morphology. Tesio (1993) has stated that traction may also improve venous circulation around the nerve root due to widening of the Intervertebral Foramina (IVF) and because over 50% of the IVF consists of venous plexuses this affect could promote healing and ultimately decrease pain over the affected area.

Another reason why Static linear traction can cause a decrease in pain is due to the flattening of the lumbar lordosis through the flexion moment produced by Static linear traction.

Lateral radiographs of Lumbar facet syndrome often show the spine in hyperlordosis, which in turn places extra stress on the lumbar facet joints (Gatterman, 1990 and Cox, 1999). This disruption of the normal spinal curvature of the lumbar spine can result in several deteriorative processes starting at that affected area. According to Abrams (1999) one of these deteriorative processes that occurs as a result of a desruption in spinal curvature is the inflammatory reaction that occurs on and around the IVD, facet joints and spinal nerves. This inflammatory process exudes toxins which are pain producing and which hypersensitize both the motor and sensory nerves. These hypersensitised motor nerves cause over reaction of the proprioceptive (stretch) fibers and result in muscle spasm. The stretching of these fibres by the traction force may reduce muscle spasm and reduce pain felt by the participants.

Thus often the aim of this form of treatment will be to produce flexion of the lumbar spine and the adoption of the fowler position (person lies supine with both legs resting on a small table or large cushion, so that flexion occurs at both hips and knees), is beneficial, as this will create a sufficient flexion moment as well as taking up a significant amount of slack of the posterior soft tissues.

This ultimately reduces the traction force required to stretch posterior soft tissues (Lee and Evans, 2001). Panjabi (1983) has shown that the mean cross-sectional area of the IVF increases during flexion. It can therefore be assumed that the flexion moment produced by traction would have an effect on the size of the IVF. Humphreys et al., (1998) has shown that the flexion moment had a more significant affect on increasing foraminal volume than the axial traction force. Thus the aim of the treatment in Group B participants was to enlarge the IVF area, which would also induce motion or stretch of the facet joint and surrounding tissues and in doing so relieving pain.

Borman et al., (2003) has stated that management goals in chronic LBP are to improve the ability to perform basic daily activities, reduce disability, and improve strength associated with reconditioning programmes, as pointed out by (Mannion et al., 2001; Van Tulder et al., 1997 and Delitto et al., 1995). For this study participants only had traction as a primary source of treatment and no other modalities were used in the three week period of treatment. However on the last visit participants were advised on appropriate strengthening exercises for long term maintenance.

### 5.2.3 Comparison of subjective findings between Groups A and B

Mean NRS (101) and PSS scores over time showed a statistically significant time effect (p=0.001) for both groups and also showed that both groups improved almost at the same rate over time (Figure 15 and 20). However there was no significant difference in the overall effect of the two treatments used (p=0.129 and p=0.165). Figures 15 and 20 showed that the slopes of the two profiles were very similar and almost parallel. Thus it was concluded that both treatments were equally effective over time and that no form of traction was more effective than the other.

Oswestry Disability Index (ODI) scores showed that there was a statistically significant time effect (p=0.001) and treatment effect (p=0.002) for both groups. Figure 21 shows that the slopes of the two profiles intersected at two points over time. This can be interpreted separately as early effects and late effects of the treatment. It can then be concluded that Leander traction was more effective in the early phase of treatment (p=0.001) and that both treatments were equally effective in the late phase of the treatment (p=0.061). However the non significant trend suggested that Static linear traction was more effective in the late phase for this outcome.

Some research though has indicated that differences in pain perception exist between the genders, with males having more positive expectations regarding the painfulness of potentially painful events (Farasyn and Meeusen, 2005). This difference may have tainted some of the scores which in turn may have affected the outcome of the study. However the distribution of male and female participants was 6:9 and 9:6 respectively so this distribution would have nullified any difference between the gender groups.

The changes seen in the early phase of ODI scores for Leander traction participants relative to those in Group B participants can be due to the ‘oscillatory ‘stretching of hypertonic multifidus muscles along with the added PA mobilizing effect on the affected facet joint areas (Schneider, 1991). These two effects combined can explain why participants felt relief faster in the early phase of the treatment compared to Group B participants. However, the overall therapeutic affect both forms of traction had on the facet joint and surrounding tissues can be explained by both treatments having similar linear curves for overall treatment effect.

## 5.3 Objective data

### 5.3.1 Comparison of Leander traction (Group A) and Static linear traction (Group B)

As stated previously, objective measurements (Algometer) were taken 2 centimetres lateral to the midline over the affected facet joint. Measurements were taken on the 1st, 2nd and 6th visits using Kemp's test and lumbar spinal extension as reliable indicators of facet joint tenderness.

Although this study was conducted on participants experiencing chronic lumbar facet syndrome, many participants had active and latent paraspinal muscle trigger points. Participants who had paraspinal muscle trigger points were not excluded from this study due to differing referral patterns of various paraspinal muscle trigger points (Travell et al., 1999 and Esenyel, 2000). Participants may have experienced intense and disabling pain at a distant site which may have influenced their pain perception in the area that was been tested by the Algometer and this may have tainted the results for both subjective and objective readings.

### 5.3.2 Kemp's Test

When comparing both groups with regards to Left and Right Kemp's test no statistically significant differences were found. Figure 16 shows that mean Right Kemp's test improved almost equally over time for both groups and can be concluded that both treatments were equally effective over time. However, Figure 17 showed that Leander traction (Group A) participants had a faster rate of increase over time than Static linear traction (Group B) participants for Left Kemp's test. However it can not be concluded that one treatment was better than the other, both showed a statistically significant decrease of pain felt over time.

When comparing the affected side in the two treatment groups, table 5 (chapter 4) showed that there were statistically significant differences found (p=0.143). As mentioned earlier there were two groups of fifteen participants each in this study. Group A had five (35.7%), who had lumbar facet syndrome on the left and Group B had nine (64.3%). Similarly, facet syndrome on the right showed that there were ten (62.5%) in Group A and six (37.5%) in Group B. When we look at the percentage split of left and right in the two groups and compare this to results obtained by algometer readings for Kemp's test and spinal extension we see that both groups improved at very similar rates and that this was statistically significant.

It is also evident that algometer readings improved in both groups at similar rates, this may be due to examiner bias, allocation concealment and that there was no control group in this study. Readings obtained from an algometer are sensitive to the rate at which the pressure is applied, thus readings could have been manipulated by the examiner (Farasyn and Meeusen, 2005) Therefore the efficacy of treatment for both groups were similar and no treatment was better than the other.

Participants receiving Leander traction were also exposed to extra stretch, as apposed to static linear traction, of posterior soft tissues due to the flexion distraction component of Leander traction (Schneider, 1991.; Cox, 1999 and Gay and Brault, 2008). This added effect, along with facet joint and multifidus muscle mobilization could explain why Group A participants showed a greater trend towards improving over time than Group B participants. Another added affect by Leander traction could be the use of PA mobilization at the end of each -12.5 degrees downward flexion moment, which through careful control of the doctors contact hand can control shear forces around the facet joint and mobilize the facet joint and surrounding tissues according to feedback obtained from the patient with regards to tolerance and comfort.

### 5.3.3 Lumbar spinal extension

A comparison of Left and Right lumbar spinal extension between Group A and Group B participants showed that both treatments showed statistically significant reduction in pain and were very similar with regards to overall treatment effect. Figure 18 showed that for Right extension, the two profiles were very similar except perhaps between the second last and last measurement (2$^{nd}$ treatment and the final visit which is three weeks after the initial treatment), where the trend suggested that Static linear traction (Group B) produced a more statistically significant rate of improvement over time. However, it cannot be concluded that one treatment was better than the other for this outcome and both showed a statistically significant rate of improvement over time.

This similar trend seen by both groups suggests that both forms of traction were effective in the treatment of lumbar facet syndrome but no particular treatment was more effective than the other. Figures 17 and 18 however, show a slight increase in the efficacy of one group over the other for Left Kemp's test and lumbar extension on the right. However this can also be attributed to the lack of a double-blinded procedure used in this study with regards to taking algometer readings. The same examiner was used to administer the treatment and to take the algometer readings.

The examiner was therefore aware of which treatment group each participant belonged to and therefore may have been biased towards a particular group. This factor may have affected the way the examiner took the results and hence this may have affected the outcome results of this study (Farasyn and Meeusen, 2005).

## CHAPTER SIX- CONCLUSION AND RECOMMENDATIONS

The aim of this study was to investigate the efficacy of Leander traction and Static linear traction in the treatment of chronic lumbar facet syndrome.

In this study, subjective and objective data measurements from both groups suggested that both forms of traction were equally effective for the treatment of lumbar facet syndrome. However some objective findings showed a slight non significant trend in favour of a particular form of traction. Leander traction showed a slightly faster rate of improvement for Left Kemp's test but Static linear traction showed a slight improvement for Right extension. These differences could have been due to examiner bias, allocation concealment and the lack of a control group.

Similar trends were seen with regards to subjective measurements, with both group's improving at similar rates over time. However slight differences were noted with regards to the ODI scores of both groups. When ODI scores were separately interpreted as early phase improvement and late phase improvement (after 3 weeks), then Leander traction was more effective in the early phase and that both treatments were equally effective in the late phase but a non significant trend suggested that Static linear traction was slightly more effective in the late phase for this outcome. So it can be concluded that both Leander traction and Static linear traction are effective in the treatment of chronic lumbar facet syndrome.

It is the opinion of Gay and Brault, (2008) that traction is advised for chronic LBP and traction procedures for acute LBP can often intensify the pain.

Every research study has its own set of confounding factors that may affect the studies clinical outcome. Although governed by strict parameters, this study was no exception.

The sample size of 30 participants may have been too small to allow the researcher to show statistically significant trends that may have shown the value of either Leander traction or Static linear traction in the treatment of chronic lumbar facet syndrome. Statistical significance is dependant on the magnitude of the clinically important differences as well as the sample size. Big clinical differences can be obtained from small sample sizes, while small clinical differences require larger samples sizes. This study showed very small differences between the groups. Therefore, post hoc calculations could be used in future studies to determine a larger sample size. According to Esterhuizen (2009) the sample size needed to show clinical and statistical significance may require hundreds if not thousands of participants. The sample population also did not equally represent various types of occupations or age groups.

To obtain the most homogenous group of participants for this study, strict inclusion and exclusion criterias were set. However the researcher did not take into account radiographic evidence of spondylosis, spondolysis and spondylolisthesis as diagnostic pain producing features.

The researcher also did not consider the pressure effects of the algometer on active trigger point areas which may have exacerbated pain scores in the area tested (Travell et al., 1999).

A blinded procedure was not used when taking algometer readings. In this study the same examiner was used to conduct the treatment and take the readings, thus the examiner was aware of which group each participant belonged to, therefore an unbiased examiner could not be guaranteed. In this study the examiner was not blinded and in studies like this it is often not possible to blind the participants or the individuals providing the treatment. The examiner believes that through the lack of allocation concealment, a potential source of bias could have been avoided. Readings obtained from an algometer are sensitive to the rate at which the pressure is applied thus readings could have been manipulated by the examiner (Farasyn and Meeusen, 2005). These oversights may have affected the clinical outcomes of this study.

Further studies could focus on a specific part of the lumbar spine. It was noted in this study that 6.6% of the sample group had thoracolumbar syndrome (Maigne's syndrome) and that 23.3% had L5/S1 facet syndrome.

Further studies could focus on the affects of PA mobilization forces applied during FD.

For the purpose of this study a stabilizing force was applied over the affected facet joint and no PA mobilization force was applied as this could be potentially harmful to the posterior elements of the facet joint (Eckard, 2007).

The speed of distraction was dictated by the Leander traction table. Further studies could focus on slowing down the rate of distraction as in the study done by Cambron, Gudavalli and McGregor (2006).

A flaw in the study was found with regards to algometer measurements at the end ranges of the orthopaedic tests for Kemp's Test and spinal extension. Algometer readings were taken over the previously specified area when the participants were at a maximum end range of motion, which may or may not have been painful to the patient. Most participants experienced pain with one or both of these orthopaedic tests as they were considered diagnostic for facet syndrome. By placing the algometer over an already painful joint and applying a horizontal downward pressure in the horizontal plane, over that joint, it may have affected the perception of pain experienced by the participant and therefore the objective outcome of this study.

It can be concluded that Static linear traction and Leander traction were both effective in the treatment of chronic lumbar facet syndrome. These both showed similar trends with regards to pain reduction for both subjective and objective clinical findings.

The researcher has pointed out certain flaws experienced with regards to objective measurements taken using the algometer as well as differences experienced between age, race and gender with regards to pain perception. The researcher feels that further studies should concentrate on specific age groups as well as specific race and gender groups and be more location specific, such as focusing on a single motion segment of the spine e.g. L5/S1.

This study showed that traction was effective in the treatment of chronic facet syndrome but without a placebo group it wasnot possible to say whether the observed changes were due to treatment effect or other variables such as non-specific effects or natural history. However further research should be done on the effectiveness of traction and FD with regards to chronic, acute and sub-acute mechanical low back pain syndromes and its subtypes. Despite the widespread use of traction, the safety, efficacy and effectiveness of FD and Static linear traction for specific conditions are not well established. Further clinical trials are needed to determine if there are subgroups of LBP sufferers who benefit from specific types of traction. Treatment variables such as duration and magnitude of traction force, direction of off-axis traction force and number of treatments should also be considered.

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**Appendix A**

# Are you between 25 – 55years old?

## DO YOU SUFFER CHRONICALLY FROM

# LOW BACK PAIN

- Are you experiencing low back pain with pain radiating into the groin, hip, buttock, and often the leg, in most cases above the knee ?
- Does bending backwards increase your pain ?
- Do any activities, such as, sleeping on the abdomen, sitting in an upright position, lifting a load in front of your body at or above the waistline, working with the hands and arms above the head, and arising from sitting, increase your pain?

Research is currently being carried out at the Durban University of Technology on the affects of traction on chronic lower back pain sufferers.

**Chiropractic Day Clinic**

# *FREE TREATMENT.*

## For more information contact John on 031 3272205 / 2512 / 084 616

**4917**

**DURBAN UNIVERSITY OF TECHNOLOGY**
**CHIROPRACTIC DAY CLINIC**
**CASE HISTORY**

Patient: _____ _____

Date:

File # : _____ _____

Age:

Sex : _____ Occupation: _____

Intern : _____ _____

Signature

**FOR CLINICIANS USE ONLY:**

Initial visit

Clinician: Signature :

**Case History:**

Examination: Previous: Current:

X-Ray Studies: Previous: Current:

Clinical Path. lab: Previous: Current:

**CASE STATUS:**

| PTT: | Signature: | Date: |
|---|---|---|

**CONDITIONAL:**
Reason for Conditional:

Signature: Date:

Conditions met in Visit No: Signed into PTT: Date:

Case Summary signed off: Date:

**Intern's Case History:**

**1. Source of History:**

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

**3. Present Illness:**

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

**4. Other Complaints:**

**5. Past Medical History:**

< General Health Status

< Childhood Illnesses

< Adult Illnesses

< Psychiatric Illnesses

< Accidents/Injuries

< Surgery

< Hospitalizations

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

< Allergies

< Immunizations

< Screening Tests incl. x-rays

< Environmental Hazards (Home, School, Work)

< Exercise and Leisure

< Sleep Patterns

< Diet

< Current Medication
Analgesics/week:
< Tobacco

< Alcohol

< Social Drugs

**7. Immediate Family Medical History:**

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

**8. Psychosocial history:**

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

**9. Review of Systems:**

< General

< Skin

< Head

< Eyes

< Ears

< Nose/Sinuses

< Mouth/Throat

< Neck

< Breasts

< Respiratory

< Cardiac

< Gastro-intestinal

< Urinary

< Genital

< Vascular

< Musculoskeletal

< Neurologic

< Haematologic

< Endocrine

< Psychiatric

## Durban University of Technology
## PHYSICAL EXAMINATION: SENIOR

**Patient Name :** _____ **File no :**_____ **Date :**_____
**Student :** **Signature :**

**VITALS:**

| | | | | |
|---|---|---|---|---|
| Pulse rate: | | | Respiratory rate: | |
| Blood pressure: | R | L | Medication if hypertensive: | |
| Temperature: | | | Height: | |
| Weight: | Any recent change? Y / N | | If Yes: How much gain/loss | Over what period |

**GENERAL EXAMINATION:**

| | | |
|---|---|---|
| General Impression | | |
| Skin | | |
| Jaundice | | |
| Pallor | | |
| Clubbing | | |
| Cyanosis (Central/Peripheral) | | |
| Oedema | | |
| Lymph nodes | Head and neck | |
| | Axillary | |
| | Epitrochlear | |
| | Inguinal | |
| Pulses | | |
| Urinalysis | | |

**SYSTEM SPECIFIC EXAMINATION:**

CARDIOVASCULAR EXAMINATION

RESPIRATORY EXAMINATION

ABDOMINAL EXAMINATION

NEUROLOGICAL EXAMINATION

COMMENTS

**Clinician:** **Signature :**

# REGIONAL EXAMINATION - LUMBAR SPINE AND PELVIS

Patient:_____
File#:_____Date:_________
Intern\Resident:_____ Clinician:_____

## STANDING:

Posture– scoliosis, antalgia, kyphosis
Body Type
Skin
Scars
Discolouration

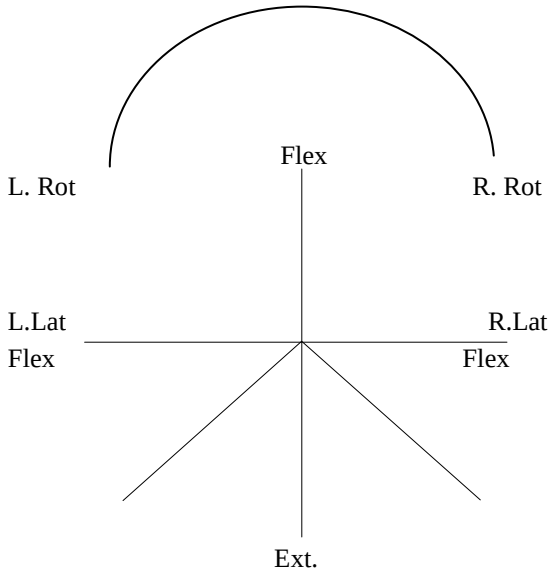
Minor's Sign
Muscle tone
Spinous Percussion
Scober's Test (6cm)
Bony and Soft Tissue Contours

## GAIT:

Normal walking
Toe walking
Heel Walking
Half squat

## ROM:

**Forward Flexion = 40-60° (15 cm from floor)**
Extension = 20-35°
L/R Rotation = 3-18°
L/R Lateral Flexion = 15-20°




### Which movt. reproduces the pain or is the worst?

- Location of pain
- Supported Adams: Relief? (SI)
- Aggravates? (disc, muscle strain)

## SUPINE:

Observe abdomen (hair, skin, nails)
Palpate abdomen\groin
Pulses - abdominal
- lower extremity
Abdominal reflexes

| **S L R** | | | LBP? | Location | Leg pain | Buttock | Thigh | Calf | Heel | Foot | Braggard |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **L** | | | | | | | | | | |
| | **R** | | | | | | | | | | |

| | **L** | **R** |
|---|---|---|
| Bowstring | | |
| Sciatic notch | | |
| Circumference (thigh and calf) | | |
| Leg length: actual - | | |
| apparent - | | |
| Patrick FABERE: pos\neg – location of pain? | | |
| Gaenslen's Test | | |
| Gluteus max stretch | | |

| | | |
|---|---|---|
| Piriformis test (hypertonicity?) | | |
| Thomas test: hip \ psoas? \ rectus femoris? | | |
| Psoas Test | | |

## SITTING:

Spinous Percussion
Valsalva
Lhermitte

| **T R I P O D** Sl, +, ++ | | | **LBP?** | **Location** | **Leg pain** | **Buttock** | **Thigh** | **Calf** | **Heel** | **Foot** | **Braggard** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **L** | | | | | | | | | | |
| | **R** | | | | | | | | | | |

| Slump 7 test | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **L** | | | | | | | | | | | |
| | **R** | | | | | | | | | | | |

## LATERAL RECUMBENT:

| | L | R |
|---|---|---|
| **Ober's** | | |
| **Femoral n. stretch** | | |
| SI Compression | | |

## PRONE:

| | **L** | **R** |
|---|---|---|
| Gluteal skyline | | |
| Skin rolling | | |
| Iliac crest compression | | |
| Facet joint challenge | | |
| SI tenderness | | |
| SI compression | | |
| Erichson's | | |
| Pheasant's | | |

| MF tp's | **Latent** | **Active** | **Radiation** |
|---|---|---|---|
| QL | | | |
| Paraspinal | | | |
| Glut Max | | | |
| Glut Med | | | |
| Glut Min | | | |
| Piriformis | | | |
| Hamstring | | | |
| TFL | | | |
| Iliopsoas | | | |
| Rectus Abdominis | | | |
| Ext/Int Oblique muscles | | | |

## NON ORGANIC SIGNS:

Pin point pain
Axial compression
Trunk rotation
Burn's Bench test
Flip Test
Hoover's test
Ankle dorsiflexion test
Repeat Pin point test

# NEUROLOGICAL EXAMINATION

Fasciculations

Plantar reflex

| level | Tender? | Dermatomes | | DTR | | |
|---|---|---|---|---|---|---|
| | | L | R | | L | R |
| T12 | | | | Patellar | | |
| L1 | | | | Achilles | | |
| L2 | | | | | | |
| L3 | | | | Proproception | | |
| L4 | | | | | | |
| L5 | | | | | | |
| S1 | | | | | | |
| S2 | | | | | | |
| S3 | | | | | | |

## *MYOTOMES*

| Action | Muscles | Levels | L | R | |
|---|---|---|---|---|---|
| Lateral Flexion spine | Muscle QL | | | | |
| Hip flexion | Psoas, Rectus femoris | | | | 5+ Full strength |
| Hip extension | Hamstring, glutes | | | | 4+ Weakness |
| Hip internal rotat | Glutmed, min;TFL, adductors | | | | 3+ Weak against grav |
| Hip external rotat | Gluteus max, Piriformis | | | | 2+ Weak w\o gravity |
| Hip abduction | TFL, Glut med and minimus | | | | 1+ Fascic w\o gross movt |
| Hip adduction | Adductors | | | | 0 No movement |
| Knee flexion | Hamstring, | | | | |
| Knee extension | Quad | | | | W - wasting |
| Ankle plantarflex | Gastroc, soleus | | | | |
| Ankle dorsiflexion | Tibialis anterior | | | | |
| Inversion | Tibialis anterior | | | | |
| Eversion | Peroneus longus | | | | |
| Great toe extens | EHL | | | | |

## BASIC THORACIC EXAM

History
Passive ROM
Orthopedic

## BASIC HIP EXAM

History
ROM: Active
Passive : Medial rotation : A) Supine (neutral) If reduced - hard \ soft end feel
B) Supine (hip flexed): - Trochanteric bursa

## MOTION PALPATION AND JOINT PLAY

L R

FEB 2007

| | | |
|---|---|---|
| Upper Thoracics | | |
| Lumbar Spine | | |
| Sacroiliac Joint | | |

**DURBAN UNIVERSITY OF TECHNOLOGY**

***Patient Name:*** ***File #:*** ***Page:***

***Date:*** ***Visit:*** ***Intern:***
***Attending Clinician:*** ***Signature:***

***S:*** ***Numerical Pain Rating Scale (Patient )*** ***Intern Rating*** ***A:***
***Least 0 1 2 3 4 5 6 7 8 9 10 Worst***

***0:*** ***P:***

***E:***

***Special attention to:*** ***Next appointment:***

***Date:*** ***Visit:*** ***Intern:***
***Attending Clinician:*** ***Signature:***

***S:*** ***Numerical Pain Rating Scale ( Patient )*** ***Intern Rating*** ***A:***
***Least 0 1 2 3 4 5 6 7 8 9 10 Worst***

***O:*** ***P:***

***E:***

***Special attention to:*** ***Next appointment:***

***Date:*** ***Visit:*** ***Intern:***
***Attending Clinician:*** ***Signature***

***S:*** ***Numerical Pain Rating Scale (Patient)*** ***Intern Rating*** ***A:***

***Least*** ***0 1 2 3 4 5 6 7 8 9 10*** ***Worst***

***O:*** ***P:***

***E:***

***Special attention to:*** ***Next appointment:***

## Appendix F

## LETTER OF INFORMATION:

Dear Participant.
Welcome to my research project.

**Title of the research:**
The effectiveness of Leander traction versus Static linear traction on chronic facet syndrome patients.

**Name of Research student:**
John Renshaw Hicklin
Contact number: 031 373 2205/2512

**Name of Research Supervisor:**
Dr. H.Kretzmann
Contact number: 031 2055520

**Institution:** Durban University of Technology (DUT)
You have been selected to take part in a research study which is looking at the relative efficacy of Leander traction versus Static linear traction in the treatment of chronic lumbar facet syndrome in mechanical lower back pain sufferers.

Thirty participants will be required to complete this study. Two groups of 15 participants between the ages of 25-55 years will be chosen for this study. Both groups must be symptomatic with lower back pain and chronic lumbar facet syndrome for longer than 6 months. Group A and B participants will receive a minimum of 5 treatments over a 3 week period. Group A will receive Leander traction and Group B will receive Static linear traction. During the treatment period subjective and objective readings will be taken on the 1$^{st}$, 2$^{nd}$ and 6$^{th}$ visit in order to determine the efficacy of Leander traction versus Static linear traction in the treatment of chronic lumbar facet syndrome in mechanical lower back pain sufferers.

Patients will be required to come for 3 treatments in the 1$^{st}$ week, starting on a Monday (1$^{st}$ treatment), Wednesday (2$^{nd}$ treatment) and Friday (3$^{rd}$ treatment). In the 2$^{nd}$ week two treatments will be scheduled on a Monday and a Wednesday. On the 6$^{th}$ visit, which will be scheduled 7 days after the 5$^{th}$ treatment, subjective and objective clinical findings will be taken in order to gauge the long term effects of the treatment. No treatment will be given on the 6$^{th}$ visit.

**Research process:**

The first consultation will take place at the DUT Chiropractic Day Clinic. Here participants will be screened for suitability for this study, which will be determined by a case history, physical examination and a lumbar spine regional examination, and specific measurements of your low back pain.

All treatments will be performed, under the supervision of a qualified chiropractor, by the research student and will be free of charge.

**Risk / discomfort:**
The research study is safe, although participants may experience transient tenderness and stiffness that is common post interventions used in this study; it is unlikely to cause any adverse side effects.

**Remuneration and costs:**
- All treatments will be free of charge and participants taking part in the study will not be offered any other form of remuneration for taking part in the study.
- Participants in this study will received two free treatments at the Durban Institute of Technology Day Clinic.
- All patient information is confidential and the results of the study will be made available in the Durban Institute of Technology library in the form of a mini-dissertation.

**Implications for withdrawal from the research:**
You are free to withdraw at any stage of the research project.

**Benefits of the study:**
Your participation and co-operation will assist the Chiropractic profession in expanding its knowledge and the treatment protocol for mechanical lower back pain, and thus making future rehabilitation of patients suffering from this condition more successful.

**Confidentiality:**
All participant information is confidential and the results will be used for research purposes only. It will be stored in the Chiropractic Day Clinic for 5 years, after which it will be shredded. Supervisors and senior clinic staff may however be required to inspect the records.

**Persons to contact with problems or questions:**
Should you have any further queries and you would like them answered by an independent source, you can contact my supervisor on the number above or alternatively you could contact the Faculty of Health Sciences Research and Ethics Committee as per Mr. Vikesh Singh at (031) 2042701.

Thank you for your participation.
Yours sincerely,

**John Renshaw Hicklin (Research Student)**

**Dr. H. Kretzman (Supervisor) (M Dip Chiropractic)**

**Appendix G**

# INFORMED CONSENT FORM

(To be completed by patient / subject)

**Date:**

**Title of research project:**

The effectiveness of Leander traction versus Static linear traction on chronic facet syndrome patients.

**Name of supervisor:** Dr H.Kretzman(M Tech Chiropractic, CCFC)
**Tel:** 031-2055520 (Work) 0832463562 (Cell)

**Name of research student:** John Hicklin
**Tel** **(031) 373 2205/2512**

| **Please circle the appropriate answer** | | **YES /NO** | |
|---|---|---|---|
| 1. | Have you read the research information sheet? | Yes | No |
| 2. | Have you had an opportunity to ask questions regarding this study? | Yes | No |
| 3. | Have you received satisfactory answers to your questions? | Yes | No |
| 4. | Have you had an opportunity to discuss this study? | Yes | No |
| 5. | Have you received enough information about this study? | Yes | No |
| 6. | Do you understand the implications of your involvement in this study? | Yes | No |
| 7. | Do you understand that you are free to withdraw from this study at any time without having to give any a reason for withdrawing, and without affecting your future health care? | Yes | No |
| 8. | Do you agree to voluntarily participate in this study? | Yes | No |
| 9. | Who have you spoken to? | | |

**Please ensure that the researcher completes each section with you**
**If you have answered NO to any of the above, please obtain the necessary information before signing.**

**Please print in block letters:**

Patient /Subject Name:_____Signature: _____

Witness Name:_____Signature:_____

Research Student Name:_____Signature:_____

## APPENDIX H

# Numerical Rating Scale - 101 Questionnaire

**Date:**_____ **File no:**_____ **Visit no:**_____

**Patient name:** _____

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

Please write only **one** number.

0 _____ 100

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

Please write only **one** number.

0_____100

## Algometer Readings:

| | Date | Location | Readings | | | |
|---|---|---|---|---|---|---|
| | | | Pre | | Post | |
| Reading 1 | | | | | | |
| | | | | | | |
| Reading 2 | | | | | | |
| | | | | | | |
| Reading 3 | | | | | | |
| | | | | | | |

Appendix J

# Revised Oswestry
# Low back pain and Disability Questionnaire

Patient Name:_____File no:_____Date_____

This questionnaire has been designed to give the doctor information as to how your back pain has affected your ability to manage everyday life. Please answer every section and mark in each section only ONE box as it applies to you. We realize you may consider that two of the statements in any one section relate to you, but please just mark the box which most closely describes your problem right now.

**Section 1 - Pain Intensity**

- G The pain comes and goes and is very mild.
- G The pain is mild and does not vary much.
- G The pain comes and goes and is moderate.
- G The pain is moderate and does not vary much.
- G The pain comes and goes and is very severe.
- G The pain is severe and does not vary much.

**Section 2 - Personal Care**

- G I would not have to change my way of washing or dressing in order to avoid pain.
- G I do not normally change my way of washing or dressing even though it causes some pain.
- G Washing and dressing increase the pain but I manage not to change my way of doing it.
- G Washing and dressing increase the pain and I find it necessary to change my way of doing it.
- G Because of the pain I am unable to do some washing and dressing without help.
- G Because of the pain I am unable to do any washing and dressing without help.

**Section 3 - Lifting**

- G I can lift heavy weights without extra pain.
- G I can lift heavy weights but it gives extra pain.
- G Pain prevents me from lifting heavy weights off the floor.
- G Pain prevents me from lifting heavy weights off the floor, but I manage if they are conveniently positioned (e.g. on a table).
- G Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned.
- G I can only lift very light weights at the most.

**Section 4 - Walking**

- G I have no pain on walking.
- G I have some pain on walking but it does not increase with distance.
- G I cannot walk more than one mile without increasing pain.
- G I cannot walk more than 2 mile without increasing pain.
- G I cannot walk more than 3 mile without increasing pain.
- G I cannot walk at all without increasing pain.

**Section 5 - Sitting**

- G I can sit in any chair as long as I like.
- G I can only sit in my favorite chair as long as I like.
- G Pain prevents me from sitting more than 1 hour.
- G Pain prevents me from sitting for more than 2 hour.
- G Pain prevents me from sitting for more than 10 minutes.
- G I avoid sitting because it increases pain straight away.

**Section 6 - Standing**

- G I can stand as long as I want without pain.
- G I have some pain on standing but it does not increase with time.
- G I cannot stand for longer than one hour without increasing pain.
- G I cannot stand for longer than 2 hour without increasing pain.
- G I cannot stand for longer than 10 minutes without increasing pain.
- G I avoid standing because it increases the pain straight away.

**Section 7 -Sleeping**

- G I get no pain in bed.
- G I get pain in bed but it does not prevent me from sleeping well.
- G Because of pain my normal night=s sleep is reduced by less than 3
- G Because of pain my normal night=s sleep is reduced by less than 2
- G Because of pain my normal night=s sleep is reduced by less than :
- G Pain prevents me from.sleeping at all.

**Section 8 - Social life**

- G My social life is normal and gives me no pain.
- G My social life is normal but increases the degree of pain.
- G Pain has no significant effect on my social life apart from limiting my more energetic interests, e.g. dancing, etc
- G Pain has restricted my social life and I do not go out very often.
- G Pain has restricted my social life to my home.
- G I have hardly any social life because of the pain.

**Section 9 - Travelling**

- G I get no pain whilst travelling.
- G I get some pain whilst travelling but none of my usual forms of travel make it any worse.
- G I get extra pain whilst travelling but it does not compel me to seek alternative form of travel.
- G I get extra pain whilst travelling which compels me to seek alternative forms of travel.
- G Pain restricts all forms of travel.
- G Pain prevents all forms of travel except that done lying down.

**Section 10 - Changing degree of pain**

- G My pain is rapidly getting better.
- G My pain fluctuates but overall is definitely getting better.
- G My pain seems to be getting better but improvement is slow at present.
- G My pain is neither getting better nor worse.
- G My pain is gradually worsening.
- G My pain is rapidly worsening.

**Pain Severity Scale:**

Rate your usual level of pain today by checking one box on the following scale

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|

**No pain** **Excruciating pain**

**Adapted from Hsieh et al 1992**

**Imibuzo ephathelene nezinhlungu kanye nokungasebenzi kahle kweqolo. (Revised Oswestry)**

Igama lesiguli: Inombolo yefayela: Usuku:

Lemibuzo yakhelwe ukunikeza udokotela wakho ulwazi lokuthi ubuhlungu obuseqolo kuyiphazamisa kanjani impilo yakho yansukuzonke. Phendula zonke izigaba umake ibhokisi elilodwa kuphela leli ovumelana nalo. Siyabona ukuthi ungavumelana nezitatimende ezimbili, kodwa sicela umake elilodwa ibhokisi leli elingachaza kangcono inkinga okuyona njengamanje.

**Isigaba 1 Amandla Obuhlungu**.

- Ubuhlungu buba khona buphinde buphele futhi bukahle
- Ubuhlungu bukahle futhi abuguquguquki kakhulu
- Ubuhlungu buyafika buphinde bunyamalale futhi buncane
- Ubuhlungu buncane futhi abuguquguquki kakhulu
- Ubuhlungu buyafika buphinde bunyamalale futhi kubuhlungu kakhulu.
- Ubuhlungu bukhulu futhi abushitshashitshi kakhulu.

**Isigaba 2 - Ukuzinakekela**

- Akufanele ngize ngishintshe indlela engiwasha ngayo nangendlela engigqoka ngayo ukuze ngigweme ubuhlungu.
- Angijwayele ukushintsha indlela engiwasha ngayo noma yokugqoka noma ngabe idala
- Ubuhlungu
- Ukugeza nokugqoka kuqhubeza phambili ubuhlungu kodwa angiyishintshi indlela engikwenza ngayo lokho
- Ukuwasha nendlela engigqoka ngayo kuqhubeza ubuhlungu futhi ngibona kunesidingo ukushintsha indlela engikwenza ngayo.
- Ngenxa yobuhlungu angikwazi ukuwasha nokugqoka ngaphandle kosizo.
- Ngenxa yobuhlungu angikwazi ukwenza noma iyiphi iwashingi nokuzigqokisa ngaphandle kosizo

**Isigaba 3 Ukuqukula**

- Ngingaziqukula izinto ezisinda kakhulu ngingabuzwa ubuhlungu.
- Ngingakuqukula okunesisindo esikhulu kodwa kunginika obunye ubuhlungu
- Ubuhlungu buyangivimba ukuthi ngiqukule okunesisindo esikhulu ngikususa phansi.
- Ubuhlungu buyangivimba ukuthi ngiqukule okunesisindo esikhulu ngikususa phansi kodwa ngiyakwazi ukuziqukula uma zibekeke kahle (Isib. phezu kwetafula).
- Ubuhlungu buyangivimbela ukuthi ngiqukule okunesisindo esikhulu kodwa ngiyakwazi ukuqukula okunesisindo esilula kuye kwesikahle uma kubekeke kahle.
- Ngingazama ukuqukula okulula kuphela

**Isigaba 4 - Ukuhamba**

- Anginabo ubuhlungu uma ngihamba
- Bukhona ubuhlungu uma ngihamba kodwa abuqhutshezwa ukwanda kwendlela.
- Angikwazi ukuhamba ngeqe imayela elilodwa ngaphandle kokuqhubeka kobuhlungu.
- Angikwazi ukuhamba ngeqe uhhafu wemayela ngaphandle kokuzwa ubuhlungu buqhubeka.
- Angikwazi ukuhamba ngeqe ikota yemayela ngingabuzwa ubuhlungu buqhubeka.
- Angikwazi ukuhamba nje sampela bungaqhubeki ubuhlungu.

**Isigaba 5 - Ukuhlala**

- Ngingahlala kunoma isiphi isihlalo uma nje ngisathanda
- Ngihlala kuphela esihlalweni engisithandayo uma nje ngisathanda
- Ubuhlungu abungivumeli ukuba ngihlale ngeqe isikhathi esingaphezu kwehora elilodwa
- Ubuhlungu abungivumeli ukuba ngihlale ngeqe isikhathi esingaphezu kwahhafu wehora.
- Ubuhlungu abungivumeli ukuba ngihlale ngeqe imizuzu eyi shumi
- Ngiyakugwema ukuhlala ngoba kuqhubezela ubuhlungu phambili.

**Isigaba 6 - Ukuma**

- Ngima isikhathi esithandwa yimina kodwa ngingabuzwa ubuhlungu
- Ziba khona lezozinhlungu uma ngimile kodwa aziqhubekeli phambili ngenxa yesikhathi.
- Angikwazi ukuma isikhathi esingaphezu kwehora elilodwa ngaphandle kokuqhubeka kobuhlungu.
- Angikwazi ukuma isikhathi esingaphezu kwahhafu wehora ngaphandle kokuqhubeka kobuhlungu.
- Angikwazi ukuma isikhathi esingaphezu kwemizuzu ewu 10, ngaphandle kokuqhubeka kobuhlungu.
- Ngiyakugwema ukuma ngoba kuqhubeza ubuhlungu nje kwaphela.

**Isigaba 7 - Ukulala**

- Angibuzwa ubuhlungu uma ngilele embedeni
- Ngiyabuzwa ubuhlungu uma ngilele embhedeni abungivimbi ukuba ngilale kahle.
- Ngenxa yobuhlungu ubuthongo engibujwayele basebusuku buncipha bube ngaphansi kwekota.
- Ngenxa yobuhlungu ubuthongo engibujwayele bunciphile bube ngaphansi kwahhafu.
- Ngenxa yobuhlungu ubuthongo engibujwayele bunciphile bube ngaphansi kwamakota amathathu.
- Ubuhlungu bungenza ukuba ngingalali nje sampela.

**Isigaba 8 - Impilo yenhlelo**

- Impilo yami yokuhlalisana ikahle futhi angibi nazo izinhlungu
- Impilo yami ikahle kodwa iqhubezela phambili ubuhlungu.
- Ubuhlungu abuyiphazamisi impilo yami ngaphandle uma ngiyeka izidingo zami ezifuna amandla isib. ukudansa, njll.
- Ubuhlungu buyivimbile impilo yami futhi angijwayele ukuzikhipha nje ngihambe ngivakashe.
- Ubuhlungu buyivimbile impilo yami ukuthi ngihlale endlini.
- Anginayo impilo yokuthi ngihlale nabanye abantu ngenxa yobuhlungu.

**Isigaba 9 - Ukuhambela Amazwe**

- Angibuzwa ubuhlungu uma ngisohambeni
- Ngiyazizwa izinhlungu uma ngisohambeni kodwa indlela engihamba ngayo ayizenzi zibe nzima kakhulu.
- Ngibuzwa kakhulu ubuhlungu uma ngihamba kodwa abungiphoqeli ukuba ngibheke enye indlela engihamba ngayo engconywana.
- Ngibuzwa kakhulu ubuhlungu uma ngihamba kodwa buyangiphoqelela ukuba ngifune enye indlela engingahamba ngayo.
- Ubuhlungu buvimba zonke izindlela engihamba ngazo.
- Ubuhlungu buvimba zonke izindlela engihamba ngazo ngaphandle kwale eyenziwa uma ulele phansi

**Isigaba 10 - Ukushitsha Kwezinga lobuhlungu.**

- Ubuhlungu buya ngokuba ngcono
- Ubuhlungu buya shintshashintsha kodwa sekukonke bona buba ngcono impela.
- Ubuhlungu bubukeka buba ngcono kodwa ukuba ngcono buza kancane okwamanje.
- Ubuhlungu abubi ngcono futhi abububi kangako
- Ubuhlungu buya ngokuya bube bubi kakhulu kancane
- Ubuhlungu buya ngokuya bube bubi kakhulu kokushesha.

**Isikalo Samandla Obuhlungu**

Kala izinga lobuhlungu bakho namuhla ngokubuka ibhokisi elilodwa kulesisikalo esilandelayo

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Abukho Ubuhlungu Ubuhlungu obuhlabayo

Kuthathwe ku Hsieh et al 1992

# ETHICS CLEARANCE CERTIFICATE

| | | | |
|---|---|---|---|
| Student Name | John R Hicklin | Student No | 20428013 |
| Ethics Reference Number | FHSEC 035/08 | Date of FRC Approval | 02/04/2008 |
| Research Title: | **The effectiveness of Leander traction versus Static linear traction on chronic facet syndrome patients.** | | |

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

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

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

SIGNATURE OF STUDENT/RESEARCHER — DATE: 21-08-08

SIGNATURE OF SUPERVISOR/S — DATE: 21-08-08

SIGNATURE OF HEAD OF DEPARTMENT — DATE: 21/8/8

SIGNATURE CHAIRPERSON OF RESEARCH ETHICS COMMITTEE — DATE: 21/08/2008