THE EFFECTIVENESS OF INTERFERENTIAL CURRENT THERAPY AS AN ADJUNCT TO MANIPULATION IN THE TREATMENT OF ACUTE MECHANICAL LOW BACK PAIN

BY

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I, Mark Aaron, do hereby declare that this dissertation is representative of my own work.

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DEDICATION

To my parents whose love and support enabled me to reach for my dreams.

To my wife whose love, inspiration and motivation make the road easier to travel.

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ABSTRACT

Background: Low back pain is a common problem for which many conservative treatments are available. Spinal manipulation is considered one of the most effective of these treatments. Interferential therapy is widely used especially for pain control and often forms part of a treatment protocol. However, there is little clinical evidence to support this usage.

Objective: The purpose of this investigation was to evaluate the effectiveness of interferential current therapy as an adjunct to manipulation in the treatment of acute mechanical low back pain in terms of subjective and objective measures.

Methods: Sixty subjects suffering from acute mechanical low back pain were recruited through advertising and randomly divided into two groups with thirty patients each. Group A received manipulation and interferential therapy and group B received manipulation only. Both groups received 4 treatments and a follow-up consultation over a 2 week period. Subjective measurements were taken using the Numerical Rating Scale – 101and revised Oswestry low back pain questionnaire. Objective measurements were taken using an algometer and an orthopaedic rating scale. All measurements were taken before treatment on the first, third and fifth consultations. Statistical inter-group analysis was completed using the two sample unpaired t-test and the Mann-Whitney U-test. Friedman's T test was used to evaluate the intra-group information. The null hypothesis was rejected at $\alpha = 0.05$ level of significance.

Results: Both treatment groups A and B achieved a significant improvement in pain and disability over the treatment period. However, no significant differences in terms of pain and disability could be found between the two groups at any stage during, or at the end of the treatment period.

Conclusions: Interferential therapy does not seem to be an effective adjunct to manipulation in the treatment of acute mechanical low back pain, at least in the short term. However these results need to be verified in a randomized, controlled, double blinded trial before firm conclusions can be drawn or recommendations made.

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LIST OF ABBREVIATIONS

Alg	=	algometer
Group A	=	treatment group receiving manipulation combined with interferential therapy
Group B	=	treatment group receiving manipulation only
IFT	=	interferential therapy
MLBP	=	mechanical low back pain
NRS	=	numerical rating scale
ORS	=	orthopaedic rating scale
OSW/ ROLBPQ	=	revised Oswestry low back pain questionnaire
s.d.	=	standard deviation

DEFINITION OF TERMS

Chiropractic: That discipline within the healing arts especially concerned with the etiology, pathogenesis, diagnostics, therapeutics and prophylaxis of functional disturbances, pathomechanical states, pain syndromes and other neurophysiologic effects related to the statics and dynamics of the neuromusculoskeletal system, particularly those related to the spine and pelvis (Schafer and Faye, 1990)

Contraindication: Any symptom or circumstance denoting the inappropriateness of a form of treatment that would otherwise be advisable (Redwood, 1997: 335).

Disease: Any morbid process altering the normal state of living tissue; it may be functional or physiologic, and may affect the organism as a whole or any of its constituent parts (Redwood, 1997: 336).

Incidence (lifetime): The proportion of subjects who have had the condition in question during their lifetime (Skovron, 1992: 559).

Joint dysfunction: joint mechanics showing functional disturbances without structural changes (Redwood, 1997: 338).

Mechanical low back pain: For the purposes of this study encompasses the lumbar facet and sacroiliac syndromes.

Prevalence (annual): The proportion of subjects who have had the condition in question over the period of a year (Skovron, 1992: 559).

Prevalence (point): The proportion of subjects who currently have the condition in question (Skovron, 1992: 559).

Randomized controlled trial (RCT): An experimental study for assessing the effects of a particular variable (e.g. a drug or treatment) where subjects are randomly assigned to either of two groups, experimental or control; the experimental group receives the procedure while the control group does not (Redwood, 1997: 343).

Sensitivity: The measure of a test's ability to correctly identify persons with a certain condition (Pope et al. 1991).

Specificity: The measure of a test's accuracy in correctly identifying persons who do not have the condition and who will test negative (Pope et al. 1991)

Subluxation: (chiropractic) an alteration of alignment, movement, integrity, and/or physiologic function of a motion segment, while the joint surfaces remain in contact; resulting neurophysiologic disturbance may be local or widespread (Redwood, 1997: 344).

Subluxation: (orthopaedic) a partial or incomplete dislocation (Redwood, 1997: 344).

CHAPTER ONE: INTRODUCTION

1.1 Introduction

Low back pain is a symptom which can only rarely be attributed to a specific disease or pathological lesion (Wipf and Deyo, 1995: 231). Approximately 85% of people with low back pain cannot be given a pathoanatomical diagnosis to explain their pain (Deyo and Weinstein, 2001: 363). This may often lead to the patient and the caregiver being unsure as to what the problem is and what treatment should be undertaken to solve it. Failure to understand the causative mechanisms of a disorder makes it difficult to prevent that disorder (Leboeuf-Yde et al. 1997: 877).

Low back pain is one of the most common reasons for visits to a physician. It affects males and females equally and is responsible for considerable medical and work loss costs around the world (Andersson, 1999: 581-583). For these reasons it is important for any proposed low back pain treatments to be scientifically shown to be clinically effective and cost effective.

Spinal manipulative therapy is one of the most common treatments for low back pain and a large number of randomized clinical trials (of varying quality) have been carried out to establish its efficacy (Koes et al. 1996: 2860). A meta-analysis of spinal manipulation by Shekelle (1994: 859) showed it to be an effective treatment for mechanical acute low back pain.

Interferential current therapy is one of the most frequently used electrotherapeutic modalities by physiotherapists (Pope, Mockett & Wright, 1995: 89). However, in contrast to a modality like transcutaneous electrical nerve stimulation (TENS), the research on interferential therapy's efficacy is minimal (Tabasam and Johnson, 1999: 15). Johnson (1999: 295) states there is "an urgent need" for studies examining the effectiveness of interferential therapy.

Goats (1990: 91) believes that further research will clarify the role of interferential therapy and show it to be a valuable adjunct to the management of the patient. This study will attempt to determine if interferential therapy is effective as an adjunct to manipulation in the treatment of acute mechanical low back pain.

1.2 Objectives of the study

The purpose of this investigation was to evaluate the effectiveness of interferential current therapy as an adjunct to manipulation in the treatment of acute mechanical low back pain, in terms of subjective and objective clinical findings, in order to determine whether this is a more effective treatment protocol than manipulation only in the management of acute mechanical low back pain.

The first objective was to evaluate interferential therapy as an adjunct to manipulation in the treatment of acute mechanical low back pain in terms of subjective clinical findings in order to establish the efficacy of this treatment approach.

The second objective was to evaluate interferential therapy as an adjunct to manipulation in the treatment of acute mechanical low back pain in terms of objective clinical findings in order to establish the efficacy of this treatment approach.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

Low back pain has been defined as pain "located between the lower ribcage and the gluteal folds on the posterior aspect of the thighs" (Pope et al, 1991: 73). This necessarily vague definition gives one little idea as to exactly where the pain is located or what the cause/s might be. The search for these causes is still continuing (Leboeuf-Yde et al, 1997).

The exact mechanisms by which spinal manipulation produces its effects are unclear. It is thought to reduce back pain by affecting the abnormal stresses on the posterior facet joints (Shekelle, 1994: 858). Notwithstanding the lack of information surrounding these mechanisms, the evidence that spinal manipulation is clinically effective is steadily increasing. This is reflected by United States guidelines supporting its use for treating acute low back pain (Bigos et al. 1994).

The main clinical use of interferential therapy is for control of pain (Palmer, 1999: 1065). However, there is little evidence to support this and other uses of interferential therapy, which are often based on anecdotal evidence or personal experience (Johnson, 1999: 294). Johnson (1999: 296) states that interferential therapy may have potential benefits over other electro-analgesic techniques and an evaluation of the use of interferential therapy treatment protocols is needed.

2.2 EPIDEMIOLOGY OF LOW BACK PAIN

Low back pain is one of mankind's most common afflictions. Upper respiratory problems are the only symptom-related reasons responsible for more visits to a physician in the USA (Deyo and Weinstein, 2001: 363). Indeed Andersson (1999: 581), after examining multiple studies on low back pain prevalence in different population groups, concluded that the lifetime incidence of back pain in the general population is 70-85%. Furthermore, the same review showed the annual prevalences of back pain range from 15-45% and the point prevalences average 30%. These statistics help to explain the considerable annual medical costs incurred by this epidemic. If disability and loss of work are included, the cost of low back pain in the USA is $60 billion annually (Shekelle et al. 1998: 10).

Waddell (2000: 80-83) suggests that the popular belief that low back pain is an epidemic is false as there is no evidence the prevalence of low back pain has changed significantly over the last 40 years. He suggests that the real epidemic is of disability associated with low back pain. This is evidenced by the marked increase in sick certification and benefits paid for this disability in all Western countries.

Low back pain affects men and women equally and most often starts between the ages of 30 and 50 (Deyo and Weinstein, 2001: 363) but it is seldom a long term problem. Several studies undertaken in different countries show similarities in recovery rates. Overall 60-70% recover by 6 weeks and 80-90% by 3 months (Andersson, 1999: 582). However Croft et al. (1998) suggest that these recovery rates are not a true reflection of what occurs in patients presenting for low back pain treatment in general practice. It was found in a large population based study (490 subjects) that only 25% of patients consulting general practice with low back pain had fully recovered twelve months later. Those who have not recovered in 12 weeks face a poor prognosis. Of those individuals disabled by low back pain for longer than 6 months, less than 50% are expected to return to work and after

2 years the percentage is close to zero (Andersson, 1999: 582). Coste et al. (1994: 579) showed that previous chronic low back pain, initial disability rather than initial pain intensity, and pain worse with standing or lying were factors indicating a poor prognosis for recovery.

A quick or slow recovery from low back pain does not however preclude recurrence of the pain. Andersson (1999: 583) suggests that recurrence rates for low back pain are so high that recurrence may form part of its natural history. The 1-year recurrence rate ranges from 20-44% and lifetime recurrence rates from 70-85% have been reported (Andersson, 1999: 583).

Few epidemiological studies have been done on low back pain in South Africa. A study done in the formal black South African township of Chesterville (van der Meulen, 1997) showed that the lifetime incidence of low back pain was 58% and the prevalence was 53%. This is an indication that low back pain could be as much of a problem among black South Africans as it is around the world.

According to Kirkaldy-Willis and Burton (1992: 105) the first phase of spinal degeneration (the dysfunction phase) is the phase during which the majority of patients are seen in a low back pain clinic. In the dysfunction phase, the two most common syndromes, for which manipulation is the treatment of choice, are the facet and sacroiliac (SI) syndromes (Kirkaldy-Willis and Burton, 1992: 247-249). These two syndromes will be discussed below.

2.3 THE LUMBAR SPINE

2.3.1 Anatomy of the lumbar facet joints.

The lumbar vertebral column consists of five separate units called vertebrae. The lumbar facet (zygapophysial) joints are the result of the articulation of the inferior articular process of one lumbar vertebra with the superior articular process of

another vertebra and are typical synovial joints: the articular facets are lined with hyaline cartilage, a synovial membrane surrounds the joint and is itself encompassed by a fibrous joint capsule (Bogduk, 1999: 33). As the facet joints are synovial joints, the synovial membrane supplies the joint surfaces with synovial fluid. The precise role of this fluid is uncertain, although it is speculated to serve as a joint lubricant and provide nutrition for the avascular articular cartilage. Regular compression and distraction of the joint surfaces must occur for adequate exchange of nutrients and waste products to take place. Immobilized joints have been shown to undergo degeneration of the articular cartilage (Bergmann et al. 1993: 38).

During childhood the lumbar facet joints assume their final form and orientation, which is approximately in the sagittal plane. Wide variation in joint angle is possible and facet asymmetry (tropism) in the joint planes, when comparing left and right, is common (Giles, 1997: 73).

Two principle types of intra-articular structure are found in the facet joints (Bogduk, 1999: 38). The first is fat, which acts as a space filler underneath the capsule. The second structure is called a meniscoid, which is a wedge-shaped projection of the joint capsule or synovium into the joint. There are three types of meniscoid defined according to structure. These are the connective tissue rim, the adipose tissue pad and the fibro-adipose meniscoids. These meniscoids are thought to increase joint surface area thereby transmitting some load and serving a protective function for the joint.

The facet joint is well innervated with free and encapsulated nerve endings arising from branches of the lumbar dorsal rami. Low and high threshold nerves have been identified, with the low threshold nerves thought to respond to capsular stretch and the high threshold nerves serving a nociceptive function (Cavanaugh, 1995: 1805).

Movement of the facet joint occurs via the lumbar muscles. The lumbar muscles are divided into three functional groups: group 1 includes psoas major which covers the anterolateral lumbar spine; group 2 includes the quadratus lumborum and intertransversarii laterals which connect and cover the transverse processes anteriorly; group 3 includes the interspinales, intertransversarii, multifidus and lumbar erector spinae which lie behind and cover the posterior elements of the lumbar spine (Bogduk, 1999: 101).

Restriction of movement arises via the lumbar ligaments. The anterior and posterior longitudinal ligaments interconnect the vertebral bodies anteriorly and posteriorly respectively. The ligamentum flavum, interspinous ligaments and supraspinous ligaments interconnect the posterior elements of the lumbar vertebrae (Bogduk, 1999: 43).

2.3.2 Biomechanics and mechanism of injury

The function of the facet joints is to guide and limit movement between vertebrae and protect the intervertebral discs from shear forces, excessive flexion and axial rotation (Giles, 1997: 75). Cadaveric studies have shown that the lumbar facet joints can resist most of the intervertebral shear forces only when the spine is in a lordotic position. The facet surfaces protect the posterior annulus whereas the capsular ligaments resist flexion. In full flexion the capsular ligaments provide 40% of the joint's resistance (Bergmann, 1993: 40). Extension of the spine results in impaction of the inferior articular process on the lamina below. Hyperextension produces rotation towards the impacted joint disrupting the capsule of the contralateral joint. Rotation is limited by impaction of the joint opposite the direction of movement. Over-rotation produces disruption of the capsule of the contralateral joint. The impacted joint in hyperextension and over-rotation may also sustain fractures. The lumbar muscles play a large role in initiating and controlling movements, and external loads that exceed the force of the back muscles render the spine liable to injury (Bogduk, 1999: 201).

The facet joints carry part of the body weight. Measurements ranging from 16-40% of axial load have been produced in healthy cadaveric lumbar facet joints and this percentage is pushed up to 47% in osteoarthritic joints (Giles, 1997: 75). The facet joints, forming part of the three joint complex with the intervertebral disc (IVD), are inevitably affected if the IVD undergoes degeneration. As the disc loses height, more weight-bearing function is placed on the facet joints leading to joint degeneration over time (Bergman, 1993: 38).

2.3.3 The lumbar facet syndrome

The lumbar facet syndrome is characterized classically by local tenderness over the facet joint, paraspinal muscle spasm and often referred pain into the buttock, groin and thigh (Gatterman, 1990: 161; Giles, 1997: 89). Other signs and symptoms may be pain on hyperextension, absence of neurological deficit, and low back stiffness, especially in the morning (Hourigan and Bassett, 1989: 294). Injection of hypertonic saline into normal facet joints produces low back pain and referred pain identical to that most commonly seen in patients (Bogduk, 1999: 200). Schwarzer et al. (1994:1132) used double diagnostic lumbar facet joint blocks in people with chronic low back pain. Forty-seven percent of the patients responded to the first block and 15% responded to the second confirmatory block. The researchers concluded that the facet joint was an important source of pain. They did however have difficulty identifying clinical features of the chronic facet syndrome.

The exact cause of this syndrome is uncertain (Bogduk, 1999: 200-201). Radiographical degenerative changes in the lumbar facet joints have not been linked to back pain, and MRI and CT scans have high false positive rates (Waddell, 2000: 300-301). Several hypotheses have been put forward. Kirkaldy-Willis and Burton (1992: 122) outline three phases of degeneration involving the three-joint complex (intervertebral disc and two facet joints). The facet joint

syndrome is said to arise in the first two phases of dysfunction and instability after repetitive trauma leads to joint dysfunction and degeneration.

Other authors propose that the facet syndrome has 3 causes: traumatic, pathologic (degenerative) and postural (Hourigan and Bassett, 1989: 293). Giles (1997: 89) suggests several soft tissue structures associated with facet joints, that may be a cause of pain, which can be seen in histological sections but not on imaging: (a) large intra-articular synovial folds, (b) joint capsule tissues becoming attached by adhesions to cartilage, (c) distorted, tractioned blood vessels, (d) neural structures attached by adhesions to synovial folds.

Biomechanical studies have shown that tears in the capsule and avulsion of the capsule may occur with rotation and extension and these lesions have also been found in postmortem studies. Meniscoid entrapment is another plausible theory for at least some low back pain produced by the facet joint such as the acute locked back (Bogduk, 1999: 201-202). It appears that several causes under different circumstances could be responsible for the same syndrome in different patients.

2.4 THE SACROILIAC JOINTS

2.4.1 Anatomy of the sacroiliac joints

The sacroiliac (SI) joints are the two articulations of the sacrum with the ilia in the pelvis (Hendler et al. 1995: 169). The sacroiliac joint is an atypical synovial joint. It differs from the typical synovial joint in that, while the cartilage on the sacral surface is normal hyaline cartilage, the cartilage on the ilium consists of fibrocartilage (Giles and Crawford, 1997: 174).

Before puberty the sacroiliac joint surfaces are flat. After puberty these surfaces develop ridges such that those on the sacral surface interdigitate with those on

the iliac surface. With increasing age the surfaces become more irregular. The main effect of these ridges is to provide joint stability at the expense of mobility (Cassidy, 1992: 41).

The strong sacroiliac ligaments also contribute to the stability of the joint. These include the anterior, posterior and interosseus sacroiliac ligaments (Hendler et al. 1995). The interosseus ligament is the most important of these in terms of its ability to bind the ilium strongly to the sacrum, allowing the bony interlocking mechanism of the SI joint to function effectively. The posterior ligament prevents flaring of the joint and backward rocking (counter-nutation) of the sacrum with respect to the ilium. The anterior ligament prevents anterior separation of the joint and helps to bind it together. These ligaments surround the joint so comprehensively that the joint capsule is said to merge with these ligaments and is often reported as rudimentary (Bogduk, 1999: 181).

Innervation of the SI joint is controversial with separate studies reporting different innervations. Modern authors generally accept the pattern of posterior innervation via the lateral branches of the posterior rami of L4 to S3 and anterior innervation from L2 to S2 (Bogduk, 1999: 182).

2.4.2 Biomechanics and mechanism of injury

The sacroiliac joint functions to allow a small amount of anteroposterior rotary movement around a transverse axis, while still giving the pelvis the stability to take the weight of the body (Hendler et al. 1995: 169).

Flexion of the hip causes the ipsilateral ilium to glide backwards and downwards across the sacrum and compresses it. During extension of the hip, the ilium glides forwards and flares away from the sacrum (Bogduk, 1999: 184). With locomotion, the sacroiliac joints flex and extend in unison with the ipsilateral hip joint. The movements of flexion or extension in one joint are mirrored by the

opposite movement at the other joint. There are no muscles which produce active movement in the SI joint. All muscles crossing the joint act on the lumbar spine or hip (Bergmann, 1993: 478).

A very small range of movement (full range of motion less than 4^0) is allowed in the SI joint. This small movement is vital to allow the pelvis to be distorted in three dimensions. Without the SI joints these torsional stresses in the pelvis would otherwise be transmitted to the sacrum resulting in fractures (Bogduk, 1999:178).

2.4.3 The sacroiliac syndrome

The classical presentation of the sacroiliac syndrome includes pain over the SI joint, pain referred to the groin, trochanter and buttock, tenderness of the SI joint to palpation, pain aggravation by pain provocation tests and restricted movement of the joint (Kirkaldy-Willis and Burton, 1992:124; McCulloch and Transfeldt, 1997:180).

As with the facet joint, SI joint injections with contrast medium in normal volunteers has been shown to produce SI joint pain with associated pain referral into the lower limb (Bogduk, 1999: 199).

In the past the apparent lack of motion in the SI joint has led to a disregard for its possible role in low back pain (DonTigny, 1999: 173). More recently it has been considered possible that up to 30% of low back pain may arise from the sacroiliac joint (Corrigan and Maitland, 1998: 123). The common cause of this pain is often considered to be a minor subluxation or anterior rotation of the SI joint leading to joint dysfunction (Hendler et al. 1995: 171; DonTigny, 1999:175; Gatterman, 1990: 115). Ventral capsular tears (Bogduk, 1999: 200) may also be a cause of pain or associated with joint dysfunction.

2.5 SPINAL MANIPULATIVE THERAPY

Spinal manipulation can be described as a low amplitude, high velocity, dynamic thrust delivered at a point of joint restriction in order to restore motion (Gatterman, 1992: 49). This form of manual therapy moves a joint past its normal end range of motion but not past its anatomic range of motion and often results in an audible click or pop (Shekelle, 1994: 858). The exact mechanisms by which manipulation produces its effects are not known but several hypotheses have been put forward. Shekelle (1994: 858) and Bergmann et al. (1993) suggest that the manipulation has several mechanical effects:

1. Release of entrapped synovial folds: this is a possible cause of the episodic acute back and locked back and is quickly resolved with manipulation.
2. Relaxation of hypertonic muscle through sudden stretch: change in relative myoelectric activity of paraspinal and extremity muscles after manipulation has been recorded.
3. Disruption of articular adhesions: following joint injury, inflammation or prolonged immobilization, fibrous adhesions may form between joint surfaces which can then be broken with a sudden manipulation.
4. Unbuckling of motion segments: biomechanical data has demonstrated buckling within motion segments from prolonged static postures and overloading events. Manipulation may cause an unbuckling action.

Kirkaldy-Willis and Burton (1992: 288) postulate some additional reflex effects such as inhibition of pain through increased proprioceptive input, and stimulation of the autonomic nervous system. It is possible that some or all of these effects may be produced when treating mechanical low back pain due to joint dysfunction with manipulation. As described above, this joint dysfunction is present in the lumbar facet and sacroiliac syndromes and explains why these

syndromes are often amenable to manipulation (Kirkaldy-Willis and Burton, 1992: 122-126).

2.5.1 Efficacy of spinal manipulation.

One of the first studies to show the long-term efficacy of chiropractic manipulation was Meade et al. (1990: 1431-7). This randomised controlled trial compared chiropractic and hospital outpatient treatment for managing mechanical low back pain in 741 patients between the ages of 18 and 65. Chiropractic treatment was shown to be more effective than hospital outpatient treatment from soon after treatment began until the 2-year follow-up. The benefits of chiropractic treatment were found to be larger for those patients with chronic or severe pain. Furthermore, in an extended follow-up, Meade et al. (1995:349-351) confirmed that after three years those patients treated by chiropractic derived more benefit and long term satisfaction than those treated in hospitals. The main criticisms of this study were that neither group had a standardized treatment protocol, as this was a pragmatic trial. Also, the number of patients, periods of treatment and number of treatments were different between the two groups. Meade et al. (1995: 350) believe that these shortcomings did not explain away the constant improvements in the chiropractic group throughout the trial.

Koes et al. (1992: 28-35) compared the effectiveness of manual therapy (manipulation), physiotherapy (exercises, massage and physical modalities), general practitioner (GP) treatment (medication and postural and exercise advise) and placebo (detuned ultrasound or short-wave diathermy) for nonspecific neck and back complaints. All 256 patients in this randomized, controlled trial had experienced the complaints for at least 6 weeks. A more favourable outcome was shown for the manual therapy and physiotherapy groups versus the GP and placebo group at the 6-week follow up point. No difference in effectiveness could be shown between the manual therapy and

physiotherapy groups, but the number of treatments was considerably less for the manual therapy group. This could be interpreted as a considerable advantage.

Some studies have been less convincing regarding the efficacy of manipulation. In a trial not dissimilar to Koes et al. (1992), Cherkin et al. (1998: 1021-9) compared physical therapy, chiropractic manipulation and an education booklet in 321 patients with low back pain lasting longer than 7 days after a primary care visit. Results at 4 and 12 weeks showed that the physical therapy and chiropractic manipulation groups had only marginally better outcomes than the minimal intervention of an educational booklet.

Systematic reviews of randomised, controlled trials (RCT's) are now a common method of evaluating the effectiveness of treatments (van Tulder et al. 1997: 2128). An analysis of 14 studies of manual therapy by Di Fabio (1992: 862) concluded that there was clear evidence to justify the use of manual therapy, particularly manipulation, in the treatment of back pain. The United States government Agency for Health Care Policy and Research (AHCPR) reviewed treatments for acute low back pain (Bigos et al. 1994). For manipulation 112 articles, 12 randomised clinical trials, 2 meta-analyses and a cost analysis were examined. They concluded that out of the 22 types of intervention reviewed for acute low back pain treatment, spinal manipulation was to be rated among the first two options to be considered for use (along with analgesics and non-steroidal anti-inflammatory drugs). A systematic review of the conservative treatments for nonspecific acute and chronic low back pain produced strong evidence for the effectiveness of manipulation in chronic low back pain and limited evidence for its effectiveness in acute low back pain (van Tulder et al. 1997: 2134-5). Koes et al. (1996: 2869) reviewed 36 RCT's comparing spinal manipulation with other treatments for low back pain. Although there were indications that manipulation might be effective in certain subgroups, it was

decided that the efficacy of spinal manipulation for acute and chronic low back pain had not been conclusively shown.

The results of these reviews may seem somewhat contradictory. This is presumably because of the different study inclusions and methodological criteria utilized (Koes et al. 1996: 2868). All 4 reviews mentioned above do concur that the quality of the RCT's needs to be improved. Overall, all the reviews give at least limited support to the use of manipulation in acute low back pain and two are strongly in favour of its use. More research is needed into the subgroups of patients in whom manipulation may be more beneficial (Koes et al. 1996: 2868). Some studies indicate beneficial effects of manipulation during the period from two to four weeks from the start of pain (Shekelle, 1994: 859).

2.5.2 Motion palpation

Motion palpation is one of the most commonly used techniques by chiropractors for detecting a restricted motion segment (dysfunctional joint/manipulable lesion) and has been shown to have good 'face validity' i.e. the proposed measure seems to be a reasonable measure of the concept it is intended to measure (Walker and Buchbinder, 1997: 585-586). However, as indicated by Panzer (1992: 522) in his review of lumbar motion palpation, most studies have demonstrated poor interexaminer reliability and good to moderate intraexaminer reliability. Similar results have been obtained for motion palpation of the sacroiliac joint (Herzog, 1989: 86 and Meijne et al. 1999: 4). Troyanovich et al. (1998) have also decided in their review that motion palpation is not a reliable measure. However, as Lewit and Liebenson (1993) and Liebenson and Chapman (1999: 631) have pointed out, palpation, due to its subjective nature, has many inherent problems in proving reliability. Indeed even such widely used tests as the straight leg raise and palpation for the presence or absence of the dorsalis pedis pulse have had disappointing interexaminer reliability (Panzer,

1992: 518). Panzer (1992: 523) and Hendler et al. (1995: 173) suggest that motion palpation be combined with multiple diagnostic tests to improve reliability.

2.5.3 Contraindications to manipulation

Although the risks for serious injury through spinal manipulation are low (Leboeuf-Yde et al. 1997: 511), it is necessary to be aware of the conditions under which manipulation should not be used. Kirkaldy-Willis and Burton (1992: 291) and Bergmann et al. (1993: 133) propose two groups of contraindications to manipulation: relative and absolute. The relative group of contraindications merely calls for a modification of technique. These include:

1. osteopaenia
2. spondyloarthropathies
3. patient on anticoagulant medication
4. bleeding disorders
5. psychological overlay

When absolute contraindications are present then no manipulative therapy should be used under any circumstances. These include:

1. destructive lesions of spine ribs or pelvis
2. healing fracture or dislocation
3. gross instability
4. cauda equina syndrome
5. large abdominal aneurysm
6. visceral referred pain

2.5.4 Side effects of manipulation

Leboeuf-Yde et al. (1997: 514) came to 6 conclusions after studying the side effects of chiropractic manipulation on 628 patients:

1. Treatment reactions are common after spinal manipulation, but they are benign and of short duration.
2. Approximately half of all new chiropractic patients report at least one treatment reaction during the course of treatment.
3. Treatment reactions appear soon after treatment (within a few hours to the next day), are mild and of short duration (gone within 48 hours).
4. Local discomfort in the area of treatment is the most likely type of reaction to occur (two-thirds).
5. Less common reactions are fatigue, pain outside the area of treatment or headache (about 10% each).
6. Nausea, dizziness or 'other' reactions are uncommon (< 5%).

2.6 INTERFERENTIAL THERAPY

Interferential therapy (IFT) is widely used, especially by physiotherapists, for the management of painful conditions (Tabasam and Johnson, 1999: 14). A survey on electrotherapeutic modality ownership in England (Pope et al. 1995: 89) showed that IFT was in the top three of the most widely owned and commonly used modalities by physiotherapists (along with ultrasound and shortwave diathermy). A similar study in Australia examined electrophysical agent usage by undergraduate physiotherapy students in two universities (Robertson and Spurritt, 1998: 335). Again it was shown that IFT is one of the most commonly available and used modalities (along with ultrasound and transcutaneous electrical nerve stimulation [TENS]).

Interferential therapy was devised in the 1950's to reduce the skin discomfort caused by low frequency currents in use at the time (Martin, 1998: 307). The principle of IFT is that two medium frequency currents (e.g. 4100 Hz and 4000 Hz) are crossed so that interference occurs between the two currents producing a net frequency (100 Hz) in the region of the crossing points (Kahn, 1994: 86). This new low frequency has been termed the beat frequency or amplitude

modulated frequency (AMF) (Martin, 1998: 308). In the past it has been generally accepted that the AMF is responsible for the therapeutic effects of IFT, but more recently this has been questioned in the literature and the medium frequency current has been postulated as being more important (Palmer et al. 1999: 1065).

Several therapeutic effects of IFT have been proposed:

1. **Muscle stimulation:** IFT is considered to be better than other low frequency methods of stimulation and is used in the treatment of stress and urge incontinence (Goats, 1990:89).

2. **Control of pain:** It is suggested that IFT works in a similar manner to TENS and stimulates large Aβ sensory fibres to reduce pain. Evidence for this effect is given below (2.6.1).

3. **Control of circulation and oedema:** IFT applied through suction electrodes at a frequency of 10-20 Hz has been shown to increase cutaneous blood flow (Noble et al. 2000:2). However, IFT at 0-100 Hz did not reduce oedema following open reduction and internal fixation of ankle fractures (Christie and Willoughby, 1990: 3).

4. **Effects on cell metabolism and healing:** IFT has been shown to affect the intracellular concentration of enzymes and molecules and is often used to promote bone healing (Goats, 1990: 90). Fourie and Bowerbank (1997: 255) however, could not produce an acceleration of healing time in new fractures of the tibia, although they did recommend further investigation.

2.6.1 Efficacy of interferential therapy in the treatment of pain

Interferential therapy is clearly widely used around the world, especially for the control of patients' pain. But there is scant scientific research to demonstrate its proposed effects and even less evidence defining which frequencies and dosages to use to produce the different effects. Much of the textbook information on IFT usage is anecdotal and protocols are often based on the trial and error of the individual therapist (Johnson, 1999: 294).

The cold-induced pain test is commonly used as an experimental pain model for determining whether a modality does indeed relieve pain (Johnson and Wilson, 1997: 463). Stephenson and Johnson (1995: 89) divided 17 healthy subjects into a control group of 10 and an experimental group of 7. Subjects in both groups had their non-dominant hand placed in ice water until the patient indicated a painful sensation. The time from immersion until pain onset was recorded as the pain threshold. Both groups underwent six trials of immersion. The experimental group received sham IFT for the first two trials and IFT for the next four trials while the control group underwent six trials without IFT. The pain threshold for the experimental group was significantly increased for all the subjects in all 4 treatment trials when compared with the controls. This preliminary study was improved upon by Tabasam and Johnson (1999) by increasing the sample size to 40 subjects and randomly allocating these subjects to an active or sham IFT group. As in the preliminary study, it was found that IFT increased the pain threshold of the subjects in the active IFT group, but produced no significant difference between the groups in terms of pain intensity or unpleasantness. These results suggest that IFT can have an effect on pain threshold, however it is difficult to extrapolate the results of this healthy group of subjects with experimental pain to patients suffering from clinical pain (Johnson and Wilson, 1997:466).

Further trials were required on patients with clinical pain. Hurley et al. (2001: 485) studied the efficacy of IFT electrode placement in patients with acute low back

pain. In this single blind, randomised, controlled trial, 60 patients were assigned to 3 groups. The first group received IFT over the painful area combined with an education booklet, 'the back book', used as a control treatment. The second group received IFT over the spinal nerve root and the `back book'. The third group received the 'back book' only. The group receiving IFT over the spinal nerve root showed a statistically significant (p=0.03) reduction in functional disability compared with the other two groups. This suggests that electrode placement is an important factor in achieving positive results with interferential current treatment.

In a randomised trial, Werners et al. (1999: 1579) separated 152 patients with low back pain into 2 equal groups. The first group received IFT and the second group received motorized lumbar traction and massage. Patients were treated in six sessions over two to three weeks. Both groups improved but there was no significant difference between the groups at the end of treatment. As traction has been shown in several studies to have little effect on low back pain, this would tend to indicate that IFT is of little use as well (Werners et al. 1999: 1583). However, this study used interferential electrode placement over the painful area and low frequency stimulation as opposed to the electrode placement over the spinal nerve and high frequency stimulation shown to be effective in the study by Hurley et al. (2001: 487). This may have affected results. The inclusion of massage in the traction group may also have skewed differences between the groups.

2.6.2 Contraindications to interferential therapy.

Although IFT is considered relatively safe and contraindications are few (Goats, 1990: 89) there are some contraindications to take note of (Watson, 2000: 139):

- Patients who do not comprehend instructions, i.e. do not speak the examiners language and may be unable to communicate distress.
- Danger of haemorrhage (e.g. recent soft tissue injury).
- Patients with pacemakers (electrical interference from IFT equipment).
- Dermatological considerations (e.g. eczema, dermatitis, anaesthetic skin).

Application of electrodes over:

- Trunk/pelvis during the first 12 weeks of pregnancy.
- The pregnant uterus at any stage of pregnancy.
- Malignant tissue (except in terminal palliative care).
- The eyes.
- Anterior aspect of the neck and carotid sinus.

2.7 CONCLUSION

Mechanical low back pain is one of the most common ailments affecting humankind worldwide. Manipulation is considered by many to be one of the most effective methods of treatment for this problem. Interferential therapy, although widely used as a treatment for pain, has not been adequately researched. This study will attempt to determine whether interferential therapy may be an effective adjunct to manipulation for the treatment of mechanical low back pain.

CHAPTER THREE: MATERIALS AND METHODS

3.1 INTRODUCTION

This chapter examines the general procedure used in the production of this study. This includes the data capture methods, measurements used, interventions applied and statistical analysis of the information. The study design was a randomized, comparative clinical trial.

3.2 THE DATA

The data consisted of primary and secondary data.

3.2.1 The primary data

1. Clinical measurements of the change in the patient's pain threshold using a pressure algometer.
2. Clinical measurements of the change of the patient's response to a group of orthopaedic tests making up an orthopaedic rating scale.
3. The patient's perception of the change in their pain intensity level using the Numerical Rating Scale-101 Questionnaire (appendix A).
4. The patient's perception of the change in their pain and disability using the Revised Oswestry Low Back Pain Questionnaire (appendix B).

3.2.2 The secondary data

This was obtained from journal articles, books and the Internet.

3.3 SAMPLING

Sixty patients were recruited through advertisements in local papers, pamphlet drops and posters around the Technikon Natal campus, libraries and community notice boards. Respondents were screened telephonically with regards to the inclusion and exclusion criteria. Those qualifying had the research process explained to them and an initial consultation was mutually agreed upon. At the initial consultation each patient underwent a case history examination (appendix C), relevant physical examination (appendix D) and lumbar regional examination (appendix E) and their compliance with inclusion criteria was tested.

3.4 INCLUSION AND EXCLUSION CRITERIA

3.4.1 Inclusion criteria

Acute low back pain has been defined as low back pain of up to 3 months duration (Bigos et al. 1994; Hurley et al. 2001: 486; Waddell, 2000: 33). Acute low back pain was chosen for this study because chronic low back pain tends to have the complications of central nervous system changes, psychological overlay and disuse atrophy (Deyo and Weinstein, 2001: 386; Kirkaldy-Willis and Burton, 1992: 75) which affect treatment protocols and outcomes.

Only patients diagnosed with acute lumbar facet syndrome or sacroiliac syndrome were included in this study to produce an homogeneous sample group. Specific orthopedic tests were performed to diagnose lumbar facet syndrome and sacroiliac syndrome. The specific tests for lumbar facet syndrome included: Kemp's test (Corrigan and Maitland, 1998: 35), facet joint challenge test (Gatterman, 1990: 84), hyperextension in a prone position (Gatterman, 1990: 162) and well-localized paraspinal tenderness (Helbig and Lee, 1988: 62).
The specific tests for sacroiliac syndrome included: posterior shear or `thigh thrust test' (Laslett and Williams, 1994: 1244), Patrick's Faber test (Broadhurst

and Bond, 1998: 342), Gaenslen's test (Magee, 1992: 319) and Yeoman's test (Magee, 1992: 320).

Each of these tests was allocated a score on production of a positive result so that the clinical data could be turned into objective quantitative data.
To determine the presence of a lumbar facet syndrome:
Kemp's test is the most useful test for reproducing facet pain according to Corrigan and Maitland (1998: 35) and Helbig and Casey (1988: 62) and therefore received a score of 4 when positive. Facet joint challenge test, prone hyperextension, and well-localized paraspinal tenderness each received a score of 2 when positive.
To determine the presence of a sacroiliac syndrome:
Posterior shear test has been shown to have good sensitivity and reliability (Laslett and Williams, 1994:1247; Broadhurst and Bond, 1998: 344) and therefore a score of 4 was given when positive, while Patrick's Faber test, Gaenslen's test and Yeoman's test each received a score of 2 when positive.
An orthopaedic assessment rating out of 10 for each syndrome was determined. Only patients with 6 or higher out of 10 for one of the two syndromes were diagnostically acceptable and were included in the study. In the case of both syndromes being present, the most prevalent syndrome was scored. A change in the score was used to give an indication as to whether there was an improvement in the subject's lumbar facet syndrome or sacroiliac syndrome.

3.4.2 Exclusion criteria

The following subjects were to be excluded from the study

(a) Patients not meeting the inclusion criteria (3.4.1).

(b) Applicants younger than 18 years old or greater than 65 years old in order to maintain a uniform adult sample group and reduce possible complications of advancing age such as osteoporosis.

(b) Subjects presenting with conditions that are contraindicated to manipulation (see **2.5.3**).

(c) Patients requiring a radiological examination (determined through consultation with a clinician), as the lumbar facet and sacroiliac syndromes can be diagnosed on clinical evidence only.

(d) Any patient with objective neurological deficit (numbness, weakness, hyporeflexia), previous lumbar spine surgery, currently under treatment for low back pain, or undergoing any change in pain medication or lifestyle modification.

(e) Subjects presenting with contraindications to interferential therapy (see **2.6.2**).

3.5 PATIENT ALLOCATION

Patients meeting the inclusion and exclusion criteria were informed of the nature of their mechanical low back pain and the nature of the treatment they could expect to receive during the study. If the patient agreed at this stage to participate in the research they were asked to complete and sign an informed consent form (appendix F) describing the terms and conditions of the study. They were also given an information sheet (appendix G) describing the research study and other information relevant to the patient.

At this point each patient was randomly allocated (Fisher and van Belle, 1993: 123) into either group A receiving manipulation and IFT or group B receiving manipulation only. No stratification of the patients took place and no patient blinding occurred, as each patient was made aware of the two treatment groups.

A total of sixty patients were used for this study – 30 in group A and 30 in group B.

3.6 MEASUREMENTS

3.6.1 Subjective measurements

These consisted of the Numerical Pain Rating Scale – 101 Questionnaire (appendix A) and the Revised Oswestry Low Back Pain Questionnaire (appendix B).

3.6.1.1 Numerical Pain Rating Scale – 101 Questionnaire (NRS)

The NRS questionnaire requires the patient to record a number from 0-100 which represents their pain intensity where 0 is 'no pain' and 100 is 'the worst pain possible' (Bolton and Wilkinson, 1998: 2). This assesses the patient's own perception of their pain. The first scale asks for the pain intensity when the pain is at its worst and the second scale asks for the pain intensity when the pain is at its least. A combined average of these two scales gives the average pain percentage.

Advantages of the NRS are that it is simple and quick to perform and score, but this leads to a drawback in that it allows patients to memorize prior pain levels more easily (Chapman-Smith, 2000: 7). However, NRS has been shown to be a more responsive and sensitive scale than the visual analogue scale (VAS) and is simpler to use. It is therefore recommended by Bolton and Wilkinson (1998: 6) for pain intensity measurement in outcome studies.

3.6.1.2 Revised Oswestry Low Back Pain Questionnaire (ROLBPQ)

The original Oswestry low back pain questionnaire was developed by Fairbank et al. (1980) to measure disability experienced by the patient. The ROLBPQ has ten sections of questions relating to how the pain affects certain areas of life (see appendix B). Each section is scored between 0 and 5, with 0 being no disability and 5 being the worst disability, producing a maximum possible score of 50. This score is converted to a percentage by multiplying it by two (Chapman-Smith, 2000: 3). Overall ratings on this scale are (Fairbank et al. 1980: 273):

0-20%	Minimal disability
20-40%	Moderate disability
40-60%	Severe disability
60-80%	Crippled
80-100%	Bed-bound or exaggerating

An improvement of 5% is regarded as significant.

The ROLBPQ has been recommended for monitoring low back pain patients (Haas et al. 1995: 86) and has been shown to be valid and reliable (Fairbank et al. 1980: 271; Hsieh et al. 1992: 9).

3.6.2 Objective measurements

These consisted of the algometer (pressure threshold meter) and the orthopaedic rating scale.

3.6.2.1 Algometer

This study makes use of the pressure threshold meter (algometer) popularized by Fischer (1986) who developed its use for the measurement of tender spots for conditions such as arthritis, fibrositis, abdominal pain and myofascial trigger points.

The algometer is a force gauge fitted with a disc of $1cm^2$. The gauge, which has an 11kg range, determines the pressure threshold, or minimum pressure, which induces pain. Pressure exerted on a given tender point through the disc moves the indicator in a clockwise direction to produce a measurement. The reading is held until it is returned to zero by pressing the zeroing knob (Fischer, 1986: 836).

Fischer (1986: 836) recommends 3 steps when using the algometer in clinical practice:

1. Prepare and position the patient: explain to the patient that pressure threshold is being measured, describe the procedure and explain that a verbal indication should be given as soon as pain is felt to prevent further pressure. The patient is then positioned in a relaxed position which allows access to the point to be measured.
2. Identification of maximum tender spot: palpate the relevant area (for this study the appropriate lumbar facet or sacroiliac joint) to identify the most tender spot.
3. Measurement of pain threshold: apply the pressure gauge at this point of maximum sensitivity at 90° to the skin. Increase the pressure at an even rate of about 1kg/sec, stopping when the patient indicates discomfort.

An increase in the pressure threshold of the same tender spot over time indicates improvement. The tender spot used for this study was the lumbar facet or sacroiliac joint and an increase in pain threshold over the joint was considered an improvement in the lumbar facet syndrome or sacroiliac syndrome respectively.

Reliability of the algometer for objectively documenting pathology has been shown to be good and is effective over an extended time period (Fischer, 1987: 122; Nussbaum and Downes, 1998:169).

3.6.2.2 Orthopaedic Rating Scale

The orthopaedic rating scale has been used in previous studies at the Natal Technikon (White, 2001). A combination of tests is often used to increase the reliability of testing (Laslett and Williams, 1994). The orthopaedic tests used in this study have been shown to be effective individually but not as a group. Although the reliability and validity of the tests as a group has not been shown, the group of tests has good face validity in combination with the other objective and subjective measures (White, 2001). The following tests were used in the orthopaedic rating scale:

KEMPS TEST: (also called the quadrant test). This test is designed to place the facet joints under maximum stress. The patient is seated with the examiner standing behind. The lumbar spine is passively extended, rotated and laterally flexed toward the side being tested side. A positive test is indicated by pain localized to the facet joint. (Corrigan and Maitland, 1990: 35)

FACET JOINT CHALLENGE: The patient lies prone. A posterior to anterior force is used on the spinous process of each lumbar vertebra to approximate or 'spring' the individual joints. A positive test is indicated by pain over the joint being tested. (Gatterman: 1990: 84)

PRONE HYPEREXTENSION TEST: For the purposes of this study the patient lies prone and, with the pelvis remaining on the examining table, pushes him/herself upwards into extension away from the table. (Gatterman,1990:162)

PARASPINAL TENDERNESS: For the purposes of this study the patient lies prone and pressure is applied manually to the lumbar paraspinal muscles. Areas of well-localized tenderness, indicated by the patient, are noted. (Helbig and Lee: 1988)

POSTERIOR THIGH THRUST TEST: The patient lies supine and the test leg is raised to 90^0 of hip flexion. The femur is adducted to the midline and axial pressure is exerted along the line of the femur. A positive test is pain localized to the sacroiliac joint. (Laslett and Williams, 1994: 1244)

GAENSLEN'S TEST: The patient lies supine and both legs are drawn up to the chest. The test leg is then released and hyperextended over the end of the bed. Pain localized to the sacroiliac joint is a positive test. (Magee, 1992: 319)

PATRICK'S FABER TEST: (Faber is an acronym for: *f*lexion, *ab*duction, *e*xternal *r*otation). This test is also known as Patrick's test or the figure 4 test. The patient lies supine and the foot of the side being tested is placed on the opposite knee. The examiner stabilizes the patient's pelvis with one hand while lowering the test leg in abduction towards the table with the other hand. A positive test for the purposes of this study is pain localized to the sacroiliac joint. (Broadhurst and Bond, 1998: 342)

YEOMAN'S TEST: The patient lies prone while the examiner stabilizes the patient's pelvis and grasps each knee in turn extending the hip. Pain localized to the sacroiliac joint indicates a positive test. (Magee, 1992: 320)

3.7 INTERVENTION

Each patient received 4 treatments and a follow-up consultation for data collection (Gatterman, 1990: 397) within a two week period to reduce the effect of the natural history of acute low back pain (Andersson: 1999: 582).
Measurements with the algometer, ORS testing results, and NRS and Oswestry responses were recorded before treatment on the first, third and fifth consultations.

3.7.1 Motion palpation

Motion palpation is a manual manoeuvre which involves passively testing the full range of motion of an individual joint and noting the direction of increased resistance (Schafer and Faye, 1990: 11). Motion palpation was utilised in this study to determine which joints of the lumbosacral spine had motion restrictions. Spinal manipulative therapy was then applied to these restricted (dysfunctional) joints.

Motion palpation of the lumbar spine was performed according to the method of Schafer and Faye (1990: 213). Each lumbar vertebra was examined for loss of motion in flexion, extension, rotation and lateral flexion. The sacroiliac joints were examined using Gillet's test (Schafer and Faye, 1990: 259). Two manual contacts are taken on the sacrum and the sacroiliac joint and loss of relative motion is assessed when the patient raises the ipsilateral knee to the chest.

3.7.2 Manipulation

Both groups A and B received spinal manipulation. The manipulations were carried out in the lumbosacral spine according to Schafer and Faye (1990: 220-282) in the direction of motion restriction determined by motion palpation. The procedure of manipulation was explained to each patient and they were instructed to report discomfort at any stage in the procedure. The following manipulations were used, with the side-posture rotation restriction manipulation being the most commonly used:

FLEXION RESTRICTION: The patient is placed in lateral recumbent position with both knees and hips flexed. A pisiform contact is used on the tip of the spinous process of the superior segment of the involved motion unit. The thrust is directed cephalad and slightly anterior to produce flexion.

EXTENSION RESTRICTION: The patient is placed in the lateral recumbent position, involved side upward with the uppermost knee and hip flexed over the underneath extended limb. The patient is positioned to increase the lumbar spine lordosis. A pisiform contact is applied on the involved articulation. The impulse is directed cephalad and anteriorly.

ROTATION RESTRICTION: The patient is placed in the lateral recumbent position, involved side uppermost. A pisiform contact is placed on the involved articulation. The patient's body is counter-rotated and an impulse is directed anteriorly, cephalad and medially.

LATERAL FLEXION RESTRICTION: The patient is placed in the lateral recumbent position with the involved side upward. A pisiform contact is made on the side of the spinous process of the superior segment of the involved motion segment. The thrust is directed obliquely downward, cephalad and anterior.

3.7.3 Interferential therapy

Interferential therapy (IFT) was applied to group A only via Dynatron 550 machine (Dynatronics® 7030 Park Central Drive, Salt Lake City, Utah 84121. Copyright 84121).

Electrodes were placed so that the intersection point of the 4 poles was just lateral to the intervertebral foramen of the target spinal nerve (supplying the painful area). This was determined through surface anatomy. Hurley et al. (2001: 487) have shown this to be the most effective electrode placement for pain reduction.

The frequency was set at 80 – 120 Hz in the sweep mode. Studies by Johnson and Wilson (1997) suggest that these settings are most effective for reducing pain and have been used effectively by Hurley et al. (2001).

Each patient in group A was instructed that as the intensity was increased they would begin to feel a 'mild tingling sensation' and that they should advise the operator when the sensation became 'strong but comfortable' (Hurley et al, 2001: 487). They were also instructed to advise the operator if the sensation decreased appreciably or if the sensation became uncomfortable so that the intensity could be adjusted appropriately.

The treatment period for IFT was set at 15 minutes (Watson, 2000: 139).

3.8 STATISTICAL ANALYSIS

3.8.1 Treatment of the data

The Technikon Natal research statistician was consulted on the statistical analysis of the data. The objective and subjective data were analysed statistically using the statistical computer software programme SPSS version 9.0 (SPSS Inc., 444N. Michigan Ave, Chicago, Illinois, 60611, USA) and are presented using bar graphs and tables. The null hypothesis was rejected at the $\alpha = 0.05$ level of significance if $p < \alpha$ where p was the observed level of significance or probability value. The null hypothesis was otherwise accepted at the same level (Daniel, 1999: 208).

Parametric testing was used to analyze the objective and subjective data, with regards to acute mechanical low back pain, as the patient number (n) for each group was equal to thirty. **Non-parametric** testing was used to analyze the objective and subjective data, with respect to the lumber facet syndrome and sacroiliac syndrome, as the patient number for each group was less than thirty.

3.8.2 Parametric testing

Inter-group comparison of the subjective and objective data was done using the two sample unpaired t-test. This test was used to determine whether any significant difference existed between the median values of groups A and B at the first, third and fifth consultations (Fisher and van Belle, 1993: 149).

Intra-group comparison of the subjective and objective data was done using Friedman's T test. This test was used to determine whether any significant change occurred between the first and third, the third to the fifth, and the first and the fifth consultations within each group (Daniel, 1999: 701).

3.8.2.1 Unpaired t-test (inter-group)

This parametric test was used to compare groups A and B as the sample size was greater than or equal to thirty ($n \geq 30$) (Fisher and van Belle, 1993: 149).

Hypothesis testing: The null hypothesis (Ho) states that there is no difference between the two groups with respect to the variable of interest. The alternative hypothesis (Ha) states that there is a difference between the two groups.

Ho: There is no difference between groups A and B
Ha: There is a difference between groups A and B
$\alpha = 0.05$ = level of significance
Decision rule:

If $p < \alpha$, reject Ho
If $p \geq \alpha$, accept Ho
Where p is the reported p-value

3.8.2.2 Friedman's T test (intra-group)

This test is a non-parametric analogue of the parametric two-way analysis of variance. Calculations are performed on ranks from the data. In the Friedman test, the observations within each block are ranked separately from smallest to largest. This was done comparing the initial, third and fifth consultations within both groups (Daniel, 1999: 701).

Hypothesis testing:

Ho: all three treatments yield identical results

Ha: at least one treatment is different from the rest

$\alpha = 0.05$

Decision rule:

$p < \alpha$, reject Ho

$p \geq \alpha$, accept Ho

If Ho is rejected then we carry out the multiple comparison Dunn Procedure to determine which of the three consultations is different.

R_i and R_j are considered significantly different if:

$$|R_j - R_k| \geq z\sqrt{\frac{bk(k+1)}{6}}$$

Where:

R_j and R_k are the j'th and k'th treatment rank totals

$z = 1 - [\alpha/k(k - 1)]$

b = number of patients

k = number of consultations

3.8.3 Non-parametric testing

Inter-group comparison of the subjective and objective data was done using the Mann-Whitney unpaired test. This was used to determine whether there was any significant difference between the median values of groups A and B for the first , third and fifth consultations (Daniel, 1999: 678).

Intra-group comparison of the subjective and objective data was done using Friedman's T test. This used to determine if there were any significant changes between the first and third, third and fifth, and first and fifth consultations.

3.8.3.1 Mann-Whitney U-test (inter-group)

This non-parametric test was used to determine whether any significant difference existed between group A and group B at the time of the initial, third and fifth consultations (Daniel, 1999: 678).

Hypothesis testing:

Ho: there is no difference between the two groups

Ha: there is a difference between the two groups

$\alpha = 0.05$

Decision rule:

If $p < \alpha$, reject Ho

If $p \geq \alpha$, accept Ho

Where p is the reported p-value.

3.8.3.2 Friedman's T test (intra-group)

This test is completed according to **3.8.2.2**.

3.9 ETHICAL CONSIDERATIONS

- The rights and welfare of the subject were protected.
- Informed consent was obtained (appendix f).
- The subject was not coerced into participating in the study.
- Information was given to the study in understandable language.
- The research involved no more than minimal risk.
- Confidentiality was maintained.
- Participation was voluntary and did not involve financial benefit.
- The subject was free to withdraw from the study at any time.

These ethical considerations were largely dealt with using the information sheet (appendix G) and informed consent form (appendix F).

3.10 SUMMARY

Sixty patients suffering from acute mechanical low back pain were selected into the study. Thirty patients were randomly allocated into two treatment groups.

Those in group A received manipulation and interferential therapy. Treatment group B received manipulation only. Each patient was assessed in terms of objective and subjective clinical findings and all the necessary data was obtained for statistical analysis.

CHAPTER FOUR: RESULTS

4.1 INTRODUCTION

This chapter presents the statistical results of the subjective and objective data obtained from the two groups of patients. Demographic data and inter-group and intra-group data are highlighted.

Group A represents the group receiving manipulation and IFT, while group B represents the group receiving manipulation only.

4.2 Demographics

The demographical data includes age distribution, gender, current smokers, occupation, regular exercisers, previous low back pain episodes, lumbar facet versus sacroiliac syndrome and duration of the low back pain.

4.2.1 Age distribution

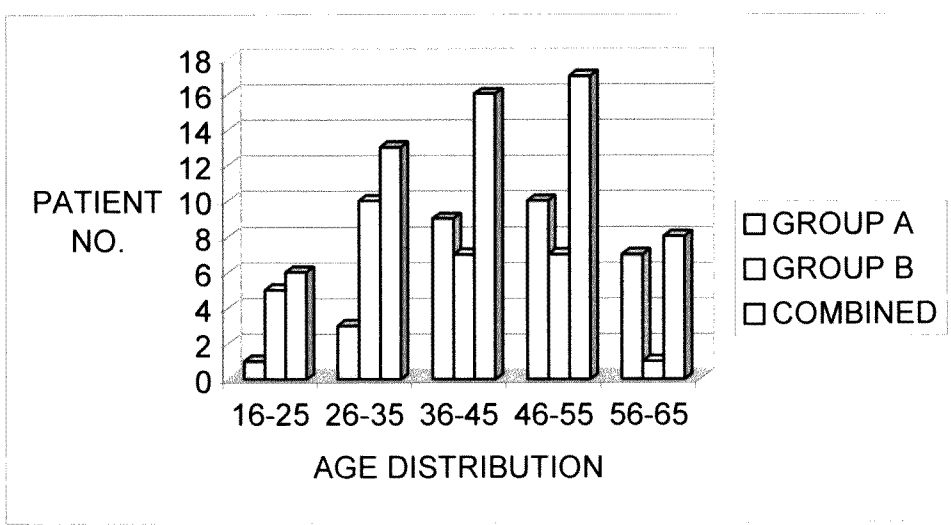


Figure 1: Distribution of ages within groups A and B

The majority of patients (33/60) were between the ages of 35 and 56. The range of ages in group A was from 19 to 65 and group B was from 23 to 61. The average age of group A was higher than that of group B (46 versus 38).

4.2.2 Gender distribution

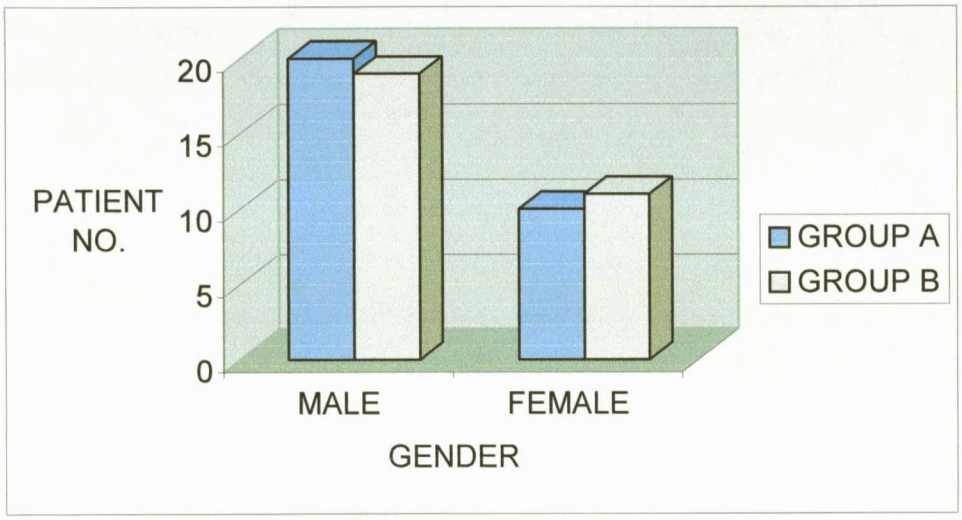


Figure 2: Distribution of genders in groups A and B

The male gender made up 65% of the patient population and females 35%. The distribution of genders within the two groups can be seen in figure two to be roughly equal (group A males 67% vs group B males 63%; group A females 33% vs group B females 37%).

4.2.3 Distribution of smokers

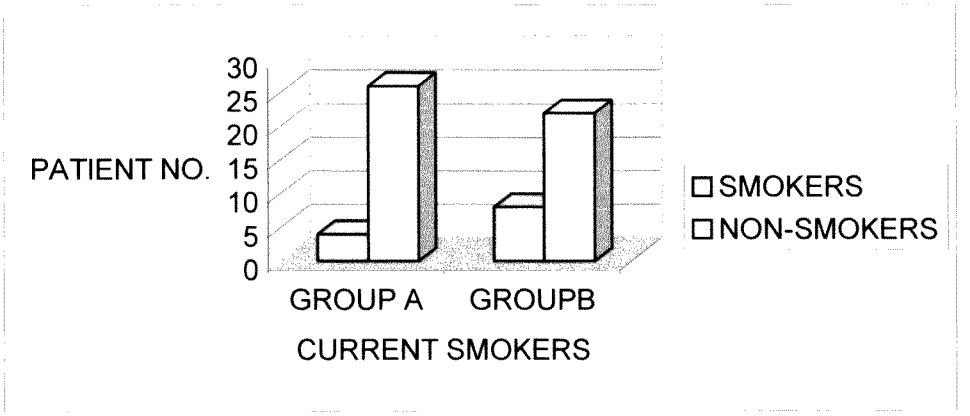


Figure 3: Distribution of current smokers within groups A and B

Figure 3 does not include those people who had at one time been smokers but had subsequently given up smoking.

4.2.4 Previous episodes of low back pain

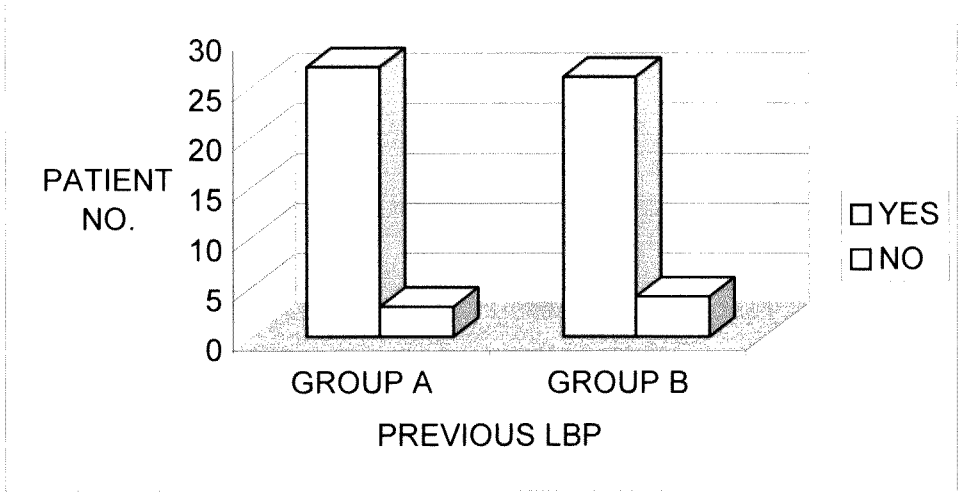


Figure 4: Distribution of patients who had had a previous episode of low back pain (LBP).

Approximately 88% (53/60) of the patients had experienced at least one previous episode of low back pain.

4.2.5 Regular exercise

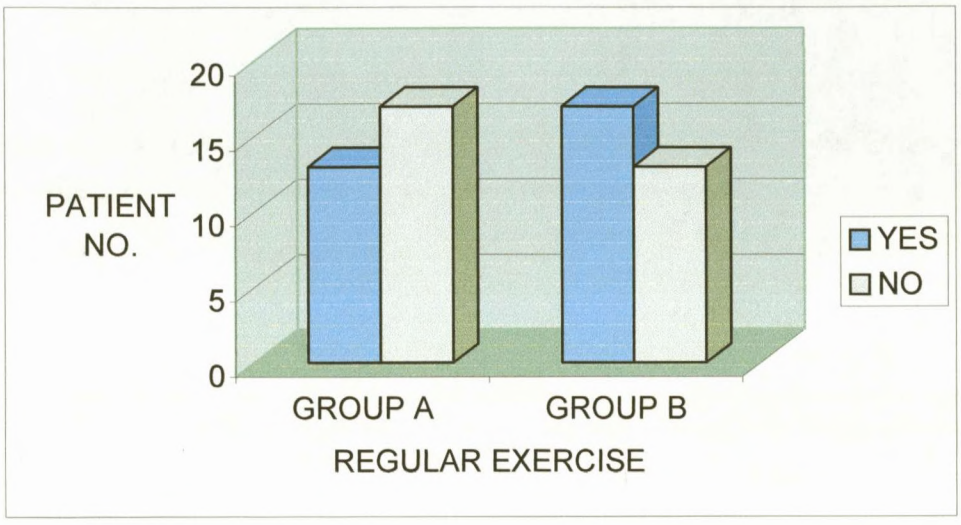


Figure 5: Distribution of patients undertaking regular exercise in groups A and B.

Regular exercise was defined for the purpose of this study as mild exertion at least once a week. Only 50% of the study group undertook regular exercise at the time of the study.

4.2.6 Occupation

OCCUPATION	GROUP A	GROUP B
Minister	1	
Sales representative	2	2
Teacher	3	2
Clerk	3	1
Lecturer	1	
Plumber	1	
Horticulturist		1
Quantity surveyor		1
Secretary	1	
Consultant	2	
Engineer	1	1
Manager	2	2
Attorney		1
Investigator		1
Technician	3	4
Credit controller	2	1
Student	2	5
Pensioner	3	1
Self-employed	2	3
Unemployed	1	3
Total	**30**	**30**

Table 1: Patient occupation distribution between groups A and B.

4.2.7 Lumbar facet syndrome versus sacroiliac syndrome

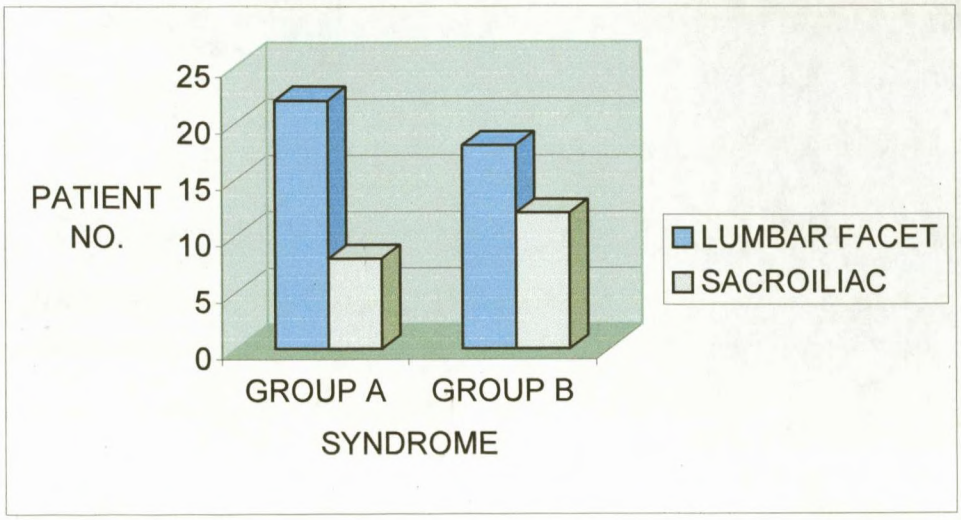


Figure 6: Distribution of lumbar facet and sacroiliac syndromes within groups A and B.

Distribution of the two syndromes in each group were similar: lumbar facet syndrome (22/30) 73% in group A and (18/30) 60% in group B; sacroiliac syndrome (8/30) 27% in group A and (12/30) 40% in group B. Lumbar facet syndrome made up two thirds of the patient population while sacroiliac syndrome made up one third.

4.2.8 Duration of complaint

Group A had a mean duration of 5.8 weeks for their acute low back pain with the range from 3 days to 3 months. Group B had a mean duration of 5.7 weeks for their low back pain with the range from 2 days to 3 months.

4.3 PATIENT EXCLUSION

NUMBER OF SUBJECTS			REASON FOR EXCLUSION
GROUP A	GROUP B	INTERVIEW	
	1		Transport difficulty
4	3		Poor compliance
	1		Re-injured low back
		7	Previous lumbar surgery
		8	Negative orthopaedic testing
		3	Over/under age limit
		10	Neurological abnormality
		9	Chronicity (over 3 months LBP)
4	5	37	Total

Table 2: Exclusion of patients from study at interview or during trial

A total of 46 patients were excluded from the trial either during participation (n = 9) or during the telephonic and initial consultation screening (n = 37).

4.4 DATA ANALYSIS

Parametric testing ($n \geq 30$) was used to analyze the subjective and objective data with regards to acute mechanical low back pain. The two sample unpaired t-test was used to analyze the inter-group information and Friedman's T test was used to analyze the intra-group information.

Non-parametric testing ($n < 30$) was used to analyze the subjective and objective data with regards to lumbar facet and sacroiliac syndromes. The Mann-Whitney

U test was used to analyze the inter-group information and Friedman's T test was used to analyze the intra-group information

4.4.1 Parametric testing: Acute mechanical low back pain (MLBP)

4.4.1.1 Inter-group analysis: two-sample unpaired t-test.

	GROUP A			GROUP B	
	Mean	s.d	p-value	mean	s.d
ALG 1	5.47	1.86	**0.378**	5.02	2.05
ALG 3	6.55	2.12	**0.662**	6.32	1.99
ALG 5	7.64	1.86	**0.055**	6.67	1.97

Table 3: Comparison of groups A and B using the results of algometer readings in consultations 1, 3 and 5 for acute MLBP.

The null hypothesis was accepted for the algometer readings indicating that at the $\propto = 0.05$ level of significance there was no difference between the two groups at the first, third and fifth consultations for acute MLBP.

	GROUP A			GROUP B	
	Mean	s.d	p-value	mean	s.d
NRS 1	45.33	15.74	**0.250**	40.93	13.52
NRS 3	31.07	18.52	**0.769**	29.83	13.39
NRS 5	26.63	17.79	**0.527**	23.83	16.27

Table 4: Comparison of groups A and B using the NRS-101 results in consultations 1, 3 and 5 for acute MLBP.

The null hypothesis was accepted for the NRS-101 results indicating that at the α = 0.05 level of significance there was no difference between the two groups at the first, third and fifth consultations for acute MLBP.

	GROUP A			GROUP B	
	Mean	s.d	p-value	mean	s.d
OSW 1	35.4	12.45	**0.927**	35.67	9.8
OSW 3	24.07	15.1	**0.614**	22.2	13.34
OSW 5	20.27	14.96	**0.531**	17.73	16.18

Table 5: Comparison of groups A and B using the revised Oswestry questionnaire (OSW) results in consultations 1, 3 and 5 for acute MLBP.

The null hypothesis was accepted for the revised Oswestry low back pain questionnaire readings indicating that at the α = 0.05 level of significance there was no difference between the two groups at the first, third and fifth consultations for acute MLBP.

	GROUP A			GROUP B	
	Mean	s.d	p-value	mean	s.d
ORS 1	8.27	1.36	**0.360**	7.93	1.44
ORS 3	5.47	2.52	**0.847**	5.33	2.8
ORS 5	3.53	2.39	**0.619**	3.2	2.76

Table 6: Comparison of groups A and B using the orthopaedic rating scale (ORS) results in consultations 1, 3 and 5 for acute MLBP.

The null hypothesis was accepted for the orthopaedic rating scale results indicating that at the α = 0.05 level of significance there was no difference between the two groups at the first, third and fifth consultations for acute MLBP.

4.4.1.2 Intra-group analysis: Friedman's T test for acute MLBP.

ALGOMETER	GROUP A			GROUP B		
TREATMENT NUMBER	1	3	5	1	3	5
MEAN RANK	1.27	1.98	2.75	1.22	2.27	2.52
SUM OF RANKS	38.1	59.4	82.5	36.6	68.1	75.3
P-VALUE	**0.000**			**0.000**		

Table 7: Results of Friedman's T test on algometer readings to determine whether there is a significant difference between consultations 1, 3 and 5 within group A and B for acute MLBP.

The null hypothesis was rejected for both groups A and B indicating that, in both groups, there was a difference between consultation 1, 3 and 5 with regards to the algometer results for acute MLBP.

NRS-101	GROUP A			GROUP B		
TREATMENT NUMBER	1	3	5	1	3	5
MEAN RANK	2.67	1.92	1.47	2.75	1.98	1.27
SUM OF RANKS	80.1	57.6	42.6	82.5	59.4	38.1
P-VALUE	**0.000**			**0.000**		

Table 8: Results of Friedman's T test on NRS-101 results to determine whether there is a significant difference between consultations 1, 3 and 5 within group A and B for acute MLBP.

The null hypothesis was rejected for both groups A and B indicating that, in both groups, there was a difference between consultation 1, 3 and 5 with regards to the numerical rating scale results for acute MLBP.

OSWESTRY	GROUP A			GROUP B		
TREATMENT NUMBER	1	3	5	1	3	5
MEAN RANK	2.93	1.68	1.38	2.82	1.8	1.38
SUM OF RANKS	87.9	50.4	41.4	84.6	54	41.4
P-VALUE	**0.000**			**0.000**		

Table 9: Results of Friedman's T test on Oswestry results to determine whether there is a significant difference between consultations 1, 3 and 5 within group A and B for acute MLBP.

The null hypothesis was rejected for both groups A and B indicating that, in both groups, there was a difference between consultation 1, 3 and 5 with regards to the revised Oswestry low back pain questionnaire results for acute MLBP.

ORS	GROUP A			GROUP B		
CONSULTATION NUMBER	1	3	5	1	3	5
MEAN RANK	2.82	1.95	1.23	2.78	1.95	1.27
SUM OF RANKS	84.6	58.5	36.9	83.4	58.5	38.1
P-VALUE	**0.000**			**0.000**		

Table 10: Results of Friedman's T test on ORS results to determine whether there is a significant difference between consultations 1, 3 and 5 within group A and B for acute MLBP.

The null hypothesis was rejected for both groups A and B indicating that, in both groups, there was a difference between consultation 1, 3 and 5 with regards to the orthopaedic rating scale results.

4.4.1.3 Dunn's procedure for use with Friedman's test for acute MLBP

Dunn's procedure is a multiple comparison procedure to determine which consultations were significantly different if the null hypothesis is rejected. The null hypothesis was rejected for all subjective and objective measures for both groups and therefore Dunn's procedure was applied to all measures:

Dunn's procedure decision rule:

If $|R_j - R_k| \geq z\sqrt{\frac{bk(k+1)}{6}}$, then there is a significant difference between R_i and R_j

In the above formula:

- R_j and R_k = sum of the j^{th} and k^{th} treatment ranks
- z = value in the inverse normal distribution corresponding to 2.12 for this study (k = 3).
- b = number of patients
- k = number of treatments

For this Dunn's procedure: z = 2.12, b = 30, k = 30, therefore:

$$|R_j - R_k| \geq 2.12\sqrt{\frac{30(3)(3+1)}{6}}$$

$$|R_j - R_k| \geq 16.42$$

4.4.1.4 a) Dunn's procedure for the algometer results of group A

The sum of the treatment ranks are:

Rank 1 (R1) = 38.1
Rank 3 (R3) = 59.4
Rank 5 (R5) = 82.5

Therefore,

$|R1 - R3| = |38.1 - 59.4| = 21.3$
$|R1 - R5| = |38.1 - 82.5| = 44.4$
$|R3 - R5| = |59.4 - 82.5| = 23.1$

- Comparing treatment 1 and 3, 21.3 ≥ 16.42. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, 44.4 ≥ 16.42. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, 23.1 ≥ 16.42. Therefore there was a difference between treatment 3 and 5.

b) Dunn's procedure for the algometer readings of group B

The sum of the treatment ranks are:

Rank 1 (R1) = 36.6
Rank 3 (R3) = 68.1
Rank 5 (R5) = 75.3

Therefore,

$|R1 - R3| = |36.6 - 68.1| = 31.5$
$|R1 - R5| = |36.6 - 75.3| = 38.7$
$|R3 - R5| = |68.1 - 75.3| = 7.2$

- Comparing treatment 1 and 3, $31.5 \geq 16.42$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $38.7 \geq 16.42$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $7.2 < 16.42$. Therefore there was no difference between treatment 3 and 5.

4.4.1.5 a) Dunn's procedure for the numerical rating scale results of group A .

The sum of the treatment ranks are:

Rank 1 (R1) = 80.1
Rank 3 (R3) = 57.6
Rank 5 (R5) = 42.6

Therefore,

$|R1 - R3| = |80.1 - 57.6| = 22.5$
$|R1 - R5| = |80.1 - 42.6| = 37.5$
$|R3 - R5| = |57.6 - 42.6| = 15$

- Comparing treatment 1 and 3, $22.5 \geq 16.42$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $37.5 \geq 16.42$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $15 < 16.42$. Therefore there was no difference between treatment 3 and 5.

b) Dunn's procedure for the numerical rating scale results of group B .

The sum of the treatment ranks are:

Rank 1 (R1) = 82.5
Rank 3 (R3) = 59.4
Rank 5 (R5) = 38.1

Therefore,

$|R1 - R3| = |82.5 - 59.4| = 23.1$
$|R1 - R5| = |82.5 - 38.1| = 44.4$
$|R3 - R5| = |59.4 - 38.1| = 21.3$

- Comparing treatment 1 and 3, $23.1 \geq 16.42$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $44.4 \geq 16.42$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $21.3 \geq 16.42$. Therefore there was a difference between treatment 3 and 5.

4.4.1.6 a) Dunn's procedure for the revised Oswestry questionnaire results of group A .

The sum of the treatment ranks are:

Rank 1 (R1) = 87.9
Rank 3 (R3) = 50.4
Rank 5 (R5) = 41.4

Therefore,

$|R1 - R3| = |87.9 - 50.4| = 37.5$
$|R1 - R5| = |87.9 - 41.4| = 46.5$
$|R3 - R5| = |50.4 - 41.4| = 9$

- Comparing treatment 1 and 3, $37.5 \geq 16.42$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $46.5 \geq 16.42$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $9 < 16.42$. Therefore there was no difference between treatment 3 and 5.

b) Dunn's procedure for the revised Oswestry questionnaire results of group B .

The sum of the treatment ranks are:

Rank 1 (R1) = 84.6
Rank 3 (R3) = 54
Rank 5 (R5) = 41.4

Therefore,

$|R1 - R3| = |84.6 - 54| = 27.6$
$|R1 - R5| = |84.6 - 41.4| = 40.2$
$|R3 - R5| = |54 - 41.4| = 12.6$

- Comparing treatment 1 and 3, $27.6 \geq 16.42$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $40.2 \geq 16.42$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $12.6 < 16.42$. Therefore there was no difference between treatment 3 and 5.

4.4.1.7 a) Dunn's procedure for the orthopaedic rating scale results of group A .

The sum of the treatment ranks are:

Rank 1 (R1) = 84.6
Rank 3 (R3) = 58.5
Rank 5 (R5) = 36.9

Therefore,

$|R1 - R3| = |84.6 - 58.5| = 26.1$
$|R1 - R5| = |84.6 - 36.9| = 47.7$
$|R3 - R5| = |58.5 - 36.9| = 21.6$

- Comparing treatment 1 and 3, $26.1 \geq 16.42$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $47.7 \geq 16.42$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $21.6 \geq 16.42$. Therefore there was a difference between treatment 3 and 5.

b) Dunn's procedure for the orthopaedic rating scale results of group B .

The sum of the treatment ranks are:

Rank 1 (R1) = 83.4
Rank 3 (R3) = 58.5
Rank 5 (R5) = 38.1

Therefore,

$|R1 - R3| = |83.4 - 58.5| = 24.9$
$|R1 - R5| = |83.4 - 38.1| = 45.3$
$|R3 - R5| = |58.5 - 38.1| = 20.4$

- Comparing treatment 1 and 3, $24.9 \geq 16.42$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $45.3 \geq 16.42$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $20.4 \geq 16.42$. Therefore there was a difference between treatment 3 and 5.

4.4.2 Non-parametric testing: lumbar facet syndrome

4.4.2.1 Inter-group analysis: Mann-Whitney test

	GROUP A			GROUP B	
	Mean rank	Sum of ranks.	p-value	Mean rank	Sum of ranks
ALG 1	22.02	484.5	**0.362**	18.64	335.5
ALG 3	20.36	448	**0.935**	20.67	372
ALG 5	23.02	506.5	**0.131**	17.42	313.5

Table 11: Comparison of groups A and B using the results of algometer readings in consultations 1, 3 and 5 for facet syndrome.

The null hypothesis was accepted for the algometer readings indicating that at the $\propto = 0.05$ level of significance there was no difference between the two groups at the first, third and fifth consultations for facet syndrome.

	GROUP A			GROUP B	
	Mean rank	Sum of ranks	p-value	Mean rank	Sum of ranks
NRS 1	21.2	466.5	**0.672**	19.64	353.5
NRS 3	21	462	**0.765**	19.89	358
NRS 5	22	484	**0.368**	18.67	336

Table 12: Comparison of groups A and B using the results of NRS readings in consultations 1, 3 and 5 for facet syndrome.

The null hypothesis was accepted for the numerical rating scale readings indicating that at the $\propto = 0.05$ level of significance there was no difference between the two groups at the first, third and fifth consultations for facet syndrome.

	GROUP A			GROUP B	
	Mean rank	Sum of ranks	p-value	Mean rank	Sum of ranks
OSW 1	19.66	432.5	**0.614**	21.53	387.5
OSW 3	20.73	456	**0.892**	20.22	364
OSW 5	22.05	485	**0.354**	18.61	335

Table 13: Comparison of groups A and B using the results of Oswestry readings in consultations 1, 3 and 5 for facet syndrome.

The null hypothesis was accepted for the revised Oswestry questionnaire readings indicating that at the $\propto = 0.05$ level of significance there was no difference between the two groups at the first, third and fifth consultations for facet syndrome.

	GROUP A			GROUP B	
	Mean rank	Sum of ranks	p-value	Mean rank	Sum of ranks
ORS 1	20.32	447	**0.905**	20.72	373
ORS 3	19.86	437	**0.690**	21.28	383
ORS 5	20.20	444.5	**0.852**	20.86	375.5

Table 14: Comparison of groups A and B using the results of ORS readings in consultations 1, 3 and 5 for facet syndrome.

The null hypothesis was accepted for the orthopaedic rating scale readings indicating that at the $\propto = 0.05$ level of significance there was no difference between the two groups at the first, third and fifth consultations for facet syndrome.

4.4.2.2 Intra-group analysis: Friedman's T test for facet syndrome

ALGOMETER	GROUP A			GROUP B		
TREATMENT NUMBER	1	3	5	1	3	5
MEAN RANK	1.25	2.02	2.73	1.19	2.22	2.58
SUM OF RANKS	27.5	44.4	60.06	21.42	39.96	46.44
P-VALUE	**0.000**			**0.000**		

Table 15: Results of Friedman's T test on algometer results to determine whether there is a significant difference between consultations 1, 3 and 5 within group A and B for facet syndrome.

The null hypothesis was rejected for both groups A and B indicating that, in both groups, there was a difference between consultation 1, 3 and 5 with regards to the algometer results for facet syndrome.

NRS-101	GROUP A			GROUP B		
TREATMENT NUMBER	1	3	5	1	3	5
MEAN RANK	2.57	1.95	1.48	2.75	2.03	1.22
SUM OF RANKS	56.54	42.9	32.56	49.5	36.54	21.96
P-VALUE	**0.000**			**0.000**		

Table 16: Results of Friedman's T test on NRS-101 results to determine whether there is a significant difference between consultations 1, 3 and 5 within group A and B for facet syndrome.

The null hypothesis was rejected for both groups A and B indicating that, in both groups, there was a difference between consultation 1, 3 and 5 with regards to the numerical rating scale results for facet syndrome.

OSWESTRY	GROUP A			GROUP B		
TREATMENT NUMBER	1	3	5	1	3	5
MEAN RANK	2.91	1.66	1.43	2.78	1.89	1.33
SUM OF RANKS	64.02	36.52	31.46	50.04	34.02	23.94
P-VALUE	**0.000**			**0.000**		

Table 17: Results of Friedman's T test on Oswestry results to determine whether there is a significant difference between consultations 1, 3 and 5 within group A and B for facet syndrome.

The null hypothesis was rejected for both groups A and B indicating that, in both groups, there was a difference between consultation 1, 3 and 5 with regards to the revised Oswestry low back pain questionnaire results for facet syndrome.

ORS	GROUP A			GROUP B		
CONSULTATION NUMBER	1	3	5	1	3	5
MEAN RANK	2.75	2.02	1.23	2.69	1.97	1.33
SUM OF RANKS	60.5	44.44	27.06	48.42	35.46	23.94
P-VALUE	**0.000**			**0.000**		

Table 18: Results of Friedman's T test on ORS results to determine whether there is a significant difference between consultations 1, 3 and 5 within group A and B for facet syndrome.

The null hypothesis was rejected for both groups A and B indicating that, in both groups, there was a difference between consultation 1, 3 and 5 with regards to the orthopaedic rating scale results for facet syndrome.

4.4.2.3 Dunn's procedure for use with Friedman's test

Dunn's procedure decision rule:

If $|R_j - R_k| \geq z\sqrt{\frac{bk(k+1)}{6}}$, then there is a significant difference between R_i and R_j

In the above formula:

- R_j and R_k = sum of the j^{th} and k^{th} treatment ranks
- z = value in the inverse normal distribution corresponding to 2.12 for this study (k = 3).
- b = number of patients
- k = number of treatments

For the Dunn's procedure in group A: z = 2.12, b =22 , k = 30, therefore:

$$|R_j - R_k| \geq 2.12\sqrt{\frac{22(3)(3+1)}{6}}$$

$$|R_j - R_k| \geq 14.06$$

For the Dunn's procedure in group B: z = 2.12, b =18 , k = 30, therefore:

$$|R_j - R_k| \geq 2.12\sqrt{\frac{18(3)(3+1)}{6}}$$

$$|R_j - R_k| \geq 12.72$$

4.4.2.4 a) Dunn's procedure for the algometer results of group A

The sum of the treatment ranks are:

Rank 1 (R1) = 27.5
Rank 3 (R3) = 44.4
Rank 5 (R5) = 60.06

Therefore,

$|R1 - R3| = |27.5 - 44.4| = 16.9$
$|R1 - R5| = |27.5 - 60.06| = 32.56$
$|R3 - R5| = |44.4 - 60.06| = 15.66$

- Comparing treatment 1 and 3, $16.9 \geq 14.06$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $32.56 \geq 14.06$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $15.66 \geq 14.06$. Therefore there was a difference between treatment 3 and 5.

b) Dunn's procedure for the algometer readings of group B

The sum of the treatment ranks are:

Rank 1 (R1) = 21.42
Rank 3 (R3) = 39.96
Rank 5 (R5) = 46.44

Therefore,

$|R1 - R3| = |21.42 - 39.96| = 18.54$
$|R1 - R5| = |21.42 - 46.44| = 25.02$
$|R3 - R5| = |39.96 - 46.44| = 6.48$

- Comparing treatment 1 and 3, $18.54 \geq 12.72$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $25.02 \geq 12.72$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $6.48 < 12.72$. Therefore there was no difference between treatment 3 and 5.

4.4.2.5 a) Dunn's procedure for the numerical rating scale results of group A.

The sum of the treatment ranks are:

Rank 1 (R1) = 56.54
Rank 3 (R3) = 42.9
Rank 5 (R5) = 32.56

Therefore,

$|R1 - R3| = |56.54 - 42.9| = 13.64$
$|R1 - R5| = |56.54 - 32.56| = 23.98$
$|R3 - R5| = |42.9 - 32.56| = 10.34$

- Comparing treatment 1 and 3, 13.64 < 14.06. Therefore there was no difference between treatment 1 and 3.
- Comparing treatment 1 and 5, 23.98 ≥ 14.06. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, 10.34 < 14.06. Therefore there was no difference between treatment 3 and 5.

b) Dunn's procedure for the numerical rating scale readings of group B

The sum of the treatment ranks are:

Rank 1 (R1) = 49.5
Rank 3 (R3) = 36.54
Rank 5 (R5) = 21.96

Therefore,

$|R1 - R3| = |49.5 - 39.96| = 12.96$
$|R1 - R5| = |49.5 - 21.96| = 27.54$
$|R3 - R5| = |36.54 - 21.96| = 14.58$

- Comparing treatment 1 and 3, 12.96 ≥ 12.72. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, 27.54 ≥ 12.72. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, 14.58 ≥ 12.72. Therefore there was a difference between treatment 3 and 5.

4.4.2.6 a) Dunn's procedure for the Oswestry results of group A

The sum of the treatment ranks are:

Rank 1 (R1) = 64.02
Rank 3 (R3) = 36.52
Rank 5 (R5) = 31.46

Therefore,

$|R1 - R3| = |64.02 - 36.52| = 27.5$
$|R1 - R5| = |64.02 - 31.46| = 32.56$
$|R3 - R5| = |36.52 - 31.46| = 5.06$

- Comparing treatment 1 and 3, $27.5 \geq 14.06$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $32.56 \geq 14.06$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $5.06 < 14.06$. Therefore there was no difference between treatment 3 and 5.

b) Dunn's procedure for the Oswestry readings of group B

The sum of the treatment ranks are:

Rank 1 (R1) = 23.94
Rank 3 (R3) = 34.02
Rank 5 (R5) = 50.04

Therefore,

$|R1 - R3| = |23.94 - 34.02| = 16.02$
$|R1 - R5| = |23.94 - 50.04| = 26.08$
$|R3 - R5| = |34.02 - 50.04| = 10.08$

- Comparing treatment 1 and 3, $16.02 \geq 12.72$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $26.08 \geq 12.72$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $10.08 < 12.72$. Therefore there was no difference between treatment 3 and 5.

4.4.2.7 a) Dunn's procedure for the orthopaedic rating scale results of group A

The sum of the treatment ranks are:

Rank 1 (R1) = 60.5
Rank 3 (R3) = 44.44
Rank 5 (R5) = 27.06

Therefore,

$|R1 - R3| = |60.5 - 44.44| = 16.06$
$|R1 - R5| = |60.5 - 27.06| = 33.44$
$|R3 - R5| = |44.44 - 27.06| = 17.38$

- Comparing treatment 1 and 3, $16.06 \geq 14.06$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $33.44 \geq 14.06$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $17.38 \geq 14.06$. Therefore there was a difference between treatment 3 and 5.

b) Dunn's procedure for the orthopaedic rating scale readings of group B

The sum of the treatment ranks are:

Rank 1 (R1) = 48.42
Rank 3 (R3) = 35.46
Rank 5 (R5) = 23.94

Therefore,

$|R1 - R3| = |48.42 - 35.46| = 12{,}96$
$|R1 - R5| = |48.42 - 23.94| = 24.48$
$|R3 - R5| = |35.46 - 23.94| = 11.52$

- Comparing treatment 1 and 3, $12.96 \geq 12.72$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $24.48 \geq 12.72$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $11.52 < 12.72$. Therefore there was no difference between treatment 3 and 5.

4.4.3 Non-parametric testing: Sacroiliac syndrome

4.4.3.1 Inter-group analysis: Mann-Whitney test

	GROUP A			GROUP B	
	Mean rank	Sum of ranks	p-value	Mean rank	Sum of ranks
ALG 1	11.69	93.5	**0.463**	9.71	116.5
ALG 3	11.5	92	**0.536**	9.83	118
ALG 5	12.44	99.5	**0.230**	9.21	110.5

Table 19: Comparison of groups A and B using the results of algometer readings in consultations 1, 3 and 5 for sacroiliac syndrome.

The null hypothesis was accepted for the algometer readings indicating that at the $\propto$ = 0.05 level of significance there was no difference between the two groups at the first, third and fifth consultations for sacroiliac syndrome.

	GROUP A			GROUP B	
	Mean rank	Sum of ranks	p-value	Mean rank	Sum of ranks
NRS 1	12.69	101.5	**0.169**	9.04	108.5
NRS 3	9.94	79.5	**0.722**	10.88	130.5
NRS 5	10.31	82.5	**0.907**	10.63	127.5

Table 20: Comparison of groups A and B using the results of NRS readings in consultations 1, 3 and 5 for sacroiliac syndrome.

The null hypothesis was accepted for the numerical rating scale readings indicating that at the $\propto$ = 0.05 level of significance there was no difference

between the two groups at the first, third and fifth consultations for sacroiliac syndrome.

	GROUP A			GROUP B	
	Mean rank	Sum of ranks	p-value	Mean rank	Sum of ranks
OSW 1	11.06	88.5	**0.728**	10.13	121.5
OSW 3	11.69	93.5	**0.459**	9.71	116.5
OSW 5	10.38	83	**0.938**	10.58	127

Table 21: Comparison of groups A and B using the results of Oswestry readings in consultations 1, 3 and 5 for sacroiliac syndrome.

The null hypothesis was accepted for the revised Oswestry questionnaire readings indicating that at the $\propto = 0.05$ level of significance there was no difference between the two groups at the first, third and fifth consultations.

	GROUP A			GROUP B	
	Mean rank	Sum of ranks	p-value	Mean rank	Sum of ranks
ORS 1	12.69	101.5	**0.129**	9.04	108.5
ORS 3	10.88	87	**0.811**	10.25	123
ORS 5	11.5	92	**0.507**	9.83	118

Table 22: Comparison of groups A and B using the results of ORS readings in consultations 1, 3 and 5 for sacroiliac syndrome.

The null hypothesis was accepted for the orthopaedic rating scale readings indicating that at the $\propto = 0.05$ level of significance there was no difference between the two groups at the first, third and fifth consultations for sacroiliac syndrome.

4.4.3.2 Intra-group analysis: Friedman's T test for sacroiliac syndrome

ALGOMETER	GROUP A			GROUP B		
TREATMENT NUMBER	1	3	5	1	3	5
MEAN RANK	1.31	1.88	2.81	1.25	2.33	2.42
SUM OF RANKS	10.41	15.04	22.48	15	27.96	29.04
P-VALUE	**0.007**			**0.006**		

Table 23: Results of Friedman's T test on algometer results to determine whether there is a significant difference between consultations 1, 3 and 5 within group A and B for sacroiliac syndrome.

The null hypothesis was rejected for both groups A and B indicating that, in both groups, there was a difference between consultation 1, 3 and 5 with regards to the algometer results.

NRS-101	GROUP A			GROUP B		
TREATMENT NUMBER	1	3	5	1	3	5
MEAN RANK	2.94	1.81	1.25	2.75	1.92	1.33
SUM OF RANKS	23.52	14.49	10	33	23.04	15.96
P-VALUE	**0.002**			**0.001**		

Table 24: Results of Friedman's T test on NRS-101 results to determine whether there is a significant difference between consultations 1, 3 and 5 within group A and B for sacroiliac syndrome.

The null hypothesis was rejected for both groups A and B indicating that, in both groups, there was a difference between consultation 1, 3 and 5 with regards to the numerical rating scale results for sacroiliac syndrome.

OSWESTRY	GROUP A			GROUP B		
TREATMENT NUMBER	1	3	5	1	3	5
MEAN RANK	2.88	1.67	1.46	3	1.75	1.25
SUM OF RANKS	36.54	20.04	17.52	24	14	10
P-VALUE	**0.001**			**0.002**		

Table 25: Results of Friedman's T test on Oswestry results to determine whether there is a significant difference between consultations 1, 3 and 5 within group A and B for sacroiliac syndrome.

The null hypothesis was rejected for both groups A and B indicating that, in both groups, there was a difference between consultation 1, 3 and 5 with regards to the revised Oswestry low back pain questionnaire results for sacroiliac syndrome.

ORS	GROUP A			GROUP B		
CONSULTATION NUMBER	1	3	5	1	3	5
MEAN RANK	3	1.75	1.25	2.92	1.92	1.17
SUM OF RANKS	24	14	10	35.04	23.04	14.04
P-VALUE	**0.000**			**0.000**		

Table 26: Results of Friedman's T test on ORS results to determine whether there is a significant difference between consultations 1, 3 and 5 within group A and B for sacroiliac syndrome.

The null hypothesis was rejected for both groups A and B indicating that, in both groups, there was a difference between consultation 1, 3 and 5 with regards to the orthopaedic rating scale results.

4.4.3.3 Dunn's procedure for use with Friedman's test

Dunn's procedure decision rule:

If $|R_j - R_k| \geq z\sqrt{\frac{bk(k+1)}{6}}$, then there is a significant difference between R_i and R_j

In the above formula:

- R_j and R_k = sum of the j^{th} and k^{th} treatment ranks
- z = value in the inverse normal distribution corresponding to 2.12 for this study (k = 3).
- b = number of patients
- k = number of treatments

For the Dunn's procedure in group A: z = 2.12, b = 8 , k = 30, therefore:

$$|R_j - R_k| \geq 2.12\sqrt{\frac{8(3)(3+1)}{6}}$$

$$|R_j - R_k| \geq 8.48$$

For the Dunn's procedure in group B: z = 2.12, b =12 , k = 30, therefore:

$$|R_j - R_k| \geq 2.12\sqrt{\frac{12(3)(3+1)}{6}}$$

$$|R_j - R_k| \geq 10.39$$

4.4.3.4 a) Dunn's procedure for the algometer results of group A

The sum of the treatment ranks are:

Rank 1 (R1) = 10.41
Rank 3 (R3) = 15.04
Rank 5 (R5) = 22.48

Therefore,

$|R1 - R3| = |10.41 - 15.04| = 4.63$
$|R1 - R5| = |10.41 - 22.48| = 12.07$
$|R3 - R5| = |15.04 - 22.48| = 7.44$

- Comparing treatment 1 and 3, 4.63 < 8.48. Therefore there was no difference between treatment 1 and 3.
- Comparing treatment 1 and 5, 12.07 ≥ 8.48. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, 7.44 < 8.48. Therefore there was no difference between treatment 3 and 5.

b) Dunn's procedure for the algometer readings of group B

The sum of the treatment ranks are:

Rank 1 (R1) = 15
Rank 3 (R3) = 27.96
Rank 5 (R5) = 29.04

Therefore,

$|R1 - R3| = |15 - 27.96| = 12.96$
$|R1 - R5| = |15 - 29.04| = 14.04$
$|R3 - R5| = |27.96 - 29.04| = 1.08$

- Comparing treatment 1 and 3, 12.96 ≥ 10.39. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, 14.04 ≥ 10.39. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, 1.08 < 10.39. Therefore there was no difference between treatment 3 and 5.

4.4.3.5 a) Dunn's procedure for the numerical rating scale results of group A.

The sum of the treatment ranks are:

Rank 1 (R1) = 23,52
Rank 3 (R3) = 14.49
Rank 5 (R5) = 10

Therefore,

$|R1 - R3| = |23.52 - 14.49| = 9.03$
$|R1 - R5| = |23.52 - 10| = 13.52$
$|R3 - R5| = |14.49 - 10| = 4.49$

- Comparing treatment 1 and 3, $9.03 \geq 8.48$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $13.52 \geq 8.48$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $4.49 < 14.06$. Therefore there was no difference between treatment 3 and 5.

b) Dunn's procedure for the numerical rating scale readings of group B

The sum of the treatment ranks are:

Rank 1 (R1) = 33
Rank 3 (R3) = 23.04
Rank 5 (R5) = 15.96

Therefore,

$|R1 - R3| = |33 - 23.04| = 9.96$
$|R1 - R5| = |33 - 15.96| = 17.04$
$|R3 - R5| = |23.04 - 15.96| = 7.08$

- Comparing treatment 1 and 3, $9.96 < 10.39$. Therefore there was no difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $17.04 \geq 10.39$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $7.08 < 10.39$. Therefore there was no difference between treatment 3 and 5.

4.4.3.6 a) Dunn's procedure for the Oswestry results of group A

The sum of the treatment ranks are:

Rank 1 (R1) = 24
Rank 3 (R3) = 14
Rank 5 (R5) = 10

Therefore,

$|R1 - R3| = |24 - 14| = 10$

$|R1 - R5| = |24 - 10| = 14$
$|R3 - R5| = |14 - 10| = 4$

- Comparing treatment 1 and 3, $10 \geq 8.48$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $14 \geq 8.48$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $4 < 8.48$. Therefore there was no difference between treatment 3 and 5.

b) Dunn's procedure for the Oswestry readings of group B

The sum of the treatment ranks are:

Rank 1 (R1) = 34.56
Rank 3 (R3) = 20.04
Rank 5 (R5) = 17.52

Therefore,

$|R1 - R3| = |34.56 - 20.04| = 14.52$
$|R1 - R5| = |34.56 - 17.52| = 17.04$
$|R3 - R5| = |20.04 - 17.52| = 2.52$

- Comparing treatment 1 and 3, $14.52 \geq 10.39$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $17.04 \geq 10.39$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $2.52 < 10.39$. Therefore there was no difference between treatment 3 and 5.

4.4.3.7 a) Dunn's procedure for the orthopaedic rating scale results of group A

The sum of the treatment ranks are:

Rank 1 (R1) = 24
Rank 3 (R3) = 14
Rank 5 (R5) = 10

Therefore,

$|R1 - R3| = |24 - 14| = 10$
$|R1 - R5| = |24 - 10| = 14$
$|R3 - R5| = |14 - 10| = 4$

- Comparing treatment 1 and 3, $10 \geq 8.48$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $14 \geq 8.08$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $4 < 8.08$. Therefore there was no difference between treatment 3 and 5.

b) Dunn's procedure for the orthopaedic rating scale readings of group B

The sum of the treatment ranks are:

Rank 1 (R1) = 35.04
Rank 3 (R3) = 23.04
Rank 5 (R5) = 14.04

Therefore,

$|R1 - R3| = |35.04 - 23.04| = 12$
$|R1 - R5| = |35.04 - 14.04| = 21$
$|R3 - R5| = |23.04 - 14.04| = 9$

- Comparing treatment 1 and 3, $12 \geq 10.39$. Therefore there was a difference between treatment 1 and 3.
- Comparing treatment 1 and 5, $21 \geq 10.39$. Therefore there was a difference between treatment 1 and 5.
- Comparing treatment 3 and 5, $9 < 10.39$. Therefore there was no difference between treatment 3 and 5.

CHAPTER FIVE: DISCUSSION

5.1 INTRODUCTION

This chapter will discuss the results obtained from the subjective and objective data presented in chapter four. Demographic data of the patient population will also be discussed. General trends of acute mechanical low back pain, lumbar facet syndrome and sacroiliac syndrome will be analysed.

Evaluation of the inter-group data for the first consultation demonstrates any difference between the two treatment groups, in terms of their initial signs and symptoms, before treatment begins. The third and fifth consultation inter-group information determines whether there was any difference between the two groups during or at the end of the treatment.

Evaluation of the intra-group data gives an indication of the effectiveness of each treatment approach from the first to third, first to fifth and third to fifth consultations.

5.2 DEMOGRAPHICS

The majority of patients (33 out of 60) fell within the age group of 35-56 which is roughly the age group most commonly affected by low back pain (Deyo and Weinstein, 2001: 363). However, as can be seen in figure 1, group A has an older distribution of ages in comparison with group B. This could have resulted in a slower recovery rate in group A, as age has a negative correlation with recovery from low back pain (Andersson, 1999: 583). This may have skewed the results producing a more favourable outcome for group B for the short recovery period (2 weeks) allowed in this study.

Gender distribution between each group was roughly equal (figure 2) although males made up 65% of the patient population and females 35% purely by coincidence.

Smoking has been significantly associated with low back pain episodes (Pope et al. 1991:141). Figure 3 illustrates that although current smokers only made up 20% of the patient population, group B had twice as many smokers as group A. This may have skewed results to a degree in favour of group A.

It is interesting to note that about 88% of the patient population (roughly equal distribution between groups) had experienced at least one episode of low back pain in the past (figure 4). This finding is supported by studies which estimate that 85 % of people who have had an episode of back pain experience at least one recurrence of their low back pain during their lifetime (Andersson, 1999: 583).

Physical fitness has been shown to have preventative effects on back injuries and may speed recovery (Pope et al. 1991: 137). Group A (figure 5) had a smaller proportion of patients participating in regular exercise (43% vs 57% in group B) and this may have meant that recovery would be slower overall in group A, skewing the results in favour of group B.

A wide representation of the various occupations was found across the two groups (table 1). Almost 87% of the patient population were employed and there were no significant biases towards one occupation in either of the groups.

The sacroiliac syndrome was found to present in about 33% of the patient population, which is a proportion similar to the 30% given by Schwarzer et al. (1995) who demonstrated that the sacroiliac joint was a likely cause of low back pain. Figure 6 does not describe those patients who may have had elements of both syndromes as the predominant syndrome (according to the orthopaedic

rating scale) was chosen. This may have affected results as resolution of the most prominent syndrome may have left the other less prominent one unresolved and therefore the patient still reports some degree of pain.

The average duration of low back pain in each group was almost equal (5.8 weeks versus 5.7 weeks) which reduced bias towards one group in terms of duration of the complaint.

Overall, age and physical fitness factors favoured a quicker recovery for group B and the smoking factor favoured group A. However, it is difficult to give a weighting to these factors to determine to what degree the groups were affected, i.e. was one group significantly affected. Although statistical analysis was not done, there did not seem to be a significant difference between the groups in terms of gender distribution, duration of complaint and occupation.

5.3 ACUTE MECHANICAL LOW BACK PAIN

5.3.1 Inter-group analysis

The subjective statistical results (ROLBPQ and NRS-101) showed no statistically significant difference between group A and group B (see table 4 and 5) at consultations one, three and five.

The objective statistical results (algometer and ORS) also showed no statistically significant difference between group A and group B (see table 3 and 6) at consultations one, three and five.

These results indicate that, in terms of acute mechanical low back pain, the combination of manipulation with interferential therapy in this study showed no benefit over manipulation only for improving the pain and disability of the low back. This is true only for the short term of the treatment period as no long term

follow-up was done. It must also be considered that different IFT treatment periods and frequency settings may have produced more favourable results. Chronic low back pain may also produce different results using the same treatment protocol. These conditions need to be tested in further studies of this nature. These results may also have been biased due to the lack of blinding of the researcher and patients. Two extremes should also be considered. Firstly, manipulation may have been so effective in each group that the possible effect of IFT was reduced. Secondly, both treatment protocols may have been completely ineffective and all improvements may have been due to natural history and/or placebo effects. A placebo control group may have been able, at least partly, to answer this problem.

5.3.2 Intra-group analysis

Subjective measures:

Statistical results of the NRS readings (table 8) for group A indicate a significant improvement between consultation 1 and 3, and 1 and 5 but not between consultation 3 and 5. NRS results for group B indicate a significant improvement between all consultations.

Statistical results of the ROLBPQ readings (table 9) for group A and B indicate a significant improvement between consultation 1 and 3, and 1 and 5 but not between consultation 3 and 5.

Objective measures:

Statistical results of the algometer readings (table 7) for group A indicate a significant improvement between all consultations. Algometer results for group B indicate a significant improvement between consultation 1 and 3, and 1 and 5 but not between consultation 3 and 5.

Statistical results of the ORS readings (table 10) for group A and B indicate a significant improvement between all consultations.

Overall, significant improvements in pain and disability for both subjective and objective measures were shown to have occurred for both groups A and B over the treatment period. However, in general, greater improvements occurred between consultation 1 and 3 than between 3 and 5, suggesting that most of the benefit of treatment arises early on during the first few treatments. Without the use of a control group in this study it is difficult to comment on the significance of these improvements as they may have been, at least in part, due to the natural history of low back pain or due to the placebo effect of each treatment protocol. It is also not possible to determine whether these improvements would have been maintained in the longer term without a long term follow-up.

5.4 LUMBAR FACET SYNDROME

5.4.1 Inter-group analysis

The subjective statistical results (ROLBPQ and NRS) showed no significant difference between group A and B at the first, third and fifth consultations (table 12 and 13).

The objective statistical results (algometer and ORS) also showed no significant difference between group A and B at the first third and fifth consultations (see table 11 and 14).

These results indicate that, in terms of lumbar facet syndrome, the combination of manipulation and interferential therapy in this study had no benefit over manipulation only for improving pain and disability of the low back in the short term. Again, protocol changes and treatment of chronic pain rather than acute pain may have produced different results.

5.4.2 Intra-group analysis

Subjective measures:

Statistical results of the NRS readings (table 16) for group A indicate a significant improvement between consultation 1 and 5 but not between consultation 1 and 3 and 3 and 5. NRS results for group B indicate a significant improvement between all consultations.

Statistical results of the ROLBPQ readings (table 17) for group A and B indicate a significant improvement between consultation 1 and 3, and 1 and 5 but not between consultation 3 and 5.

Objective measures:

Statistical results of the algometer readings (table 15) for group A indicate a significant improvement between all consultations. Algometer results for group B indicate a significant improvement between consultation 1 and 3, and 1 and 5 but not between consultation 3 and 5.

Statistical results of the ORS readings (table 18) for group A indicate a significant improvement between all consultations. ORS results for group B indicate a significant improvement between consultation 1 and 3, and 1 and 5 but not between consultation 3 and 5.

Overall, significant improvements in pain and disability for both subjective and objective measures were shown to have occurred for both groups A and B. However, in general, greater improvements occurred between consultation 1 and 3 than between 3 and 5 as was seen for MLBP as a whole. It is possible that an underlying mild or subclinical sacroiliac syndrome may have affected the degree of improvement in each lumbar facet syndrome subgroup.

5.5 SACROILIAC SYNDROME

5.5.1 Inter-group analysis

The subjective statistical results (ROLBPQ and NRS) showed no significant difference between group A and B at the first, third and fifth consultations (table 20 and 21).

The objective statistical results (algometer and ORS) also showed no significant difference between group A and B at the first third and fifth consultations (see table 19 and 22).

These results indicate that, in terms of sacroiliac syndrome, the combination of manipulation and interferential therapy in this study had no benefit over manipulation only for improving pain and disability of the low back in the short term. Therefore, those patients with sacroiliac syndrome did not fare better or worse than those with lumbar facet syndrome using this treatment protocol. However, the patient numbers in the sacroiliac subgroups were relatively small relative to the lumbar facet syndrome subgroups and MLBP groups overall. Equal and larger numbers of each syndrome would be a better indicator of whether one syndrome is affected differently from the other using this treatment protocol.

5.4.2 Intra-group analysis

Subjective measures:

Statistical results of the NRS readings (table 24) for group A indicate a significant improvement between consultation 1 and 3 and 1 and 5, but not between consultation 3 and 5. NRS results for group B indicate a significant improvement between consultation 1 and 5 but not between 1and 3 and 3 and 5.

Statistical results of the ROLBPQ readings (table 25) for group A and B indicate a significant improvement between consultation 1 and 3, and 1 and 5 but not between consultation 3 and 5.

Objective measures:

Statistical results of the algometer readings (table 23) for group A indicate a significant improvement between consultation 1 and 5, but not between consultation 1 and 3 and 3 and 5. Algometer results for group B indicate a significant improvement between consultation 1 and 3, and 1 and 5 but not between consultation 3 and 5.

Statistical results of the ORS readings for groups A and B indicate a significant improvement between consultation 1 and 3, and 1 and 5 but not between consultation 3 and 5.

Overall, significant improvements in pain and disability for both subjective and objective measures were shown to have occurred for both groups A and B. However, in general, the improvements between consultation 1 and 3 and 3 and 5 were less marked than in the acute MLBP and lumbar facet syndromes. This was probably due to the smaller sample sizes in the sacroiliac syndrome subgroups. It is also possible that an underlying mild or subclinical lumbar facet syndrome may have affected the degree of improvement in each sacroiliac syndrome subgroup.

5.6 COMPARISON WITH SIMILAR STUDIES

An as yet unpublished 2001 study by Hurwitz et al. (as cited by Chapman-Smith, 2001: 1) examined 681 patients with current acute or chronic low back pain. The patients were randomly assigned to 1 of 2 groups. The first group received

chiropractic care in the form of spinal manipulation, instruction in strengthening and flexibility exercises and instruction in proper back care. No modalities were used. Group 2 received the same chiropractic care as group 1 with physical modalities added at the discretion of the chiropractor. These modalities included heat or cold therapy, ultrasound and electrical muscle stimulation.

No clinically significant differences between the groups were found in terms of pain and disability outcomes. However, patients in group 2 receiving physical modalities did report a higher satisfaction with treatment, although cost was significantly higher. The researchers did acknowledge that individual physical therapies might well be effective for certain patients.

The results for the Hurwitz study are in accordance with this study for IFT and spinal manipulation. However, no measure was taken for patient satisfaction for comparison with the Hurwitz trial, although it is this researcher's impression that a similar finding would have been obtained. One of the weaknesses of the Hurwitz study is that modalities were not studied individually. This means more effective modalities may have been masked by less effective ones.

5.7 PROBLEMS WITH THE SUBJECTIVE DATA

Although the numerical rating scale is relatively easy to use this does in turn make it easier for the patient to recall the previous rating and report improvements to please the examiner. The NRS scale was sometimes difficult to score for those patients only experiencing their pain under particular circumstances and not on a regular basis.

Some of the revised Oswestry low back pain questionnaire questions did not apply to some patients and other patients experienced difficulty in choosing between questions.

5.8 PROBLEMS WITH THE OJECTIVE DATA

The validity and reliability of the orthopaedic rating scale has not been investigated. The scale does not differentiate between a mild positive and a strong positive and therefore may not accurately reflect changes from one consultation to the next.

The placement of the algometer may not have been accurate enough between treatments through human error, thereby misrepresenting the tender areas. Patient reporting of the start of pain may have been affected by familiarity with the instrument in subsequent consultations and not reporting quickly enough.

It should be noted that all data measurements were carried out by a chiropractic student who was not experienced in the application of the tests or recording of the measurements.

CHAPTER SIX: RECOMMENDATIONS AND CONCLUSIONS

6.1 RECOMMENDATIONS

Blinding of researchers and patients should be utilized in order to reduce bias and make this study more scientifically acceptable. Separate examiners should be used to record findings and administer treatment with blinding of both examiners. Examiners with greater experience in examination procedures and application of treatment are preferable.

A one month or three month follow-up would have been preferable to determine the medium term benefits of either treatment, although this was not possible during this study owing to time constraints. This may however reduce patient compliance and require a larger sample size.

The validity and reliability of the orthopaedic rating scale should be investigated to justify its use in future studies. Failing this an alternative scale should be sought which has been tested.

A control group should be used in future studies to determine the true benefits of each treatment protocol. This would allow for the natural history of low back pain and the placebo effect of the two treatment protocols to be controlled.

A future study should consider examining sacroiliac syndrome or lumbar facet syndrome individually as each syndrome may react differently to the treatment protocols. Furthermore, chronic pain should be tested individually or against acute pain as the two types of pain may react differently to the same protocol.

Patient satisfaction is an important consideration in determining treatment protocols and a questionnaire to examine this factor would be of interest in future studies of this nature.

A similar study comparing IFT with TENS in terms of efficacy and cost-effectiveness is important as the TENS equipment is considerably less expensive than IFT.

6.2 CONCLUSIONS

This study attempted to determine whether manipulation combined with IFT would provide a more effective treatment protocol than manipulation only in the treatment of acute MLBP. Sixty patients were divided into two groups of thirty. Group A received manipulation and IFT and group B received manipulation only. Each group received 5 treatments over a 2 week period.

Statistical analysis at the 95 % confidence interval showed significant improvements in both groups over the treatment period for all subjective and objective measures. However, no significant differences could be found between the two groups at any of the measurement intervals for all subjective and objective measures.

These results indicate that manipulation combined with IFT may be no more effective than manipulation only in the treatment of acute MLBP. In the absence of evidence to the contrary this means that serious consideration should be used when utilizing this therapy for acute MLBP when less expensive alternatives are available. However, this study can only act as an indicator. More blinded, randomised, controlled trials are required before this modality is abandoned.

REFERENCES

Andersson, G. B. J. 1999. Epidemiological features of chronic low-back pain. Lancet, **354**: 581-85.

Bergmann, T. F., Peterson, D. H., Lawrence, D. J. 1993. Chiropractic Technique. New York: Churchill Livingstone.

Bigos, S., Bowyer, O., Braen, G., et al. 1994. Acute Low Back Problems in Adults. Clinical Practice Guideline No. 14. AHCPR Publication No. 95-0624. Rockville, MD: Agency for Health Care Policy and Research, Public Health Service, U.S. Department of Health and Human Services.

Bogduk, N. 1999. Clinical Anatomy of the Lumbar Spine and Sacrum. 3rd ed. London: Churchill Livingstone.

Bolton, J. E., Wilkinson, R. C. 1998. Responsiveness of pain scales: a comparison of three pain intensity measures in chiropractic patients. Journal of Manipulative and Physiological Therapeutics, **21**(1): 1-7.

Broadhurst, N. A., Bond, M. J. 1998. Pain provocation tests for the assessment of sacroiliac joint dysfunction. Journal of Spinal Disorders, 11(4): 341-345.

Cassidy, J. D. 1992. The Pathoanatomy and Clinical Significance of the Sacroiliac Joints. Journal of Manipulative and Physiological Therapeutics, **15**(1): 41-42.

Cavanaugh, J. M. 1995. Neural mechanisms of lumbar pain. Spine, **20**(16): 1804-1809.

Chapman-Smith, D. (ed.) 2000. Measuring results with patient questionnaires: why and how. The Chiropractic Report, **14**(4): 1-8.

Chapman-Smith, D. (ed.) 2001. LBP – Physical Modalities. The Chiropractic Report, **15**(4): 1-4.

Cherkin, D. C., Deyo, R. A., Battie, M., Street, J., Barlow, W. 1998. A comparison of physical therapy, chiropractic manipulation and provision of an educational booklet for the treatment of patients with low back pain. New England Journal of Medicine, **339**: 1021-9.

Christie, A. D., Willoughby, G. L. 1990. The effect of interferential therapy on swelling following open reduction and internal fixation of ankle fractures. Physiotherapy Theory and Practice, **6**: 3-7.

Corrigan, B., Maitland, G. D. 1998. Vertebral Musculoskeletal Disorders. Oxford: Reed Educational and Professional Publishing Ltd.

Coste, J., Delecoeuillerie, G.; Cohen de Lara, A., Le Parc, J.M., Paolaggi, J. B. 1994. Clinical course and prognostic factors in acute low back pain: an inception cohort study in primary care practice. British Medical Journal, **308**: 577-580.

Croft, P. R., Macfarlane, G. J., Papageorgiou, A. C., Thomas, E., Silman, A. J. 1998. Outcome of low back pain in general practice: a prospective study. British Medical Journal, **316**: 1356-1359.

Daniel, W. W. 1999. Biostatistics: A Foundation for Analysis in the Health Sciences. 7th ed. U.S.A: Wiley and Sons.

Deyo, R. A., Weinstein, J. N. 2001. Low Back Pain. New England Journal of Medicine, **344**: 363-370.

Di Fabio, R. P. 1992. Efficacy of manual therapy. Physical Therapy, 72(12): 853-864.

DonTigny, R. L. 1999. Critical analysis of the sequence and extent of the result of the pathological failure of self-bracing of the sacroiliac joint. The Journal of manual and Manipulative Therapy, 7(4): 173-181.

Dynatron 850 and Dynatron 550 Operator's Manual. 1996. Dynatronics® Corporation, 7030 Park Central Drive, Salt Lake City, Utah 84121, USA. 117.

Fairbank, J. C. T., Couper, J., Davies, J. B., O'Brien, J. P. 1980. The Oswestry Low Back Disability Questionnaire. Physiotherapy, **66**(8): 271-273.

Fischer, A. 1986. Pressure Threshold Meter: It's use for quantification of tender spots. Archives of Physical Medicine and Rehabilitation, **67**: 836-838.

Fisher, L. D., van Belle, G. 1993. Biostatistics: A Methodology for the Health Sciences. U.S.A: John Wiley and Sons.

Fourie, J. A., Bowerbank, P. 1997. Stimulation of bone healing in new fractures of the tibial shaft using interferential currents. Physiotherapy Research International, **2**(4): 255-268.

Gatterman, M. I. 1990. Chiropractic Management of Spine Related Disorders. Baltimore: Williams and Wilkins. ISBN 0643034383.

Giles, L. G. F. 1997. Zygapophysial (facet) joints. *In*: Giles, L. G. F., Singer, K. P. (eds.) Volume 1: Clinical Anatomy and Management of Low Back Pain. Oxford: Butterworth-Heinemann. pp.72-96.

Giles, L. G. F., and Crawford, C. M. 1997. Sacroiliac Joint. *In*: Giles, L. G. F., Singer, K. P. (eds.) Volume 1: Clinical Anatomy and Management of Low Back Pain. Oxford: Butterworth-Heinemann. pp.173-182.

Goats, G. C. 1990. Interferential current therapy. British Journal of Sports Medicine, **24**(2): 87-92.

Haas, M., Jacobs, G. E., Raphael, R., Petzing, K. 1995. Low back pain outcome measurement assessment in chiropractic teaching clinics: responsiveness and applicability of two functional disability questionnaires. Journal of Manipulative and Physiological Therapeutics, **18**(2): 79-87.

Helbig, T., Lee, C. K. 1988. The lumbar facet syndrome. Spine,**13**(1): 61-64.

Hendler, N., Kozikowski, J. G., Morrison, C., Sethuraman, G. 1995. Diagnosis and Management of Sacroiliac Joint Disease. Journal of the Neuromusculoskeletal System, **3**(4): 169-174.

Hertzog, W., Read, L. J., Conway, P. J. W., Shaw, L. D., McEwen, M. C. 1989. Reliability of motion palpation procedures to detect sacroiliac joint fixations. Journal of Manipulative and Physiological Therapeutics, **12**(2):86-91.

Hourigan, C. L., Bassett, J. D. 1989. Facet syndrome: Clinical signs, symptoms, diagnosis and treatment. Journal of Manipulative and Physiological Therapeutics, **12**(4): 293-297.

Hsieh, C. J., Phillips, R. B., Adams, A. H., Pope, M. H. 1992. Functional outcomes of low back pain: comparison of four treatment groups in a randomized controlled trial. Journal of Manipulative and Physiological Therapeutics, **15**(1): 4-9.

Hurley, D. A., Minder, P. M., McDonough, S. M., Walsh, D. M., Moore, A. P., Baxter, D. G. 2001. Interferential therapy electrode placement technique in acute low back pain: a preliminary investigation. Archives of Physical Medicine and Rehabilitation, **82**(4): 485-93.

Johnson, M. I., Wilson, H. 1997. The analgesic effects of different swing patterns of interferential currents on cold-induced pain. Physiotherapy, **83**(9): 461-467.

Johnson, M. I. 1999. The use of interferential currents when used to manage pain. Physiotherapy, **85**(6): 294-297.

Kahn, J. 1994. Principles and Practice of Electrotherapy. 3rd ed. New York: Churchill Livingstone.

Kirkaldy-Willis, W. H., Burton, C. V. 1992. Managing Low Back Pain. 3rd ed. New York: Churchill Livingstone. ISBN 044308789.

Koes, B. W., Bouter, L. M., van Mameren, H., Essers, A. H. M., Verstegen, G. M. R., Hofhuizen, D. M., Houben, J. P., Knipschild, P. G. 1992. The effectiveness of manual therapy, physiotherapy and treatment by general practitioner for nonspecific neck and back complaints: A randomised clinical trial. Spine, **17**:28-35.

Koes, B. W., Assendelft, W. J., van der Heijden, G. J., Bouter, L. M. 1996. Spinal Manipulation for Low Back Pain. An updated systematic review of randomized clinical trials. Spine, **21**(24): 2860-2871.

Laslett, M., and Williams, M. 1994. The reliability of selected provocation tests for sacroiliac joint pathology. Spine, **9**(11): 1243-1249.

Leboeuf-Yde, C., Lauritson, J. M., Lauritson, T. 1997. Why has the search for the causes of low back pain largely been nonconclusive? Spine, **22**: 877-881.

Lewit, K., Liebenson, C. 1993. Palpation - problems and implications. Journal of Manipulative and Physiological Therapeutics, **16**(9): 586-590.

Liebenson, C., Chapman, S. 1999. Motion palpation: it's time to accept the evidence [letter, in reply]. Journal of Manipulative and Physiological Therapeutics, **22**(9): 631-632.

Magee, D. J. 1992. Orthopaedic Physical Assessment. 2nd ed. Philadelphia: W B Saunders Company. 655p. ISBN 0721643442

Martin, D. 1998. Interferential Therapy. *In*: Kitchen, S., Bazin, S. (eds.) Clayton's Electrotherapy. 10th ed. Great Britain: WB Saunders Company Ltd.

McCulloch, J. A., Transfeldt, E. E. 1997. Macnab's Backache. 3rd ed. Baltimore: Williams & Wilkins.

Meade, T. W., Dyer, S., Browne, W., Townsend, J., Frank A. O. 1990. Low back pain of mechanical origin: randomised comparison of chiropractic and hospital outpatient treatment. British Medical Journal, **300**: 1431-7.

Meade, T. W., Dyer, S., Browne, W., Townsend, J., Frank A. O. 1995. Randomised comparison of chiropractic and hospital outpatient management for low back pain: results from extended follow up. British Medical Journal, **311**: 349-351.

Meijne, W., van Neerbos, K., Aufdemkampe, G., van der Wurff, P. 1999. Intraexaminer and interexaminer reliability of the Gillet test. Journal of Manipulative and Physiological Therapeutics, **22**(1): 4-9.

Noble, J. G., Henderson, G., Cramp, A. F. L., Walsh, D. M., Lowe, A. S. 2000. The effect of interferential therapy upon cutaneous blood flow in humans. Clinical Physiology, **20**(1): 2-7.

Nussbaum, E. L., and Downes, L. 1998. Reliability of Clinical Pressure-Pain Algometric Measurements Obtained on Consecutive Days. Physical Therapy, **78**(2):160-169.

Palmer, S. T., Martin, D. J., Steedman, W. M., Ravey, J. 1999. Alteration of interferential current and transcutaneous electrical nerve stimulation frequency: effects on nerve excitation. Archives of Physical Medicine and Rehabilitation, **80**: 1065-1071.

Panzer, D. M. 1992. The reliability of lumbar motion palpation. Journal of Manipulative and Physiological Therapeutics, **15**(8): 518-524.

Pope, M. H., Andersson, G. B., Frymoyer, J. W., Chaffin, D. B. 1991. Occupational Low Back Pain. St. Louis: Mosby-year book.

Pope, G. D., Mockett, S. P., Wright, J. P. 1995. A survey of the electrotherapeutic modalities: ownership and use in the NHS in England. Physiotherapy, **81**(2): 82-91.

Redwood, D. (ed.) 1997. Contemporary Chiropractic. New York: Churchill Livingstone.

Robertson, V. J., Spurritt, D. 1998. Electrophysical agents: Implications of their availability and use in undergraduate clinical placements. Physiotherapy, **84**(7): 335-344.

Schafer, R. C. and Faye, L. J. 1990. Motion Palpation and Chiropractic Technique. 2nd Ed. Huntington Beach, California, The Motion Palpation Institute. ISBN 0924889004.

Schwarzer, A. C., Aprill, C. N., Derby, R. Fortin, J., Kine, G., Bogduk, N. 1994. Clinical features of patients with pain stemming from the lumbar zygapophysial joints. Spine, **19**(10): 1132-1137.

Schwarzer, A. C., Aprill, C. N., Bogduk, N. 1995. The sacroiliac joint in chronic low back pain. Spine, **20**(1): 31-37.

Shekelle, P. G. 1994. Spine Update: Spinal Manipulation. Spine, **19**(7): 858-861.

Shekelle, P. G., Coulter, I., Hurwitz, E.L., Genovese, B., Adams, A. H., Mior, S. A., Brook, R. H. 1998. Congruence between decisions to initiate chiropractic spinal manipulation for low back pain and appropriateness criteria in North America. Annals of Internal Medicine, **129**: 9-17.

Skovron, M. L. 1992. Epidemiology of low back pain. Bailliere's Clinical Rheumatology, **6**(3): 559-573.

Stephenson, R., Johnson, M. 1995. The analgesic effects of interferential therapy on cold-induced pain in healthy subjects: a preliminary report. Physiotherapy Theory and Practice, **11**(2): 89-95.

Tabasam, G., Johnson, M. I. 1999. Electrotherapy for pain relief: does it work? A laboratory-based study to examine the analgesic effects of electrotherapy on cold-induced pain in healthy individuals. Clinical effectiveness in nursing, **3**: 14-21.

Troyanovich, S. J., Harrison, D. D., Harrison, D. E. 1998. Motion Palpation: it's time to accept the evidence. Journal of Manipulative and Physiological Therapeutics, **21**: 568-571.

Van der Meulen, A. G. 1997. An epidemiological investigation of low back pain in a formal black South African township. M.Tech: Chiropractic dissertation, Technikon Natal, Durban, South Africa.

van Tulder, M. W., Koes, B. W., Bouter, L. M. 1997. Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions. Spine, **22**: 2128-2156.

Waddell, G. 2000. The Back Pain Revolution. London: Churchill Livingstone. ISBN 0 443 060398.

Walker, B. F., Buchbinder, R. 1997. Most commonly used methods of detecting spinal subluxation and the preferred term for its description: a survey of chiropractors in Victoria Australia. Journal of Manipulative and Physiological Therapeutics, **20**(9): 583-589.

Watson, T. 2000. The role of electrotherapy in contemporary physiotherapy practice. Manual Therapy, **5**(3): 132-141.

Werners, R., Pynsent, P. B., Bulstrode, C. J. 1999. Randomized clinical trial comparing interferential therapy with motorized lumbar traction and massage in the management of low back pain in a primary care setting. Spine, **24**(15): 1579-84.

White, R. H. 2001. The effectiveness of combined nonsteroidal anti-inflammatory drug therapy (Adco-Diclofenac) and manipulation compared to manipulation only in the treatment of low back pain. Mtech: Chiropractic dissertation, Technikon Natal, Durban, South Africa.

Wipf, J. E., Deyo, R. A. 1995. Low back pain. Medical clinics of North America, **79**(2): 231-237.

APPENDIX A

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.

_____

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.

_____

APPENDIX B

Revised Oswestry
Low back pain and Disability Questionaire

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

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

Section 2 - Personal Care

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

Section 3 - Lifting

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

Section 4 – Walking

☐I have no pain on walking.
☐I have some pain on walking but it does not increase with distance.
☐I cannot walk more than one mile without increasing pain.
☐I cannot walk more than ½ mile without increasing pain.
☐I cannot walk more than ¼ mile without increasing pain.
☐I cannot walk at all without increasing pain.

Section 5 – Sitting

☐I can sit in any chair as long as I like.
☐I can only sit in my favorite chair as long as I like.
☐Pain prevents me from sitting more than 1 hour.
☐Pain prevents me from sitting for more than ½ hour.
☐Pain prevents me from sitting for more than 10 minutes.
☐I avoid sitting because it increases pain straight away.

Section 6 - Standing

☐I can stand as long as I want without pain.
☐I have some pain on standing but it does not increase with time.
☐I cannot stand for longer than one hour without increasing pain.
☐I cannot stand for longer than ½ hour without increasing pain.
☐I cannot stand for longer than 10 minutes without increasing pain.
☐I avoid standing because it increases the pain straight away.

Section 7 –Sleeping

☐I get no pain in bed.
☐I get pain in bed but it does not prevent me from sleeping well.
☐Because of pain my normal night's sleep is reduced by less than ¼
☐Because of pain my normal night's sleep is reduced by less than ½
☐Because of pain my normal night's sleep is reduced by less than ¾
☐Pain prevents me from.sleeping at all.

Section 8 - Social life

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

Section 9 – Travelling

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

Section 10 - Changing degree of pain

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

Adapted from Hsieh et al 1992

APPENDIX C

TECHNIKON NATAL 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:** .....

All Conditions met in Visit No.:.....

To be signed into PTT:.....

Signature:..... **Date:** .....

Signed off:.....

Intern's Case History:

1. **Source of History:**

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

3. **Present Illness:**

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

4. **Other Complaints:**

5. **Past Medical History:**

- ▸ General Health Status
- ▸ Childhood Illnesses
- ▸ Adult Illnesses

- Psychiatric Illnesses
- Accidents/Injuries
- Surgery
- Hospitalizations

6. Current health status and life-style:

- Allergies
- Immunizations
- Screening Tests incl. xrays

- 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

APPENDIX D

TECHNIKON NATAL

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC

PHYSICAL EXAMINATION

Patient:_____File#: _____Date:_____
Clinician:_____Signature:_____
Intern:_____Signature:_____

1. VITALS

Pulse rate:
Respiratory rate:
Blood pressure: R L
Temperature:
Height:
Weight:

2. GENERAL EXAMINATION

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

Urinalysis:

3. CARDIOVASCULAR EXAMINATION

1) Is this patient in **Cardiac Failure ?**
2) Does this patient have signs of **Infective Endocarditis ?**
3) Does this patient have **Rheumatic Heart Disease ?**

Inspection - Scars
- Chest deformity:
- Precordial bulge:
- Neck -JVP:

Palpation: - Apex Beat (character + location):
- Right or left ventricular heave:
- Epigastric Pulsations:
- Palpable P2:
- Palpable A2:

Pulses:
- General Impression:
- Radio-femoral delay:
- Carotid:
- Radial:
- Dorsalis pedis:
- Posterior tibial:
- Popliteal:
- Femoral:

Percussion: - borders of heart

Auscultation: - heart valves (mitral, aortic, tricuspid, pulmonary)
- Murmurs (timing,systolic/diastolic, site, radiation, grade).

4. RESPIRATORY EXAMINATION

1) Is this patient in **Respiratory Distress ?**

Inspection
- Barrel chest:
- Pectus carinatum/cavinatum:
- Left precordial bulge:
- Symmetry of movement:
- Scars:

Palpation
- Tracheal symmetry:
- Tracheal tug:
- Thyroid Gland:
- Symmetry of movement (ant + post)
- Tactile fremitus:

Percussion
- Percussion note:
- Cardiac dullness:
- Liver dullness:

Auscultation
- Normal breath sounds bilat.:
- Adventitious sounds (crackles, wheezes, crepitations)
- Pleural frictional rub:
- Vocal resonance
  - Whispering pectoriloquy:
  - Bronchophony:
  - Egophony:

5. ABDOMINAL EXAMINATION

1) Is this patient in **Liver Failure ?**

Inspection
- Shape:
- Scars:
- Hernias:

Palpation
- Superficial:
- Deep = Organomegally:

- Masses (intra- or extramural)
- Aorta:

Percussion - Rebound tenderness:
- Ascites:
- Masses:

Auscultation - Bowel sounds:
- Arteries (aortic, renal, iliac, femoral, hepatic)

Rectal Examination
- Perianal skin:
- Sphincter tone & S4 Dermatome:
- Obvious masses:
- Prostate:
- Appendix:

6. G.U.T EXAMINATION

External genitalia:
Hernias:
Masses:
Discharges:

7. NEUROLOGICAL EXAMINATION

Gait and Posture
- Abnormalities in gait:
- Walking on heels (L4-L5):
- Walking on toes (S1-S2):
- Rombergs test (Pronator Drift):

Higher Mental Function
- Information and Vocabulary:
- Calculating ability:
- Abstract Thinking:

G.C.S.:
- Eyes:
- Motor:
- Verbal:

Evidence of head trauma:

Evidence of Meningism:
- Neck mobility and Brudzinski's sign:
- Kernigs sign:

Cranial Nerves:

I Any loss of smell/taste:
Nose examination:

II External examination of eye:
- Visual Acuity:
- Visual fields by confrontation:

- Pupillary light reflexes = Direct:
  = Consensual:
- Fundoscopy findings:

III Ocular Muscles:
Eye opening strength:

IV Inferior and Medial movement of eye:

V
a. Sensory - Ophthalmic:
- Maxillary:
- Mandibular:
b. Motor - Masseter:
- Jaw lateral movement:
c. Reflexes - Corneal reflex
- Jaw jerk

VI Lateral movement of eyes

VII
a. Motor - Raise eyebrows:
- Frown:
- Close eyes against resistance:
- Show teeth:
- Blow out cheeks:
b. Taste - Anterior two-thirds of tongue:

VIII General Hearing:
Rinnes = L: R:
Webers lateralisation:
Vestibular function - Nystagmus:
- Rombergs:
- Wallenbergs:
Otoscope examination:

IX & X Gag reflex:
Uvula deviation:
Speech quality:

XI Shoulder lift:
S.C.M. strength:

XII Inspection of tongue (deviation):

Motor System:

a. Power
- Shoulder = Abduction & Adduction:
= Flexion & Extension:
- Elbow = Flexion & Extension:
- Wrist = Flexion & Extension:

- Forearm = Supination & Pronation:
- Fingers = Extension (Interphalangeals & M.C.P's):
- Thumb = Opposition:
- Hip = Flexion & Extension:
  = Adduction & Abduction:
- Knee = Flexion & Extension:
- Foot = Dorsiflexion & Plantar flexion:
  = Inversion & Eversion:
  = Toe (Plantarflexion & Dorsiflexion):

b. Tone
- Shoulder:
- Elbow:
- Wrist:
- Lower limb - Int. & Ext. rotation:
- Knee clonus:
- ankle clonus:

c. Reflexes
- Biceps:
- Triceps:
- Supinator:
- Knee:
- Ankle:
- Abdominal:
- Plantar:

Sensory System:

a. Dermatomes
- Light touch:
- Crude touch:
- Pain:
- Temperature:
- Two point discrimination:

b. Joint position sense
- Finger:
- Toe:

c. Vibration:
- Big toe:
- Tibial tuberosity:
- ASIS:
- Interphalangeal Joint:
- Sternum:

Cerebellar function:

Obvious signs of cerebellar dysfunction:
= Intention Tremor:
= Nystagmus:
= Truncal Ataxia:

Finger-nose test (Dysmetria):
Rapid alternating movements (Dysdiadochokinesia):
Heel-shin test:
Heel-toe gait:
Reflexes:
Signs of Parkinsons:

8. **SPINAL EXAMINATION:**(See Regional examination)

Obvious Abnormalities:
Spinous Percussion:
R.O.M:
Other:

9. **BREAST EXAMINATION:**

Summon female chaperon.

Inspection - Hands rested in lap:
- Hands pressed on hips:
- Arms above head:
- Leaning forward:

Palpation - masses:
- tenderness:
- axillary tail:
- nipple:
- regional lymph nodes:

APPENDIX E

TECHNIKON NATAL CHIROPRACTIC DAY CLINIC
REGIONAL EXAMINATION - *LUMBAR SPINE AND PELVIS.*

PATIENT: _____

FILE #: _____ DATE: _____

INTERN/RESIDENT: _____

SUPERVISING CLINICIAN: _____

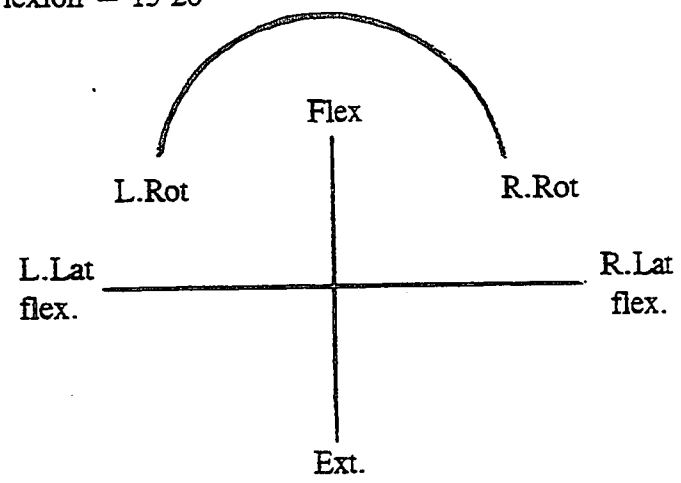
STANDING:

Posture
Minor's Sign
Skin
Scars
Discoloration
Muscle Tone
Bony & Soft Tissue Contours

Spinous Percussion
Schober's Test (6cm)
Treadmill
Body Type
Attitude

RANGE OF MOTION

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



SUPINE:

Skin
Hair
Nails
Palpate Abdomen/groin
Pulses (abdomen)

Observe abdomen
Fasciculations
Abdominal Reflexes

Pulses (extremities)
SLR
Bowstring
Plantar Reflex
Circumference (thigh, calf)
Leg Length:
- actual
- apparent

Sciatic Notch
Patrick FABERE
Gaenslen's Test
Gluteus Maximus Stretch
Hip Medial rotation
Psoas Test
Thomas' Test:
- hip joint
- Rectus Femoris

LATERAL RECUMBENT

S-I Compression
Ober's Test
Femoral Nerve stretch
Myotomes:
- QL
- Gluteus Medius

NON ORGANIC SIGNS

Pin Point Pain
Axial Compression
Trunk Rotation
Burn's Bench Test
Flip Test
Hoover's Test
Ankle Dorsiflexion Test.

GAIT

Rhythm
On toes (standing)
On Heels (standing)
Half squat on one leg

PRONE

Gluteal skyline
Skin rolling
Iliac crest compression
Facet joint challenge
S-I tenderness
Erichson's Test
Pheasant's Test
Myotome:
- Glut. Max

Active MF Trigger Pts:
- QL
- Glut. Med
- Glut. Min
- Glut. Max
- Piriformis
- Hamstrings
- TFL

NEUROLOGICAL EXAMINATION

DERMATOMES			MYOTOMES			REFLEXES		
	L	R		L	R		L	R
T12			Hip Flex			Pat.		
L1			Hip int rot			Achil		
L2			Hip ext rot			H/S		
L3			Hip abd					
L4			Hip add					
L5			Knee flex					
S1			Knee ext					
S2			Dorsiflex					
S3			Plantarflex					
			Eversion					
			Ext.hal.long					

Tripod
Kemp's Test

MOTION PALPATION and JOINT PLAY:

LEFT: Upper Thoracics:
Lumbar Spine:
Sacroiliac Joint:

RIGHT: Upper Thoracics:
Lumbar Spine:
Sacroiliac Joint:

Basic Exam: Hip
Case History:

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

Observ/Palpation:

Basic Exam: Thoracic Spine
Case History:

ROM: Motion Palp:
Active:
Passive:
Orthpaedic/Neuro/
Vascular:

Observ/Palpation:

APPENDIX F

INFORMED CONSENT FORM
(To be completed in duplicate by patient/subject)

Date :_____

Title of research project : The effectiveness of interferential current therapy as an adjunct to manipulation in the treatment of acute mechanical low back pain.

Name of supervisor :Dr B Kruger

Name of research student :Mark Aaron

Name of institution: Technikon Natal

This study involves research on 60 patients testing whether it is more effective to use manipulation combined with interferential therapy than manipulation only in the treatment of acute low back pain.

You are required to undergo 4 treatment sessions with a fifth consultation for data collection within a period of two weeks. The first appointment will take approximately 2 hours with the following appointments taking approximately half an hour. You will undergo a history taking, physical examination and lumbar spine examination during your first consultation. This will be followed by either a treatment comprised of lumbar spine manipulation combined with interferential therapy, or manipulation only, depending on which treatment group you are assigned to. You are asked not to change any lifestyle habits or pain medication for the treatment period as this may affect the results of the research.

All patient information is confidential although supervisory staff may be required to inspect the records. You have a right to be informed of any new findings which are made. Your treatment in this clinical trial is free of charge and your participation is voluntary. You may drop out at any stage without any adverse consequences and, if required, the researcher is entitled to end your participation in this trial at any stage. You have the right to access to a knowledgeable person other than the researcher and if required you may make a complaint to the Technikon Research Ethics Committee.

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. Who have you spoken to?_____		
7. Do you understand the implications of your involvement in this study?	**Yes**	**No**
8. Do you understand that you are free to withdraw from this study?	**Yes**	**No**
a) at any time		
b) without having to give any reason for withdrawing, and		
c) without affecting your future health care.		
9. Do you agree to voluntarily participate in this study.	**Yes**	**No**

If you have answered no to any of the above, please obtain the information before signing.

Please Print in block letters:

Patient/Subject Name:_____**Signature:**_____

Witness Name:_____ Signature:_____

Research Student Name: **Mark Aaron** Signature:_____

APPENDIX G

SUBJECT INFORMATION SHEET

Research title: The effectiveness of interferential current therapy as an adjunct to manipulation in the treatment of acute mechanical low back pain.

Dear _____

The research in which you will participate will endeavour to determine if a form of electrotherapy (interferential current therapy - IFC), when combined with manipulation, will provide a more effective treatment protocol than manipulation only when treating acute low back pain. This will aid the researcher in providing more effective treatment for low back pain. You will be randomly allocated to one of two groups. The first group will receive manipulation and IFC. The second group will receive manipulation only. Both of these types of treatment have a relatively low risk. Occasional side effects are increased pain initially and skin irritation. Any discomfort felt during the treatment should be mild and short-lived.

Initially you will be examined to determine if you are a suitable candidate for the research. If accepted, you will then undergo 4 treatments and a follow-up appointment within a 2 week period.

You are asked not to alter your lifestyle for the sake of this research project e.g. if daily activities include typing for 2 hours a day or playing sport 3 times a week then continue to do so.

You are requested not to take any new medication or change medication related to your back pain while you are on the research as this may alter the outcome of the treatment

Thank you for participating in this clinical trial.

Yours sincerely

_____

Mark Aaron
6th year Chiropractic Student